BASS STRAIT OIL COMPANY LTD

ZANEGREY-1/ST1/ST2

WELL COMPLETION REPORT

INTERPRETIVE DATA

FEBRUARY 2006

VOLUME 1 OF 1

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ZANEGREY-1/ST1/ST2

WELL COMPLETION REPORT

VOLUME 1 OF 1

(INTERPRETIVE DATA)

VIC/P42
GIPPSLAND BASIN

OFFSHORE
VICTORIA

Date: February 2006
Compiled by: R. Fisher
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1.1 INTRODUCTION AND SUMMARY

The ZaneGrey-1/ST1/ST2 well is located in Commonwealth waters within Permit Vic/P42 approximately 230nm east of Port Melbourne (Figure 1), mid-way between the Kingfish and Bream oil and gas fields (Figure 2). The ZaneGrey Prospect lies beneath the oil pipeline on the seafloor that connects the two producing fields. This location is covered by the SJ 55 1:1,000,000 Melbourne Map Sheet in Graticular Block 2208. Vic/P42 is located offshore in the southern part of the Gippsland Basin, straddling the Southern Platform, Southern Terrace and southern part of the Central Deep.

The ZaneGrey-1 well was designed as a deviated exploration well (to avoid the Bream Oil Pipeline) to test the ZaneGrey North Prospect, primarily to test Latrobe Group reservoirs within a faulted anticline, up-dip of the Nannygai-1 well drilled in 1972. The structure was interpreted from the BSOC 2002 GBA02B 3D seismic survey. The specific objectives of the well were:

Determine the depth of the top of the Latrobe Group (Gurnard Formation) at the well location, following which a decision to abandon the well could be made if it could be demonstrated that the depth conversion was invalid and structural closure was unlikely.
Test the Upper Latrobe Group reservoirs within a faulted anticline up-dip of the Nannygai-1 well. If the top of the Latrobe Group was encountered within prognosis, the well would be deepened to a TD of -3155mTVD SS to enable evaluation of the Roundhead Member of the Volador Formation, sealed beneath the Kate Shale and other significant reservoir seal pairs of the Kingfish Formation, including the reservoir where live oil was encountered in Nannygai-1.

ZaneGrey-1 was drilled in 72.5 metres (238') (MSL) of water by the DOGC 'Ocean Patriot' semi-submersible drilling unit and spudded on the 29th January 2005 at 14:30 hrs. The well was drilled as a deviated exploration well, with kick-off commencing below 486mMD RT within the Gippsland Limestone. This well bore reached a depth of 2772.5mMD RT (-2399.26mTVD SS) at 09:00 hrs on the 11th February 2005 in the Late Paleocene Kingfish Formation prior to setting an intermediate casing. Ran and cemented 244mm (9 ⅝") casing to 2184mMD RT after being unable to go below this depth. After drilling out the casing, a balanced cement plug was set and ZaneGrey-1ST1 was successfully kicked-off. Directional drilling resumed in 216mm (8 ½") hole to a depth of 3107mMD RT (-2684.75mTVD SS) which was reached on the 25th February 2005 at 19:30 hrs. The bit, motor bit box and motor drive shaft were left in the hole, following which two balanced cement plugs were set from 3106 to 3026mMD RT to enable kick off and sidetrack around the fish. At this point ZaneGrey-1ST2 was commenced and directional drilling continued to a total depth of 3675mMD RT (-3198.3mTVD SS). Wireline logs were acquired at this depth, during which the RCI-GR tool string became stuck at 3185mMD RT and the remainder of the RCI-GR programme was completed as 'logging while fishing' on drill pipe. The well was subsequently plugged and abandoned as a non-commercial gas/condensate discovery and the rig released to Woodside Energy Ltd at 19:20 Hrs 18th March 2005. Total time on ZaneGrey-1/ST1/ST2 location was 50.52 days. There was one lost time accident and no environmental accidents during the drilling of ZaneGrey-1/ST1/ST2.

The Well Card (Appendix 1) summarises pertinent data from the ZaneGrey-1/ST1/ST2 well.

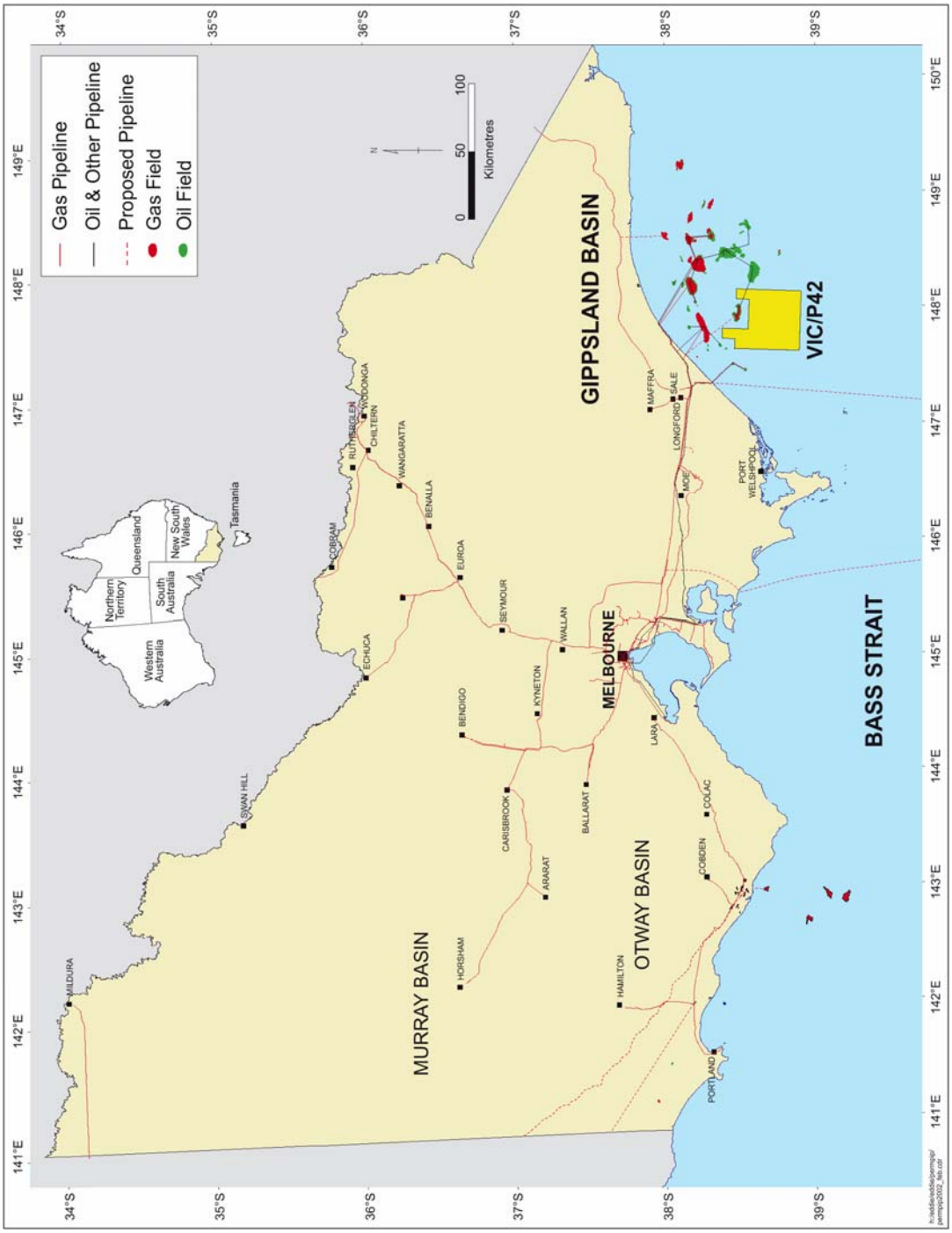


FIGURE-1: VIC/P42 LOCATION MAP

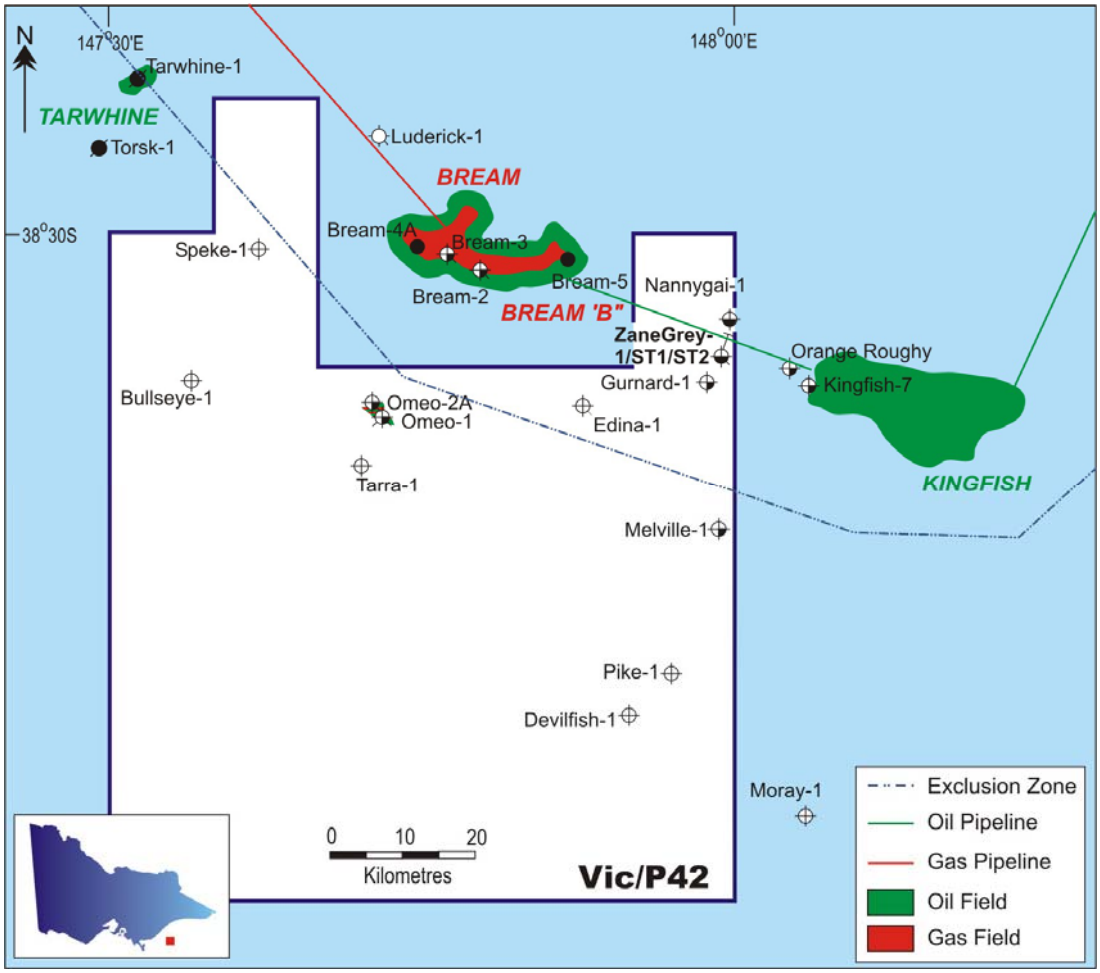


FIGURE 2: ZANEGREY-1/ST1/ST2 LOCATION MAP

1.2 GEOLOGICAL AND FORMATION EVALUATION SUMMARY

1.2.1 Prospect Summary

The ZaneGrey Prospect is a faulted anticline up-dip of Nannygai-1 that was drilled in 1972. The anticline appears to be formed by a major basin forming normal fault striking NW-SE through the northeastern graticular block of Vic/P42. Nannygai-1 was drilled in 1972 on a TWT structure beneath a 'high velocity' submarine canyon. This well had an interpreted low relief closure at Top Latrobe level, valid in time.

Depth conversion work, albeit equivocal, suggested Nannygai-1 may have been drilled on the northern closure limit at intra-Latrobe Group levels. Interpreted spill points were mapped northeast of Nannygai-1 and east of the ZaneGrey Prospect, although both these areas are beyond the limit of good data quality in the BSOC 3D, and over the Kingfish 3D dataset. Good hydrocarbon shows were encountered in sandstone over the interval 2898 - 2914m in the Kingfish Formation (*L. balmei* zone) sediments. Log analysis interpreted some 6m of live oil in the interval 2898-2904m (Phillips 1994) and was used to demonstrate structural closure.

The acquisition of the GBA02B 3D survey in 2002 over the area has recognised a significant up-dip component to Nannygai-1 at the level of the interpreted pay zone and at deeper and shallower horizons in both time and depth. Detailed velocity information through the high velocity submarine canyon sequence has been derived from advanced geophysical processing techniques, although a significant depth conversion risk remained. A minor laterally discontinuous normal fault was identified at intra-Latrobe Group levels, down-throwing the Nannygai-1 area close to the well location, from a significant area up-dip (in TWT and depth) to the southwest. This and the interpreted closure at the level of the pay zone, augurs well for this being up-dip and within depth closure at intra-Kingfish and Volador formation levels. The deeper Roundhead Member, which forms an amalgamated sequence of sandstones, deposited in lower and upper shoreface settings with minor marine shale interbeds formed a primary objective in the ZaneGrey Prospect. Seal for the Roundhead Member was formed by the shallow coastal marine shales of the overlying Kate Shale. A smaller areal anticlinal closure at Top Latrobe Group formed a secondary objective.

Regional correlation across the southern Gippsland Basin had identified that a prospective sequence of reservoir seal pairs remained untested (by Nannygai-1) up-dip in the ZaneGrey Prospect for the Kingfish Formation and within deeper un-drilled sequences of the Kingfish and Volador formations, and within deep Golden Beach Subgroup deposits (the latter correlated over long distance with Archer-1 and Anemone-1 wells to the southeast).

Whilst ZaneGrey North is predominantly a faulted anticlinal closure, lateral fault seal on the major basin forming fault to its southwest may also enhance structural closure, albeit with a higher risk. Lateral juxtaposition of high net to gross sequences in this downthrown block, with lower net to gross sequences of the deeper Volador Formation in the ZaneGrey South fault block, augured well for any cross fault seal.

The main risks for the ZaneGrey Prospect related to the mapped depth closure and hence the depth conversion. A strong lateral velocity variation in the overburden made the depth conversion problematic and the single greatest geological risk. Detailed seismic velocity

data and analysis were used to minimise the risk, and structural closure was considered to be greater than depth uncertainty. Whilst depth closure was a high risk, there was also significant upside in the mapped spill to the east and northeast. Intra-formational sealing and breaching by minor faulting was a secondary risk.

1.2.2 Geological and Formation Evaluation Summary

ZaneGrey-1 was spudded at 14:30 hrs on the 29th January 2005 and penetrated a sedimentary section ranging in age from Tertiary/Recent to Late Cretaceous (Maastrichtian). The stratigraphic section encountered was essentially as predicted with all of the formation tops close to their prognosis. A comparison of the Actual and Predicted section drilled in ZaneGrey-1/ST1/ST2, including a brief summary of drilling and formation evaluation data is included in Enclosure 3. The geological formations and data encountered for each hole section are discussed below.

The Miocene to Pliocene Gippsland Limestone was encountered at seafloor (covered by a veneer of Recent sediments) at 94mMD RT (-72.5mTVD SS), the upper part of which down to a depth of 1095mMD RT was drilled riserless in the 914mm (36”) and 406mm (16”) hole sections with the benefit of LWD gamma ray and resistivity. The 406mm (16”) hole section was directionally drilled below 486mMD RT, reaching a deviation/azimuth of some $34^{O}/15.1^{O}$ by 1009mMD RT. Intermediate 340mm (13 ⅜”) casing was subsequently run to 1090.61mMD RT and the BOP’s and marine riser nippled-up. The 311mm (12 ¼”) hole was drilled with the benefit of LWD gamma ray, resistivity and directional control to 2772.5mMD RT in the ZaneGrey-1 wellbore before setting an intermediate string of 244mm (9 ⅝”) casing to 2184.1mMD RT, abandoning some 588m of drilled hole and commencing ZaneGrey-1ST1 and sidetracking in 216mm (8 ½”) hole from 2190mMD RT to 3107mMD RT. This hole section was also drilled with the benefit of LWD gamma ray, resistivity and directional control. After losing a “fish” in the hole at 3107mMD RT, ZaneGrey-1ST2 commenced from 3075mMD RT and drilled 216mm (8 ½”) hole to total depth at 3675mMD RT (-3198.3mTVD SS). The main 216mm (8 ½”) hole section to total depth was wireline logged after reaching TD and this provides the depth control for the stratigraphic sub-divisions included herein, in combination with LWD logs in the upper hole sections, together with the assistance of biostratigraphic control.

The lower part of the Gippsland Limestone below 1095mMD RT consists of argillaceous calcilutite with calcisiltite and minor calcarenite. The base Gippsland Limestone/Top Lakes Entrance Formation is identified at 1560mMD RT (-1396.5mTVD SS). It was encountered 11.5 metres low to prognosis, based upon the appearance of calcareous claystone and marl in the section. The Oligocene to early Miocene Lakes Entrance Formation consists of interbedded calcareous claystone and claystone with minor marl, sandstone and siltstone.

The Middle Eocene Gurnard Formation, a tertiary objective, was intersected at 2513.3mMD RT (-2194.0mTVD SS), 10m low to prediction and consists of calcareous claystone, claystone, argillaceous sandstone, siltstone and greensand. All lithologies are generally rich in glauconite. The Paleocene to Early Eocene Kingfish Formation was intersected at 2554.4mMD RT (-2227.8mTVD SS), 9.2m high to prognosis. The sequence consists of interbedded quartzose sandstone, siltstone and claystone with common thin coal beds.

While drilling the Kingfish Formation at a depth of 3107mMD RT, the BHA parted, leaving the bit and bottom of the motor in the hole. After setting cement above the “fish”,

the well was sidetracked from a depth of 3075mMD RT and ZaneGrey-1ST2 commenced and drilling resumed in 216mm (8 ½") hole through the Kingfish Formation.

The hydrocarbon zone, approximately equivalent to the Nannygai zone of interpreted hydrocarbons in the Nannygai-1 well was intersected at 3306mMD RT (-2857.5mTVD SS). The Early Paleocene Kate Shale was intersected at 3508.1mMD RT (-3043.1mTVD SS), 1.9m high to prognosis. The Kate Shale consists predominantly of claystone grading to silty claystone with rare accessory glauconite and minor argillaceous sandstone.

The Roundhead Member of the Volador Formation was intersected at 3546.7mMD RT (-3078.8mTVD SS), 6.8m low to prognosis and the base of the Roundhead Member was intersected at 3581.5mMD RT (-3111.0mTVD SS), 3m low to prognosis. The Roundhead Member consists of an amalgamated sequence of porous, medium to coarse quartzose sandstone of fair reservoir quality, while the remainder of the Volador Formation consists of an interbedded sequence of claystone and sandstone with rare thin coal stringers.

The well reached TD within the Volador Formation at 3675mMD RT (-3198.3mTVD SS), which was reached at 20:34 Hrs on the 11th October 2004. Baker Atlas wireline logs were run at this depth. The primary wireline log recorded was the DLL-MLL-MAC-DSL-ZDL-CN-TTRM-4401 which was logged from 3674-3184mMD RT, after which the GR-MAC was logged up through casing to the seafloor, although the acoustic signal deteriorated towards the seafloor. This log represents the primary depth control for ZaneGrey-1/ST1/ST2. TD was shallow to driller's TD by 1m owing to possible fill on bottom and the 340mm (13 3/8") casing shoe was found 0.25m shallower than driller's depth. The second logging run was with the RCI-GR tool for formation pressures and samples, which was logged over the gross interval 3179.6 to 3622.8mMD RT; while logging with the RCI-GR tool string, the tool became stuck at 3185mMD RT and unable to free; pulled 80% of weak point and tool came out of rope socket; rigged down BakerAtlas. Tensioned wireline and cut cable. Made up and tested wireline surface latching equipment. RIH with 86mm (3 ⅜") grapple on drill pipe, stripping over wireline to top of "fish"; circulated above and latched onto "fish"; rigged up for 'logging while fishing' and resumed RCI-GR programme on drill pipe; RCI tool failure occurred when on depth at 3627mMD RT due to overheating of electronics in gamma ray, resulting in no further communications with the tool; aborted remainder of tests and POOH with wireline tool on drill pipe; rigged down BakerAtlas.

Total gas, chromatographic breakdown of the ditch gas and trip gas was recorded from 1095 m to 3675mMD RT throughout the 311mm (12 ¼") and 216mm (8 ½") hole sections. Trace to minor amounts of total gas consisting predominantly of methane (C_1), together with trace to minor amounts of ethane (C_2), propane (C_3) and butane (iC_4 & nC_4) was recorded upon commencement of first drilling returns in the 311mm (12 ¼") hole section below 1095mMD RT. Below approximately 1800mMD RT, nil to trace amounts of pentane (iC_5 & nC_5) were also recorded. Background gas levels remained at these levels throughout the remainder of the 311mm (12 ¼") hole section to section TD at 2772mMD RT in ZaneGrey-1. Maximum gas recorded in ZaneGrey-1 was 1.0% total gas which consisted of 11000ppm (C_1), 266ppm (C_2), 108ppm (C_3), 26ppm (iC_4) and 16ppm (nC_4). A number of slightly higher levels of total gas to 1.07% were recorded between 1800m and 2034mMD RT, however the chromatograph was malfunctioning during these intervals and no chromatographic data was recorded. The 244mm (9 ⅝") casing was subsequently set at 2184.1mMD RT after failing to reach section TD and ZaneGrey-1ST1 was commenced in sidetrack hole at this depth in 216mm (8 ½") hole.

Background gas levels were moderately uniform throughout the drilling of ZaneGrey-1ST1 over the gross interval 2184-3107mMD RT and consisted of trace to minor amounts of total gas, composed mainly of methane (C_1) and ethane (C_2) along with low levels of propane (C_3), butane (iC_4 & nC_4) and pentane (iC_5 & nC_5). Maximum gas recorded in ZaneGrey-1ST1 was 1.59% total gas at 2751mMD RT and consisted of 6895ppm C_1, 2036ppm C_2, 71ppm C_3, 177ppm iC_4, 255ppm nC_4 and 910ppm iC_5.

ZaneGrey-1ST2 commenced after kicking off in 216mm (8 ½") hole at 3075mMD RT. Background gas levels recorded initially were low to moderate and locally increased in response to the volume of coal being cut in the stratigraphic section. Background levels consisted of trace to minor amounts of C_1 to C_5 from 3075m to 3306mMD RT. Below this depth, a prominent gas peak of 18.08% total gas (above a background of 0.5%) was recorded over the interval 3306-3319mMD RT and consisted of 84,479ppm C_1, 11,492ppm C_2, 6,960ppm C_3, 84ppm iC_4, 1,517ppm nC_4, 639ppm iC_5 and 542ppm nC_5. The centre of the gas peak occurred at 3314mMD RT in association with a sandstone that exhibited nil direct fluorescence, however displayed a slow, faint bluish yellow cut fluorescence with a faint patchy bluish yellow residual ring fluorescence. An isotube gas sample was also collected from this gas peak, however at the time of writing this report no further analyses have been attempted on this sample.

Below 3319m to total depth at 3675mMD RT, gas levels were moderately uniform and consisted of low to minor amounts of total gas consisting of C_1-C_5. No further significant gas peaks were recorded.

No evidence of direct sample fluorescence was observed in cuttings during the drilling of ZaneGrey-1 over the gross interval 1095-2772.5mMD RT. The only sample show recorded in ZaneGrey-1/ST-1 occurred at a depth of 2960mMD RT (~ 2559mTVD SS) in which a coal displayed nil direct fluorescence, however it exhibited a very slow yellowish-blue cut with a bright, solid bluish yellow residual cut fluorescence. This show represents the shallowest recording of any evidence of possible hydrocarbons recorded in the ZaneGrey well. The only sample show associated with reservoir sandstone occurred in ZaneGrey-1/ST-2 where aggregates of sandstone over the interval 3300–3310mMD RT (~2854-2863mTVD SS) exhibited slow, faint bluish yellow cut fluorescence and faint patchy bluish yellow residual cut fluorescence. The only other sample shows evident during the drilling of ZaneGrey-1/ST-2, also occurred in association with coals over the gross interval 3092-3470mMD RT (~2671-3008mTVD SS). These shows typically consisted of very slow yellowish blue cut fluorescence with a bright, solid bluish yellow residual cut fluorescence. Trace evidence of amber also occurred in association with coal and sandstone aggregates which exhibited bright yellow white direct fluorescence and nil cut fluorescence.

Wireline log interpretation of ZaneGrey-1/ST2 over the target interval indicated the potential presence of a thin hydrocarbon column (1.3 – 2.5 m) within the upper portion of the target interval from 3305.7–3308mMD RT (2880 – 2882mTVD). Average porosity in this interval is 17% and average water saturation is interpreted to be between 53 and 63% (depending on the resistivity device used). Elevated gas chromatograph readings were recorded across this interval, with minor fluorescence shows as described above.

Based on the results from the initial wireline log analysis, RCI pressure data was acquired through adjacent water sands and through the target interval, and light hydrocarbons were successfully recovered using RCI sampling within the upper portion of the target interval at a measured depth of 3307mMD RT. There is no data to determine if the in-situ fluids are

fully saturated or not, however PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. This data is supportive, but not in itself proof of a down dip oil leg.

Based on the available data, a gas-condensate hydrocarbon accumulation would seem to exist up-dip from the ZaneGrey-1ST2 intersection, and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence in the well to support hydrocarbons below the lowest net pay interpretation (-2882mTVD).

While it is possible that the 'live oil shows' interpreted in the offset Nannygai-1 well do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZaneGrey-1ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZaneGrey-1ST2. Also a 30m hydrocarbon column (if present) should have provided enough buoyancy to give higher oil saturations than those observed in ZaneGrey-1ST2. This interpretation also seems to contradict the indirect evidence of water from the failed RCI sampling attempts.

ZaneGrey-1/ST1/ST2 was plugged and abandoned as a non-commercial gas condensate discovery and the rig released to Woodside Energy Ltd at 19:20 Hrs on the 18th March 2005. Total time on ZaneGrey-1/ST1/ST2 location was 50.52 days. A composite well log of the lithology intersected in ZaneGrey-1 and ZaneGrey-1/ST1/ST2 are included as Enclosures 1 and 2 respectively.

1.3 DRILLING SUMMARY

ZaneGrey-1 operations commenced at 05:00 hrs 27th January 2005 when towing of the Diamond Offshore General Company MODU "Ocean Patriot" commenced with two AHSV's ("Far Grip" & "Pacific Wrangler") from the Apache Energy's Grayling-1 location. The MODU was towed to the ZaneGrey-1 location (Figures 1 and 2) at an average speed of 6.1 k/hr (3.3 knots), a distance of 72km (39nm). The MODU arrived on location at 15:30 hrs 27th January 2005 when anchor handling operations commenced, with first anchor down at 16:55 hrs. Positioning the rig on location was completed by 04:20 hrs 28th January 2005 at which time the rig was ballasted down to drilling draft at 23:00 hrs. The final location for ZaneGrey-1 was confirmed as being 1.7m from the proposed location on a bearing of 216.2° grid. The final position for ZaneGrey-1 was:

Latitude: 38° 34' 31.64" S
Longitude: 147° 59' 16.27" E
Easting: 586,049.89m
Northing: 5, 729,856.42m
Rig Heading: 43.2° (True)
DATUM: AGD 84; Zone 55S; Central Meridian 147° East.

The 914mm (36") BHA made up and run in hole tagging the seafloor at 94m corrected to Mean Sea Level (MSL). The water depth at MSL was recorded as 72.5m, with a drill floor elevation of 21.5m. ZaneGrey-1 was spudded at 14:30 hrs on 29th January 2005 with a 914mm (36") hole drilled from seafloor (94mMD RT) to a depth of 129.5mMD RT, pumping 200 bbl guar gum and 50 bbl hi-vis mud on connection. Conducted wiper trip to 96mMD RT. Pumped 200 bbl gel mud and dropped TOTCO survey and pulled out of hole. Made up 762mm (30") housing running tool to 762mm (30") conductor and PGB in moonpool. Ran 762mm (30") conductor with ROV assistance placing the shoe at 127.75mMD RT and which was cemented in place using 792 sacks (168 bbls) of cement slurry at 15.8 ppg, returns to seafloor.

The 406mm (16") BHA was made up, orienting mud motor and programming LWD tools in the process. The BHA was then run in hole using the ROV to assist entering the hole. The cement was tagged at 124.7mMD RT. The shoe track was then drilled and cleaned out and new hole was drilled from 124.7m to 129.5mMD RT. Drilling continued ahead to 486mMD RT at which point the well was kicked off. The well was directionally drilled from 486m to 1095mMD RT (section TD), building inclination to a maximum 34.99° with an azimuth of 14.71° at 1080.74mMD RT. Pumped 150 bbl hi-vis pill and circulated this out of the hole. Pumped 1000 bbl hi-vis pill followed by 200 bbls of 9.6 ppg KCl mud. Pulled out of hole with 406mm (16") BHA and racked same prior to downloading LWD tools. Ran 340mm (13 ⅜") casing, setting shoe at 1090.61mMD RT and cemented with 417 sacks (166 bbls) of 12.5 ppg lead slurry and 327 sacks (67 bbls) of 15.8 ppg tail slurry. No surface indication of top plug shearing. Displaced cement using rig pump, bumping plug early at 3862 strokes and 15858kPa (2300 psi). Ran BOPs and marine riser, waited on weather for 22.5hrs before successfully landing BOP stack. Ran diverter and tested BOPs.

The 311mm (12 ¼") BHA was made up, orienting mud motor and programming LWD tools in the process. The BHA was then run in hole to 251mMD RT at which point the LWD tools were shallow pulse tested. The LWD tools failed the shallow pulse test. Performed 4,500 psi connector test and then pulled out of the hole laying out the LWD tools and the backup LWD tools were picked up. This BHA was then run in hole successfully shallow pulse testing the

LWD tools. Continued to run in hole tagging cement at 1058.77mMD RT. Drilled cement, shoe track and shoe from 1058.77m to 1095mMD RT and then 3m of new hole to 1098mMD RT. Circulated hole clean and conducted Formation Integrity Test (FIT) with 1.03sg (8.6 ppg) mud against lower pipe rams to 815 psi (1.6 SG) equivalent. Directionally drilled ahead to 2103mMD RT. An incident with the dynamic break (on the top drive system) inadvertently releasing caused excessive weight to be set down on the drill string, bending 3 joints of drill pipe (an incident report can be found in Appendix 20 & 22 of the ZaneGrey-1/ST1/ST2 Well Completion Report – Basic Data). The bent stand was racked back and the motor alignment cylinder on the top drive system was replaced. A decision to pull out of the hole to inspect all drill pipe on the way out was made. On surface, the LWD pulser was changed out and the bend in the motor decreased to 0.78°. Surface tested MWD, motor and adjustable gauge stabiliser. This BHA was then run in the hole to the 340mm (13 ⅜") casing shoe at which point the mud was circulated and conditioned. Continued to run in the hole having to wash and ream down from 1916 to 2103mMD RT due to tight hole. Drilled ahead to 2702mMD RT and due to difficult drilling with high torque on bottom, the BHA was pulled out of the hole. On surface the motor was laid out to run in hole with a rotary drilling assembly due to the motor stalling out on regular occasions. Ran in the hole having to wash and ream from 1767m to 2702mMD RT due to tight hole. Drilled ahead from 2702 to 2725mMD RT. Repaired swivel packing and pumps. Drilled ahead from 2725 to 2772mMD RT which was reached at 09:00 hrs on the 11th February 2005. Pulled out of the hole performing a short wiper trip from 1968mMD RT back to bottom due to tight hole conditions. Pulled out of hole racking back the BHA in the derrick. The ROV observed traces of fluid (suspected to be drilling fluid) seeping from the wellhead.

The 244mm (9 ⅝") casing was run to 1776mMD RT (127 joints) at which point the casing was unable to pass. 127 mm (5") drill pipe handling gear was rigged up to enable circulation. The casing was then circulated and reamed from 1776m to 1778mMD RT. At this stage it was decided to pull the casing out of the hole. A 311mm (12 ¼") rotary clean out assembly was then run in the hole to perform a wiper trip. Washed and reamed down from 1777 to 2284mMD RT. Circulated and back reamed out of the hole from 2284 to 1740mMD RT. Circulated bottoms up and commenced washing and reaming back in the hole to 2283mMD RT. Circulated while raising the mud weight to 1.20sg (10.0ppg). Washed and reamed back into the hole to 2735mMD RT. Circulated hole clean and pulled out of hole. Ran 244mm (9 ⅝") casing down to 2194mMD RT washing down past tight spots. Unable to get casing beyond this depth, so 8 joints were pulled back out of the hole and the casing hanger was run. The casing shoe was set at 2184mMD RT and cemented with 321 sacks (128 bbls) of 12.5 ppg lead slurry and 249 sacks (51 bbls) of 15.8 ppg tail slurry. The cement job went well with both the top and bottom plugs observed shearing. Displacement was then performed to the maximum calculated volume and no bump was observed.

The 216mm (8 ½") BHA was made up, orienting the mud motor and programming the LWD tools in the process. The BHA was then run in the hole to 251mMD RT, where a successful shallow pulse test of the LWD tools was performed. Continued to run in the hole, tagging cement at 2158mMD RT. Drilled float, plugs, cement and shoe track from 2158 to 2184mMD RT. Drilled to 2192mMD RT and then washed down to 2260mMD RT (in the original 311mm (12 ¼") hole). Circulated hole clean and pulled into the shoe conducting a Formation Integrity Test (FIT) with 1.1sg (9.2 ppg) mud resulting in an FIT of 1.65sg (13.7ppg). Pulled out of the hole to set a balanced kick off plug. Pumped a 54m (203 sacks) balanced cement plug.

At this time, ZaneGrey-1/ST1 was commenced. Ran in the hole with 216mm (8 ½") BHA and tagged firm cement at 2184mMD RT. Time drilled to kick off well and directionally drilled ahead to 3107mMD RT at which depth the BHA was pulled out of the hole due to poor rate of penetration. On surface it was found that the bit, motor bit box and motor drive

shaft were left in the hole. It was decided that fishing for the tools left in the hole would prove difficult. An 80m (97sacks) balanced plug was set from 3106 to 3026mMD RT to kick off and sidetrack around the fish.

At this time, ZaneGrey-1/ST2 was commenced. Ran in the hole with 216mm (8 ½") BHA, washing and reaming from 2996 to 3075mMD RT with no hard cement being tagged. Eventually the fish was tagged at 3107mMD RT. The BHA was then pulled out of the hole to set another cement plug. A 160m (195sacks) balanced plug was set from 3106 to 2946mMD RT. The bend on the motor was increased to 1.5° and the bit changed to aid kick off. This assembly was unable to kick off due to cement not being hard enough. Attempted to open hole sidetrack the well by time drilling while waiting on cement to harden; this proved unsuccessful. The BHA was then pulled out of the hole. The bit and BHA configuration were altered to aid kicking off. This new BHA was then run in the hole and the cement was still not hard enough to sidetrack. This BHA was then pulled out of the hole after time drilling to sidetrack again proved unsuccessful. A sidetracking bit was then used to successfully kick off the well. This BHA was then pulled out of the hole. A conventional directional BHA was then run in the hole and drilled to 3162mMD RT at which depth the top drive system (TDS) on the rig failed. A short trip to the casing shoe was performed and the TDS was repaired over the next three days. After repairing the TDS, the BHA was tripped back to bottom and the well drilled ahead to total depth (TD) at 3675mMD RT which was reached at 17:00 hrs on the 10th March 2005. The BHA was then pulled out of hole.

Rigged up BakerAtlas for running wireline logs and ran the following logs; RUN#1: DLL-MLL-MAC-ORIT-ZDL-CNL-DSL-TTRM over the interval 3764m to 2184mMD RT with MAC pulled through casing to 1983mMD RT and GR through casing to 94mMD RT and RUN#2: RCI-GR over the gross interval 3179.6m to 3622.8mMD RT for pressures and samples; while logging with the RCI-GR tool string, the tool became stuck at 3185mMD RT and unable to free; pulled 80% of weak point and tool came out of rope socket; rigged down BakerAtlas. Tensioned wireline and cut cable. Made up and tested wireline surface latching equipment. RIH with 86mm (3 ⅜") grapple on drill pipe, stripping over wireline to top of 'fish'; circulated above and latched onto "fish"; rigged up for 'logging while fishing' and resumed RCI-GR programme on drill pipe; RCI tool failure occurred when on depth at 3627m due to overheating of electronics in the gamma ray sonde, resulting in no further communications with the tool; the remainder of the tests were aborted and POOH with wireline tool on drill pipe; rigged down BakerAtlas.

Commenced plug and abandonment operations at 15:30 hrs 14th March 2005. Picked up and ran in hole with 73mm (2 ⅞") tubing cement stinger on 127mm (5") drill pipe to 3390mMD RT and pumped 30 bbls of 15.8 ppg Class G cement slurry, setting Plug#1 from 3350mMD RT to 3250mMD RT. Tagged top of cement plug at 3203mMD RT with 0.9Mt (2klbs). Pulled out of hole to 2230mMD RT and pumped 30 bbls of 15.8 ppg Class G cement slurry setting Plug#2 from 2230mMD RT to 2130mMD RT. Tagged top of cement Plug#2 at 2153mMD RT with 0.9Mt (2klbs). Pulled out of hole. Cut 244mm (9 ⅝") casing, retrieving and laying out same. Picked up 340mm (13 ⅜") bridge plug and ran in hole to 176mMD RT and set same. Displaced the hole to 1.15sg (9.6ppg) inhibited mud. Set cement Plug#3 from top of the bridge plug to 125mMD RT. Picked up wellhead jetting tool and ran in hole to clean stack and wellhead. Pulled riser and BOP's and secured same. Picked up 508mm x 762mm (20" x 30") spear and cutting assembly and ran in hole, stabbing into the 18 ¾" wellhead and cut 508mm (20") casing at 96.42mMD RT and pulled out of hole with casing cut-off stub and housing due to the 508mm (20") rotating inside the 762mm (30") conductor. Re-dressed spear and RIH, stabbing into 762mm (30") housing, cutting 762mm (30") casing at 95.94mMD RT. Conducted final seabed survey while pulling anchors.

Commenced anchor handling operations at 03:40 hrs 18th March 2005. Last anchor racked at 19:20 hrs 18th March 2005 and the rig released to Woodside Energy Ltd. Total time on the ZaneGrey-1/ST1/ST2 location was 50.52 days.

A more comprehensive summary of the drilling may be found in the ZaneGrey-1/ST1/ST2 Well Completion Report –Basic Data issued under separate cover.

2. WELL HISTORY

2.1 WELL DATA SUMMARY

Well Name		ZaneGrey-1/ST1/ST2
Operator		Bass Strait Oil Company Ltd
Equity Partners		Bass Strait Oil Company Ltd. (50%)
		Inpex Corporation (50%)
Permit		VIC/P42
Basin		Gippsland Basin
Type of Well		Exploration
Well Status		Plugged & Abandoned as Non-Commercial Gas Condensate Discovery
Surface Well Location	**Easting**	586049.89m E
	Northing	5,729,856.42m N
	Latitude	38° 34’ 31.64” S
	Longitude	147° 59’ 16.27” E
	Datum	AGD 84
Map Reference		SJ 55 1:1,000,000 Melbourne Map Sheet; Graticular Block 2208
Objectives	***Primary***	Kingfish Fm (Nannygai Zone)
	Secondary	Volador Fm (Roundhead Mbr)
Total Depth	**mRT**	2772mRT (ZaneGrey-1)
Total Depth	**mRT**	3107mRT (ZaneGrey-1/ST1)
Total Depth	**mRT**	3675mRT (ZaneGrey-1/ST2)
	mSS	3653.5mSS
Elevations	**Water Depth**	72.5m (MSL)
	Rotary Table	+21.5m
Rig on Contract		27th January 2005; 05:00 hours
Spud Date		29th January 2005; 14:30 hours
Well Reach TD		10th March 2005; 17:00 hours
Rig Released		18th March 2005; 19:20 hours

2.2 OPERATIONS SUMMARY

Detailed information on drilling and engineering data may be found in the ZaneGrey-1/ST1/ST2 Well Completion Report - Basic Data.

3. GEOLOGY

3.1 SUMMARY OF PREVIOUS EXPLORATION

Permit Vic/P42 which covers an area of 1,876 km^2 in water depths of 50-80 m in Bass Strait, is located in close proximity to the producing Bream and Kingfish oil and gas fields. The permit was granted to Bass Strait Oil Company (100%) pursuant to the PSLA by the Designated Authority for an initial six year period commencing on the 14th May 1998. As a result of variations to Permit Vic/P42, the current permit anniversary now falls on the 13th February and the initial period ends on the 13th February 2008.

By a farm-in agreement made between Bass Strait Oil Company Ltd (BAS) and INPEX Corporation in 2001, INPEX acquired a 50% interest in permit Vic/P42, while BAS remained as operator. Inpex earned the 50% interest by contributing to the costs of the Year 2 work commitments, which included the Melville-1 Well and the GBA02B 3D Seismic Survey.

3.1.1 Seismic Data

Seismic coverage varies over Vic/P42. BAS operated the 423sqkm GBA02B 3D Seismic Survey over the north-eastern portion of the permit in 2002. This provided excellent coverage over this area, which lead to the delineation of four ready to drill prospects (ZaneGrey, ZaneGrey South, Edina Deep and Hemmingway). Additional relevant 3D seismic coverage is provided by the extension of the western portion of the Kingfish 3D (1991) Seismic Survey into Vic/P42, and the East (1992) and West (1995) Bream 3D surveys, which lie adjacent to the northern border of the permit. BAS obtained these three Esso datasets by trading GBA02B. 2D seismic coverage of the remainder of the permit varies from an 0.5 to 4 km grid. In 2001, seismic coverage over the western portion of the permit was improved by contracting Australian Seismic Brokers to reprocess over 500km of Vic/P42 2D, of largely 1980's data. Re-processing aimed to increase definition of interpreted Latrobe Siliciclastics and Golden Beach Sub-Subgroup reservoirs.

ZaneGrey targeted a faulted anticline up-dip of Nannygai-1, which was interpreted to contain 6m of live oil within the Kingfish Formation. Nannygai-1 was drilled in 1972 on a TWT structure beneath a 'high velocity' submarine canyon. This well had an interpreted low relief closure at Top Latrobe level, valid in time. Pre-drill depth conversion work, suggested that Nannygai-1 may have been drilled close to the northern closure limit at intra-Latrobe Group levels. Interpreted spill points were mapped northeast of Nannygai-1 and east of ZaneGrey North, although both these areas were beyond the limit of good data quality in the GBA02B 3D, and over the Kingfish 3D dataset. Interpretation of the ZaneGrey feature highlighted a significant up-dip component to Nannygai-1 at the level of the interpreted pay zone and at deeper and shallower horizons in both time and depth. The following key horizons were interpreted to define closure.

- Top Latrobe Group
- 53Mya (intra-Kingfish Formation) Seismic Event
- Nannygai Payzone Event
- Deep Latrobe Event

Seismic data over the ZaneGrey area is subject to distortion due to significant velocity uncertainty in the Gippsland Limestone submarine canyon sequence due to strong lateral velocity variations resulting from variable fill in the submarine canyon sequences. This

uncertainty provided a significant risk in performing accurate depth conversion. Detailed velocity information through the submarine canyon sequence was derived from advanced geophysical processing techniques. However, a significant depth conversion risk still remained pre-drill. The closeness of post-drill formation tops compared to pre-drill prognosis has indicated that depth conversion techniques used by BAS were able to overcome this velocity problem.

3.1.2 Well Data

Early exploration by Esso and BHP in the Vic/P42 area led to the discovery of the Kingfish Oil Field in 1967 and the Bream Oil and Gas field in 1969, both of which are currently in oil production. Bream has now been further developed to produce its gas reserves. These fields lie immediately adjacent to the northern boundaries of Vic/P42 (Figure 2). Some eleven wells have been drilled in the current Vic/P42 area, with the first, Gurnard-1, drilled in 1969 by Esso Australia and encountering good oil shows.

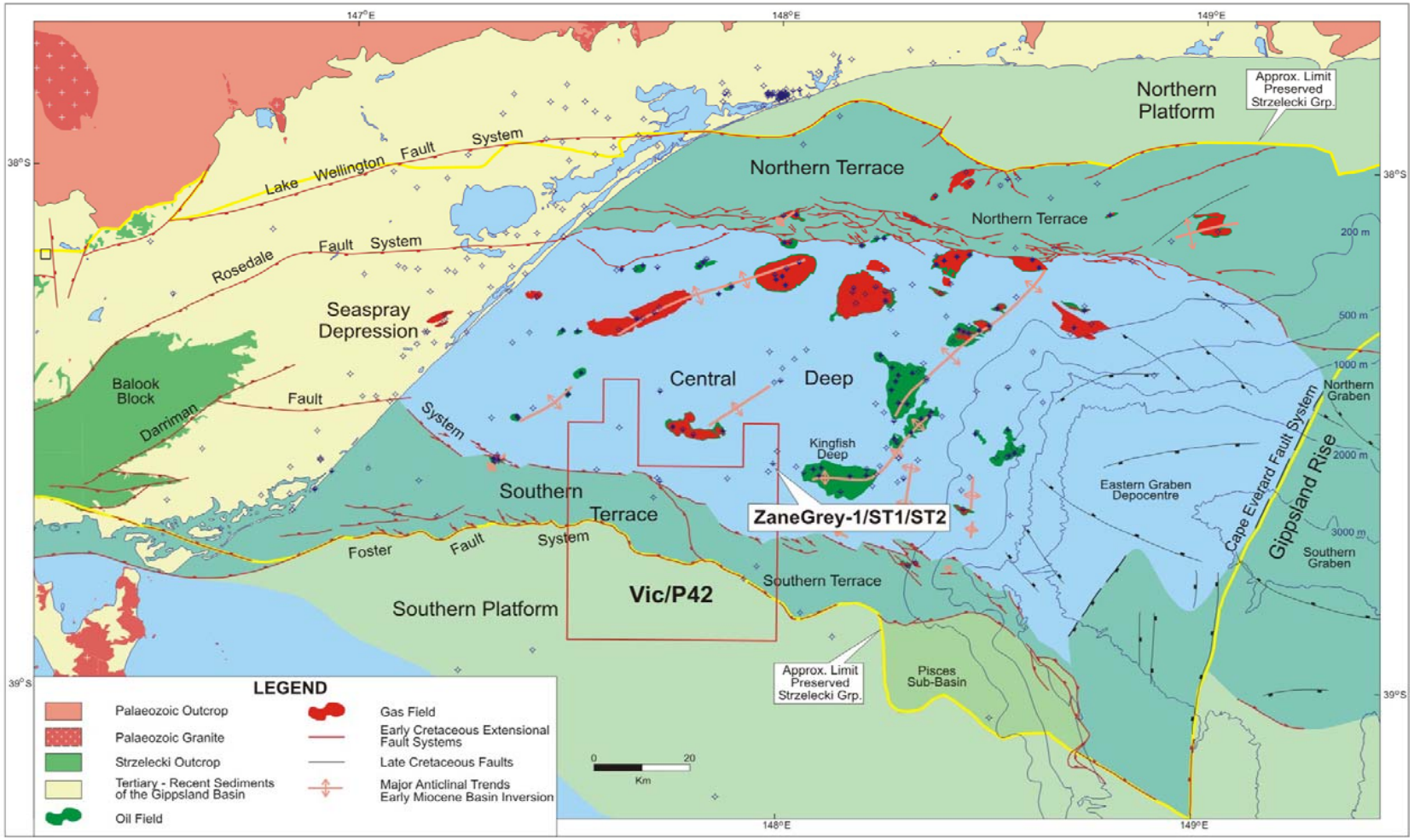
The next well, Nannygai-1 drilled in 1972, encountered hydrocarbon fluorescence within the Latrobe Group and log analysis interpreted 6m of live oil in the interval 2898 – 2904m KB. Nannygai-1 was the most important offset well used to define the ZaneGrey Prospect.

Another Vic/P42 well, Omeo-1 drilled in 1983, encountered live hydrocarbons and recent analysis of wireline logs indicates 34.4m of net gas sands occur in stacked reservoirs of the Golden Beach and Emperor subgroups. Significant gas bearing sands are interpreted over the interval 3073-3160m, with average porosities ranging from 10.5% to 13.6%. This discovery is currently the subject of further seismic interpretation work, since BAS completed reprocessing of the existing 2D seismic database.

The final well drilled in Vic/P42 prior to ZaneGrey-1/ST1/ST2 was Melville-1 (which recorded hydrocarbon shows), which was drilled and operated by BAS in 2001. Not any of the wells drilled in Vic/P42 prior to ZaneGrey-1/ST1/ST2 were located on 3D data.

3.2 REGIONAL STRUCTURE AND GEOLOGY

Vic/P42 is located offshore straddling the southern margins of the Gippsland Basin, approximately 230nm east of Port Melbourne. The southern and central portions of the permit lie to the south of the Darriman Fault System and cover the Southern Terrace and Southern Platform areas, the latter two areas separated by the Foster Fault System. The northern portions of Vic/P42 including the area of ZaneGrey-1/ST1/ST2 lie within the Central Deep to the north of the Darriman Fault System, mid-way between the Kingfish and Bream oil and gas fields. The structural setting of Vic/P42 is illustrated on the tectonic elements map included as Figure 3. The Generalised Stratigraphic Column reflecting the Early Cretaceous to Recent gross lithostratigraphic units of the Gippsland Basin (Figure 4) summarises much of the following discussion.



After Woollands & Wong (Eds), 2001

FIGURE 3: TECTONIC ELEMENTS MAP (MODIFIED AFTER WONG D., BERNECKER T. & MOORE D., 2001.)

3.2.1 Geological Evolution

The east-west trending Gippsland Basin was formed as a consequence of Gondwana break-up (Rahmanian et al 1990; Willcox et al 1992; Willcox et al 2001; Norvick & Smith 2001; Norvick et al 2001) and the basin evolution is recorded by several depositional sequences that range from Early Cretaceous to Recent in age (Thomas et al 2003).

The profound tectonic control on sedimentary systems in the basin is exemplified by several basin-wide angular unconformities that are easily recognised on seismic sections. Other time-breaks are only recognised using biostratigraphic age determinations delineating missing sections. This is of particular relevance in the context of the upper Latrobe Group, where extensive channel incision and subsequent infill processes resulted in complex sedimentary sequences that developed at slightly different time intervals, the extent of which cannot be resolved by seismic mapping alone.

3.2.2 Tectonic History

The Gippsland Basin is an asymmetric graben formed by the incipient break-up of Australia and Antarctica (Otway Rift) during the earliest Cretaceous (130-96 Ma). As part of this Early Cretaceous rift system, the Gippsland Basin architecture initially featured a classic extensional geometry consisting of a depocentre (the Central Deep) flanked by platforms and terraces. These are defined by the Rosedale and Lake Wellington Fault systems on the northern basin margin and by the Darriman and Foster Fault systems on the southern margin. The Central Deep hosts most of the oil and gas fields and, to the east, is characterised by rapidly increasing water depths which exceed 3000m in the Bass Canyon (Hill et al 1998). The eastern boundary of the basin is defined by the Cape Everard Fault System, a prominent NNE-striking basement high clearly evident from the aeromagnetic data (Moore & *Wong* 2002). The western onshore extent of the basin is traditionally placed at the Mornington High, but for the units described in this report it is essentially represented by out-crops of Early Cretaceous Strzelecki Group sediments (Hocking 1988). A tectonic elements and basin setting map is included herein as Figure 3 (modified after Wong D., Bernecker T. & Moore D., 2001.).

Crystalline basement is formed by the low grade metamorphic and igneous rocks of the Palaeozoic Tasman Fold Belt that have a general north-south tectonic grain and are cross-cut by NE-SW trending basement-involved fault zones formed during the Cretaceous rift phase.

Australia commenced its separation from Antarctica during the Cenomanian. The plate suture did not extend into the Gippsland Basin, but instead continued down the western side of Tasmania. The break-up created an unconformity at the end of the Early Cretaceous, not only in those basins where new oceanic crust formed but also further east in the Bass and Gippsland Basins.

Initial rifling in the Early Cretaceous resulted in 30% crustal extension (Power et al 2001) and created a complex system of grabens and half-grabens. A compressional phase accompanied by uplift occurred between 100 and 95 Ma which has been linked to the separation of Australia from Antarctica (Duddy & Green, 1992). This produced a new basin configuration and provided the accommodation space for large volumes of basement derived sediments. A second phase of crustal extension, produced by rifting between

Australia and the Lord Howe Rise (Tasman Rift), began at the end of the Early Cretaceous and produced northwest-southeast oriented basement-involved normal faults and established the Central Deep as the main depocentre. The first marine incursion is recorded by Late Santonian sediments in the eastern part of the basin (Partridge, 1999). Many: of the earlier generated faults were reactivated during this tectonic phase.

Rifting was followed by the development of a margin-sag basin characterised by rapid subsidence. Extensional tectonism prevailed until the Early Eocene and produced pervasive NW-SE trending normal faults. By the Middle Eocene, sea-floor spreading had ceased in the Tasman Sea and a period of compressional tectonism began to affect the Gippsland Basin, initiating a series of NE to ENE trending anticlines (Smith. 1988). Compression and structural growth peaked in the Middle Miocene and resulted in basin inversion. All the major fold structures at the top of the Latrobe Group which became the hosts for the large oil and. gas accumulations such as Barracouta, Tuna, Kingfish, Snapper and Halibut are all related to this tectonic episode.

A second regional event at this stage was a widespread mid-Eocene marine transgression that is recognised in the Gippsland, Taranaki and southern Australian margins (Norvick et al, 2001). Plate reorganisation occurred at this time leading to the onset of fast spreading south of Australia, obduction in New Caledonia and other movements in New Zealand. The Lakes Entrance Formation became a widespread depositional unit at this time and was succeeded by prograding carbonate wedge deposits of the Gippsland Limestone that continue to be deposited today.

Tectonism has continued to overprint the basin as documented by localised uplift during the Late Pliocene to Pleistocene. This is also reflected in the uplift of Pliocene sediments on the Barracouta, Snapper and Marlin anticlines as well as around the township of Lakes Entrance on the Victorian coastline. Ongoing tectonic activity is episodically recorded by seismic events around the major basin bounding faults.

The superposition of different age structures in the Gippsland Basin has produced a structural style characterised by multi-directional fault, fold and erosional patterns, allowing a range of trapping mechanisms, from large anticlines to complex, fault-controlled rotated blocks and truncation plays. The timing of the structuring, specifically the large compressional anticlines initiated in the Late Eocene, is particularly critical to the entrapment of most of the hydrocarbons in the basin, as the key geometry of the traps was in place prior to the generation of most of the oil and gas.

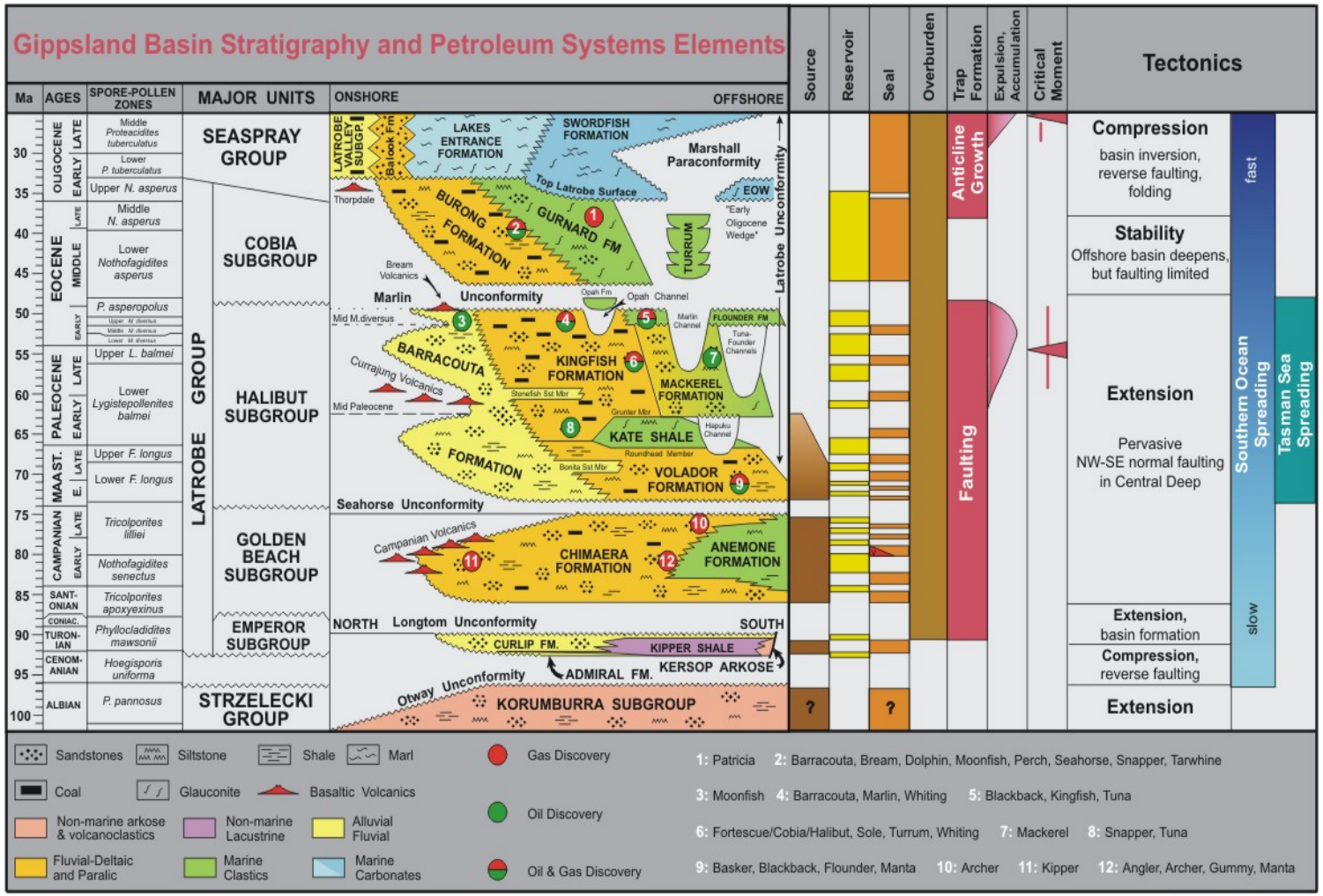


FIGURE 4: GENERALISED STRATIGRAPHIC COLUMN OF THE GIPPSLAND BASIN (AFTER BERNECKER, T., THOMAS, H. & DRISCOLL, J., 2003.

3.3 STRATIGRAPHY

ZaneGrey-1/ST1/ST2 penetrated a sedimentary section ranging in age from Late Cretaceous to Recent. The lithologies described herein follow the convention that the dominant lithology is mentioned first. Depths are measured depths (MD) in metres below the Drill Floor (DF) which was 21.5m above Mean Sea Level (MSL) and 94m above the seafloor, unless otherwise stated. Subsea depths are metres below Mean Sea Level (MSL) and corrected for hole deviation as defined by the definitive survey data supplied by Halliburton (refer Section 3.5; ZaneGrey-1/ST1/ST2 Well Completion Report - Basic Data).

No ditch cuttings samples were collected over the 914mm (36") and 445mm (17 ½") hole sections drilled between the seabed (94mMD RT) and 1095mMD RT (-1012.63mTVD SS) in ZaneGrey-1. Following installation of the marine riser, the well was drilled from 1095mMD RT to 2772.5mMD RT (Total Depth of ZaneGrey-1) with full returns. After setting the 244mm (9 ⅝") casing at 2184mMD RT and setting a cement plug, ZaneGrey-1ST1 was drilled with full returns from 2184mMD RT to 3107mMD RT (Total Depth of ZaneGrey-1ST1). After setting two cement plugs, ZaneGrey-1ST2 was successfully kicked-off and drilled with full returns from 3074mMD RT to 3675mMD RT (-3198.3mTVD SS), Total Depth of ZaneGrey-1/ST1/ST2.

The wellsite lithological descriptions of the cuttings samples are contained in Appendices 1, 2 and 3 of the ZaneGrey-1/ST1/ST2 Well Completion Report - Basic Data. A composite log of the lithology is provided in Enclosures 1 and 2. The lithology described hereunder is a synthesis of the lithological descriptions of drilled ditch cuttings. No additional sidewall core or conventional core samples were acquired to validate the cutting descriptions. Table 1 below summarises the formations intersected and the relevant depths to the top of the formation.

Formation/Age (Drill Floor = 21.5m)	Depth (mMD RT)	Depth (mTVD SS)	Thickness TVD (m)	TWT (ms)
Miocene-Pliocene/Recent Gippsland Limestone (Seafloor)	94.0	72.5	1324.0	95
Oligocene-Early Miocene Lakes Entrance Fm	1560.0	1396.5	797.5	1054
Middle Eocene-Early Oligocene Gurnard Fm	2513.3	2194.0	33.8	1612
Paleocene to Early Eocene Kingfish Fm	2554.4	2227.8	815.3	1626
Early Paleocene Kate Shale	3508.1	3043.1	35.7	2058
Late Cretaceous (Maastrichtian) Volador Fm	3546.7	3078.8	119.5	2075
Top Roundhead Mbr	3546.7	3078.8	32.2	2075
Base Roundhead Mbr	3581.5	3111.0		2090
TOTAL DEPTH	**3675.0**	**3198.3**		2131

TABLE 1: ZANEGREY-1/ST1/ST2 STRATIGRAPHIC TABLE.

***Subsea depths in metres below Mean Sea Level (MSL) and corrected for hole deviation where appropriate.**

The stratigraphic section encountered was essentially as predicted with all of the formation tops close to their prognosis. A comparison of the Actual and Predicted section drilled in ZaneGrey-1/ST1/ST2, including a brief summary of drilling and formation evaluation data is included in Enclosure 3. The geological formations and data encountered for each hole section are discussed below.

The sub-division of the sedimentary section of ZaneGrey-1/ST1/ST2 by formation boundaries and chronostratigraphic units as shown on the composite logs (Enclosures 1 and 2) were determined primarily using a combination of wireline logs, lithological descriptions, drilling parameters and biostratigraphic data. A basic biostratigraphic report is included as Appendix 9 of the ZaneGrey-1/ST1/ST2 Well Completion Report – Basic Data and an interpretive biostratigraphic report is included herein as Appendix 3. Log correlation with nearby offset wells was also used to define formation tops.

3.3.1 Gippsland Limestone/Recent — Seafloor – 1560mMD RT (72.5-1396.5mTVD SS)

True Vertical Thickness	1324m
Age:	Miocene-Pliocene/Recent
Palynozone:	Not defined
Depositional Environment:	Marine
Seismic Time:	0.095 Sec TWT

No ditch cuttings were collected over the upper portion of the Gippsland Limestone above 1095mMD RT and no open hole wireline logs were recorded above 1095mMD RT. An MWD-gamma ray-resistivity-directional logging assembly was run as part of the bottom hole assembly (BHA) while drilling riserless in the 406mm (16”) hole section below the surface conductor set at 127.8mMD RT, to a depth of 1095mMD RT and prior to setting the 340mm (13 ⅜”) casing at 1090.6mMD RT within the Gippsland Limestone. This MWD package was run primarily to monitor well bore direction and inclination following kick-off within the Gippsland Limestone at 486mMD RT. A similar MWD-LWD logging package was also run in the 311mm (12 ¼”) hole section after running the BOP’s and prior to eventually setting the 244mm (9 ⅝”) casing at 2184mMD RT within the central portion of the Lakes Entrance Formation.. This 311mm (12 ¼”) hole section included the lower part of the Gippsland Limestone, Lakes Entrance Formation, Gurnard Formation and Kingfish Formation. A cased hole wireline gamma ray was recorded from 2184mMD RT to seafloor at 94mMD RT, while a cased hole sonic (MAC) was recorded to 1983mMD RT. The wireline gamma ray is used as the primary depth reference in ZaneGrey-1/ST1/ST2 to which all LWD logs have been depth matched.

Lithology above 1095mMD RT is largely interpreted from surrounding offset well data, LWD log response and ROP.

The Gippsland Limestone is interpreted to consist of calcarenite with interbedded and intergradational calcisiltite and calcilutite above 1095mMD RT. The lower part of the unit below 1095mMD RT consists predominantly of argillaceous calcilutite and calcisiltite with minor calcarenite. The LWD gamma ray is generally uniform throughout, varying between 20 and 40 API units, increasing slightly with increasing depth, while the LWD resistivity increases from <1 ohm-m at the top of the sequence to 4 ohm-m towards the base. Rare thin beds have a maximum reading of 6-7 ohm-m.

The Gippsland Limestone unconformably overlies the Lakes Entrance Formation at 1560mMD RT (-1396.5mTVD SS), at a seismic time of approximately 1.054msec TWT. The contact is defined by an increase in gamma ray response from 28 API units above 1560mMD RT to 45-50 API units below, while the LWD log (SEDP curve) exhibits an increase in resistivity from 4.5 ohm-m above 1560mMD RT to 10 ohm-m below. These log changes reflect the first appearance of marl and calcareous claystone in the section below 1560mMD RT and correlation with offset wells.

The unconformable nature of the contact at 1560mMD RT is based on regional evidence only and is not able to be documented directly in ZaneGrey-1/ST1/ST2.

No direct biostratigraphic age dating was attempted in ZaneGrey-1/ST1/ST2 through the Gippsland Limestone, however based on regional evidence the sequence is defined as being Miocene to Pliocene in age with a probable veneer of Recent sediments on the seafloor.

Lithology (ZaneGrey-1)

94-129.5mMD RT (35.5m) — *Calcarenite*
ROP range (average): 2-234 (77) m/hr

No Samples – Returns to Seafloor

129.5 – 1095mMD RT (250.5m) — *Calcarenite, Calcisiltite and Calcilutite*
ROP range (average): 4-489 (88) m/hr

No Samples – Returns to Seafloor

1095-1200m (105m) — *Argillaceous Calcilutite with abundant interbedded Calcisiltite:*
ROP range (average): 9-63 (35) m/hr

Calcilutite (20-40%): argillaceous, white to light grey, light brownish grey, light to medium grey, soft to firm, hard in part, blocky, 5-10% detrital clay, trace-30% calcisilt grading to *calcisiltite* in part, trace very fine dark green glauconite grains.
Calcisiltite: light - medium grey to light brownish grey, medium dark grey, firm to moderately hard, calcareous silt with trace-10% very fine calcareous sand, 10-20% micritic clay and 5-10% detrital clay, grading to *calcilutite***,** trace very fine dark green glauconite grains.

1200-1250m (50m): — *Argillaceous Calcilutite with abundant interbedded Calcisiltite and rare Calcarenite*
ROP range (average): 21-79 (60) m/hr

Calcilutite (20-50%): argillaceous, light to medium grey, light brownish grey, soft to firm, hard in part, blocky, 20–35% detrital clay, trace-30% calcisilt grading to *calcisiltite* in part, trace very fine dark green glauconite grains in part.
Calcisiltite: light to medium grey, light grey brown, firm-hard, blocky, calcareous silt, 10–20% micritic clay and 5-10% detrital clay, grading to *calcilutite***,** trace very fine dark green glauconite grains.

Calcarenite: light grey, pale yellowish brown in part, firm - hard, very fine to fine grained (fL-vfU), 10-15% calcareous cement, trace-5% detrital (and micritic?) clay, trace-15% fine to very fine glauconite grains, trace shell fragments and large forams.

1250-1320m (70m): *Argillaceous Calcilutite with abundant interbedded Calcisiltite*
ROP range (average): 21-81 (61) m/hr

Calcilutite (40-60%): argillaceous, white, light to medium grey, light brownish grey in part, soft to firm, dispersive in part, blocky, 20-40% detrital clay, trace-30% *calcisiltite* grading to *calcisiltite* in part, trace very fine dark green glauconite grains in part.
Calcisiltite: light to medium grey, firm, blocky, calcareous silt, 10-20% micritic clay and 5-20% detrital clay, grading to and finely interbedded with *calcilutite***,** trace very fine dark green glauconite grains.

1320-1560m (240m): *Argillaceous Calcilutite with abundant interbedded Calcisiltite and rare Calcarenite*
ROP range (average): 8-84 (54) m/hr

Calcilutite (10-70%): argillaceous, off-white, very light grey, grading into medium light grey in parts, soft, predominantly crumbly, occasionally slight amorphous in places, 5-25% detrital clay, grading to *Calcilutite*, trace glauconite staining, occasional trace very fine black carbonaceous flakes, rare trace of very dark green glauconite grains.
Calcisiltite: very light grey to medium light grey, becoming light olive grey to olive grey with depth, soft to firm, occasionally moderately hard, crumbly, 5-10% micritic clay and 30-40% detrital clay, trace-1% very fine dark green glauconite grains, trace fine black carbonaceous flakes.
Calcarenite: pale yellowish brown, light grey, light olive grey, firm-hard, partly recrystallised clasts, trace shell fragments and forams, trace fossil fragments and forams

3.3.2 Lakes Entrance Formation 1560 – 2513.3mMD RT (1396.5 – 2194.0mTVD SS)

True Vertical Thickness	797.5m
Age:	Late Oligocene-Early Miocene
Palynozone:	Not Defined
Depositional Environment:	Open Marine
Seismic Time:	1.054 Sec. TWT

The Lakes Entrance Formation consists predominantly of calcareous claystone and claystone with rare to common interbedded marl and rare argillaceous calcilutite, siltstone and sandstone.

The Lakes Entrance Formation unconformably overlies the Gurnard Formation at 2513.3mMD RT (-2194.0mTVD SS), at a seismic time of 1.612msec TWT. The contact is defined by an increase in gamma ray response from 70 API units above 2513.3mMD RT to 90-155 API units below, while the DLL log (R_D curve) exhibits a decrease from 7 ohm-m above 2513.3mMD RT to generally 2-3 ohm-m below. Furthermore, the interval transit time on the sonic curve exhibits an increase from 68 msec/ft above 2513.3mMD RT, to 80-85 msec/ft below.

The unconformable nature of the contact at 2513.3mMD RT is not able to be documented directly in ZaneGrey-1/ST1/ST2 and is based on regional evidence only and by correlation with offset wells.

No palynological age dating was undertaken on any samples from the Lakes Entrance Formation, consequently its precise age in ZaneGrey-1/ST1/ST2 is not defined. Based upon regional evidence and correlation with offset well data, the sequence is considered to be Late Oligocene to Early Miocene.

Lithology (ZaneGrey-1)

1560-1714m (154m): *Calcareous Claystone with abundant interbedded Marl and rare to common Argillaceous Calcilutite*
ROP range (average): 5-140 (88) m/hr

Claystone (0-80%): calcareous, light grey to medium grey and brownish grey, soft to moderately firm, amorphous to blocky, 20-40% micrite, trace calcisilt, trace fossil fragments, nil to trace fine, dark green disseminated glauconite and nodular glauconite, trace fine pyrite.
Marl: light to medium light grey, locally dark grey, very soft to soft, dispersive in part, amorphous, 35-45% detrital clay, grading to *Argillaceous Calcilutite* in part, trace calcisilt in part, trace very fine black carbonaceous flakes, trace very fine dark green disseminated glauconite, trace fossil fragments and forams.
Calcilutite: argillaceous, soft-slightly firm, very light to medium grey, 20-30% detrital clay, trace to 10% calcisilt, trace fossil fragments incl. coral debris, bryozoan, spicules, shell fragments and forams, trace fine dark green disseminated glauconite and nodular glauconite, trace fine pyrite.

1714-1770m (56m): *Calcareous Claystone*
ROP range (average): 75-130 (99) m/hr

Claystone (100%): calcareous, light to medium dark grey, soft to firm, sub blocky to blocky, 20-40% micrite, trace-5% calcisilt in part, trace very fine disseminated pyrite and nodular pyrite, nil to trace very fine grained glauconite.

1770-2081m (311m): *Calcareous Claystone with common to abundant interbedded Claystone*
ROP range (average): 10-133 (91) m/hr

Claystone (50-90%): calcareous, light to medium light grey, soft to firm, sub blocky to blocky, 20-40% micrite, locally grading to *Claystone*, trace-5% calcisilt in part, trace very fine disseminated pyrite and nodular pyrite, nil to trace very fine grained glauconite.
Claystone: light to medium dark grey, soft to firm, sub blocky to blocky, 10-20% micrite, locally grading to *Calcareous Claystone***,** trace very fine disseminated pyrite and nodular pyrite, nil to trace very fine grained glauconite

2081-2150m (69m): *Calcareous Claystone with abundant interbedded Claystone*
ROP range (average): 28-128 (85) m/hr

Claystone (40-80%): calcareous, very light grey to yellowish grey, light olive grey, very soft to soft, rare firm, sub blocky, commonly amorphous and plastic, increasingly

homogenous 20-35% micrite, locally grading to *Claystone***,** trace fossil fragments and forams, nil to trace very carbonaceous flakes, fine disseminated pyrite and coarse nodular pyrite,
Claystone: medium grey-medium dark grey, olive grey, firm, occasionally moderately hard, blocky, common sub splintery, 5-20% micrite, locally grading to *Calcareous Claystone***,** trace-rare fossil fragments and forams, trace carbonaceous flakes, trace very fine disseminated and nodular pyrite, trace micro-mica flakes.

2150-2230m (80m): *Calcareous Claystone with rare to abundant interbedded Claystone and rare Sandstone and Siltstone*
ROP range (average): 23-123 (81) m/hr

Claystone (70-100%): calcareous, very light grey to medium light grey, light olive grey, very soft to soft, rare firm, sub blocky-blocky, occasionally amorphous, increasingly silty and slightly arenaceous in places 20-30% micrite, grading to *Claystone***,** trace fossil fragments and forams, nil to trace very carbonaceous flakes, fine disseminated pyrite and coarse nodular pyrite,
Claystone: medium grey to medium dark grey, olive grey, soft to firm, rarely moderately hard, blocky, trace sub splintery, 1-20% micrite, grading to *Calcareous Claystone* in part**,** trace-rare fossil fragments and forams, trace carbonaceous flakes, trace very fine disseminated and nodular pyrite, trace micro-micaceous flakes
Sandstone: light olive grey, hard, very fine grained (vfL), occasional loose transparent quartz grains (cL), angular, elongated, well sorted, sub angular to angular, calcite matrix, poor inferred porosity, grading to siltstone, trace micro-micaceous flakes, trace glauconite grains, no shows.
Siltstone: pale yellowish brown to olive grey, firm sub blocky to hard angular-blocky fragments, slightly calcareous with 5-10% micrite, nil-very poor trace very fine grained glauconite, trace siliceous silt, trace carbonaceous specks.

2230-2350m (120m): *Calcareous Claystone with common to abundant interbedded Claystone and rare to common Marl*
ROP range (average): 9-107 (64) m/hr

Claystone (30-70%): calcareous, very light grey to medium light grey, very soft to firm, sub blocky to blocky, 1-5% calcisilt, trace quartz silt, 20-35% micrite, locally grading to *Marl* and *Claystone*, nil to trace very fine carbonaceous flakes, trace very fine disseminated pyrite and coarse nodular pyrite, trace micro-micaceous flakes.
Claystone: medium grey - medium dark grey, olive grey, firm, occasionally moderately hard, blocky, 1-5% calcisilt, 10-20% micrite, grading to *Calcareous Claystone* in part**,** trace very fine to fine glauconite, trace fossil fragments and forams, trace very fine carbonaceous flakes, trace very fine disseminated and coarse nodular pyrite, trace micro-micaceous flakes.
Marl: very light grey, very soft to soft, blocky to amorphous, 35-45% micrite, grading to *Calcareous Claystone***,** trace carbonaceous flecks.

2350-2477m (127m): *Calcareous Claystone with abundant interbedded Claystone*
ROP range (average): 13-68 (42) m/hr

Claystone (20-60%): calcareous, very light grey to medium light grey, very soft to firm, sub blocky to blocky, 1-10% calcisilt, 5-35% micrite, grading to *Claystone*, nil to trace

very fine carbonaceous flakes, trace very fine disseminated pyrite and coarse nodular pyrite, trace micro-micaceous flakes, trace forams.
Claystone: light grey to medium dark grey, light olive grey, yellowish grey to dusky yellow, mottled in part, soft to firm, occasionally moderately hard, blocky, 1-10% calcisilt, 5-20% micrite, grading to *Calcareous Claystone***,** trace very fine carbonaceous flakes, trace very fine disseminated and coarse nodular pyrite, trace very fine glauconite, trace micro-micaceous flakes, trace forams.

2477-2513.3m (36.3m): *Calcareous Claystone with abundant interbedded Claystone and rare to common Marl*
ROP range (average): 10-40 (25) m/hr

Claystone (30-70): calcareous, very light grey to medium light grey, very soft (amorphous in part) to firm, sub blocky to blocky, 5-20% calcisilt in part, 20-35% micrite, grading to *Marl* and *Claystone,* nil to trace very fine carbonaceous flakes, trace very fine disseminated pyrite and as fine darker laminations, trace coarse nodular pyrite, trace fine glauconite in part, nil - trace light brownish yellow fossil fragments.
Claystone: light grey to medium dark grey, brownish grey, firm to moderately hard, splintery, blocky, 1-15% calcisilt, 5-20% micrite, grading to *Calcareous Claystone***,** trace very fine carbonaceous flakes, trace very fine disseminated and coarse nodular pyrite, trace fine glauconite in part, nil to trace light brownish yellow fossil fragments.
Marl: white to very light grey, soft to firm, blocky to amorphous, 35-45% micrite, grading to *Calcareous Claystone***,** trace carbonaceous flecks.

3.3.3 Gurnard Formation — 2513.3 – 2554.4mMD RT (2194 – 2227.8mTVD SS)

True Vertical Thickness	33.8m
Age:	Middle-Late Eocene
Palynozone:	Middle *Nothofagidites asperus*
Depositional Environment:	Shallow marine
Seismic Time:	1.612 Sec. TWT

The Gurnard Formation, which was not a reservoir objective in ZaneGrey-1/ST1/ST2, was intersected in both the ZaneGrey-1 and ZaneGrey-1ST1 wellbores. However, it was an objective to determine its structural elevation and thereby validate the velocity model used to test the integrity of the Prospect. Following the intersection of this stratigraphic unit 10m high to prognosis, it therefore confirmed the pre-drill model and consequently a decision was made to continue drilling to the deeper reservoir objectives.

The Gurnard Formation consists of a complex lithological mix of intergradational claystone with accessory glauconite, locally grading to glauconitic claystone, greensand, argillaceous siltstone and rare argillaceous sandstone. The sequence consists of three depositional cycles:

2513.3-2533m: a claystone dominated sequence with apparent oscillating shallow marine conditions, possibly across a narrow shelf as defined by a gamma ray curve that varies between 90 and 130 API units.

2533-2547m: a claystone dominated sequence in a pronounced prograding or coarsening-upward cycle as defined by the gamma ray with a funnel-shaped response. A number of second-order prograding cycles are also within this sequence.

2547-2554.4m: a claystone dominated sequence in a fining-upward cycle as defined by the gamma ray with a bell-shaped response. The top of this sequence may represent a maximum flooding surface during deposition of the shallow marine Gurnard Formation.

The Gurnard Formation unconformably overlies the Kingfish Formation at 2554.4mMD RT (-2227.8mTVD SS), at a seismic time of approximately 1.626 seconds TWT. The contact is well defined by the gamma ray curve which exhibits a decrease from 100API units above 2554.4mMD RT to 70 API units below, while the sonic log displays a reduction in interval transit time from an average 85µsec/ft above 2554.4mMD RT to 75-80µsec/ft below.

The unconformable nature of the contact at 2554.4mMD RT is not able to be documented directly in ZaneGrey-1/ST1/ST2 and is based on regional evidence only and by correlation with offset wells.

Palynological analysis of drilled ditch cuttings from the interval 2525-2530mMD RT within the central portion of the Gurnard Formation, contained an assemblage dominated by *Nothofagidites* pollen, confirming assignment to the *Nothofagidites asperus* palynozone of Middle Eocene to Early Oligocene age. The presence of the index species *Triorites magnificu*s indicates that the Late Eocene Middle subzone is present in the interval. Analysis of cuttings from the interval 2515-2520mMD RT and 2550-2555mMD RT were essentially barren of palynomorphs and unable to be assigned to a palynozone.

Lithology (ZaneGrey-1)

2513.3-2554.4m (41.1m): *Claystone with rare to abundant interbedded Greensand and Argillaceous Siltstone.*
ROP range (average): 18-62 (35) m/hr

Claystone (25-65%): light grey**,** light olive grey to brownish grey, olive grey, mottled, soft, dispersive, generally amorphous, 5-15% calcisilt, 5-20% micrite, abundant glauconite (up to 35%) in part grading to *Glauconitic Claystone* and *Glauconitic Calcareous Claystone,* commonly arenaceous imbedded with vfL-vfU quartz grains, grading to *Argillaceous Sandstone*, trace very fine disseminated and coarse nodular pyrite, trace fine glauconite in part.
Greensand: dark yellowish green to dusky green in a white to light grey matrix, soft, loose in part, very fine to medium quartz grains (vfL-mL), commonly silty, 20-75% glauconite grains (fL-fU), loose glauconite grains in part, trace-40% quartz, 10-20% calcareous matrix (micrite?), trace shell fragments, nil visual porosity.
Siltstone: argillaceous, dark brownish grey, soft, friable, with 20-30% detrital clay matrix, 10% very fine quartz, common (5-20%) medium to coarse glauconite grains and diffuse glauconite patches, locally grading to Glauconitic Siltstone, trace very fine white mica, nil visual porosity.

Lithology (ZaneGrey-1/ST1)

2513.3-2554m (40.7m): *Interbedded Claystone, Greensand, Argillaceous Siltstone and Sandstone*
ROP range (average): 3-40 (20) m/hr

Claystone (65-80%): brownish grey, moderate yellowish brown, speckled and stained with green glauconite, soft, amorphous, trace firm, blocky, 5-15% calcisilt, 5-20% micrite, abundant glauconite (up to 35%) in part grading to *Glauconitic Claystone* and *Glauconitic Calcareous Claystone,* trace very fine disseminated pyrite.
Greensand: dark yellowish green to dusky green in a white to moderate yellowish brown matrix, soft, amorphous, loose in part, 50-75% glauconite, very fine to coarse grained (vfU-cU), loose glauconite grains in part, trace nodular glauconite, trace-20% quartz silt and very fine quartz, 10-20% micritic matrix, trace shell fragments, nil visual porosity, no show.
Siltstone: argillaceous, dark brownish grey, soft, friable, with 20-30% detrital clay matrix, 10% very fine quartz, 5-20% medium to coarse glauconite grains and diffuse glauconite patches, trace very fine white mica, nil visual porosity.
Sandstone: dark brownish grey, soft, amorphous, transparent to translucent, occasionally frosted, yellowish orange, loose quartz grains, vfL-fU, mainly vfU, moderately sorted, rounded to sub-angular, 20-30% detrital clay matrix, silty grading to *Argillaceous Sandstone* and *Argillaceous Siltstone*, no show, poor inferred porosity.

3.3.4 Kingfish Formation

2554.4 – 3508.1mMD RT (2227.8 – 3043.1mTVD SS)

True Vertical Thickness	815.3m
Age:	Paleocene to Early Eocene?
Palynozone:	Lower *Lygistepollenites balmei*
Depositional Environment:	Non-marine to lower coastal plain
Seismic Time:	1.626 Sec. TWT

The Kingfish Formation which formed a secondary reservoir objective in ZaneGrey-1/ST1/ST2 consists of a thick sequence of quartzose and argillaceous sandstone with interbedded claystone and siltstone and rare to abundant coal beds. The latter commence below 2745mMD RT and are generally ≤ 1m thick clustered over a 15-20m interval, interbedded with claystone and siltstone between the thicker and amalgamated beds of quartzose sandstone.

The Kingfish Formation overlies the Kate Shale with apparent conformity at 3508.1mMD RT (-3043.1mTVD SS), at a seismic time of approximately 2.058 seconds TWT. The contact is moderately well defined on wireline logs, with the gamma ray exhibiting an increase from 120 API units above 3508.1mMD RT to 160 API units below, while DLL log (R_D) curve exhibits an increase from 3 ohm-m above 3508.1mMD RT to 10 ohm-m below. The density curve (ZDEN) exhibits an increase from 2.30-2.35g/cc above 3508.1mMD RT to 2.55-2.60g/cc below. These wireline log changes reflect a change in lithology from sandstone above 3508.1mMD RT to claystone below. Recognition of this particular claystone bed below 3508.1mMD RT as being the Kate Shale is based on the inclusion of trace amounts of accessory glauconite which defines this unit as being shallow marine in origin.

The conformable nature of the contact at 3508.1mMD RT is documented directly in ZaneGrey-1/ST1/ST2 by assignment of the *Lygistepollenites balmei* palynozone of Early Paleocene age immediately above and below the contact, despite the assemblages above the contact being of largely non-marine origin, compared to those below the contact which are interpreted to be shallow marine in origin.

Palynological analysis of five (5) ditch cutting samples from the gross interval 3290-3445mMD RT within the lower part of the Kingfish Formation are all characterised by the consistent presence of *Lygistepollenites balmei* and the common occurrence of the probable aquatic herb *Australopollis obscurus,* resulting in assignment to the Lower *Lygistepollenites balmei* palynozone of Early Paleocene age.

Lithology (ZaneGrey-1)

2554.4-2658m (103.6m): *Sandstone with rare to abundant interbedded Argillaceous Siltstone and Claystone and rare Coal*
ROP range (average): 5-42 (22) m/hr

Sandstone (20-95%): quartzose, very light grey, clear to translucent grains, occasionally frosted, trace very light orange/brown (iron stained), fine to very coarse (vfL-vcL), predominantly medium to coarse (mL-cL), sub rounded to rounded, occasionally angular, moderate to high sphericity, loose, poorly sorted, cU pyrite nodules, very good inferred porosity. No fluorescence or cut.
Siltstone: argillaceous, greyish brown, moderate to dark yellowish brown, dark yellowish orange, soft, friable, sub-blocky, (washing out), 20-30% detrital clay matrix, micaceous, abundant carbonaceous material and laminae, arenaceous with 5-10% very fine to fine quartz, trace coarse pyrite nodules.
Claystone: light grey**,** light olive grey to brownish grey, medium grey, olive grey, mottled, soft, dispersive, generally amorphous, slightly calcareous in part with 5 10% micrite, becoming non-calcareous with depth, nil to trace glauconite (up to 10%) in part, commonly silty and grading to *Argillaceous Siltstone***,** commonly arenaceous, imbedded with vfL-vfU quartz grains grading into *Argillaceous Sandstone*, trace very fine disseminated and coarse nodular pyrite.
Coal: brownish black, firm-moderately hard, sub blocky, earthy to sub vitreous lustre.

2658-2729.5m (71.5m): *Sandstone with rare to abundant interbedded Argillaceous Siltstone and rare Coal.*
ROP range (average): 2-29 (13) m/hr

Sandstone: quartzose, loose quartz grains, predominantly translucent-frosted, very light grey, occasionally clear, trace opaque, trace very pale orange, dark yellowish orange clay coating and stain in part, fine to very coarse (fL-vcU), predominantly medium to coarse (mL-cL), poorly sorted, predominately sub angular to angular, commonly sub-rounded to rounded coarse grains with angular fractures, trace pyrite cemented aggregates, trace coarse mica flakes (muscovite), very good inferred porosity, no fluorescence or cut.
Siltstone: argillaceous, greyish brown, moderate to dark yellowish brown, dark yellowish orange, soft, friable, sub-blocky, (washing out), 20-30% detrital clay, micaceous, abundant carbonaceous material and laminae, arenaceous with 5-10% very fine to fine quartz, trace coarse pyrite nodules, non calcareous.
Coal: brownish black to black, moderately firm, sub blocky, earthy to sub vitreous lustre.

2729.5-2772.5 (43m) *Argillaceous Siltstone, Siltstone and Silty Claystone with common interbedded Sandstone and rare Coal*
ROP range (average): 3-31 (10) m/hr

Siltstone (20-50%): argillaceous, dark yellowish brown, soft, blocky friable in part, dispersive, (washing out), 20-30% detrital clay matrix, grading to *Silty Claystone* in part, quartz silt to very fine quartz, micro-micaceous, trace fine pyrite, trace fine carbonaceous material, non calcareous.
Siltstone: light grey, soft to firm, dispersive in part, trace-10% detrital clay matrix, quartz silt to very fine quartz, grading to *Sandy Siltstone*, trace fine pyrite, non calcareous.
Claystone: silty, moderate to dark yellowish brown, moderate reddish brown, soft, trace blocky, generally dispersive, (washing out), 20-35% quartz silt to very fine quartz, micro-micaceous, trace fine pyrite, trace fine carbonaceous material, non calcareous.
Sandstone: loose quartz grains, translucent-frosted, very light grey, occasionally clear, trace opaque, isolated very pale orange, (fU-vcL), predominantly (mU-cL), moderately well sorted, angular-sub angular, common sub rounded-rounded coarse grains with angular fractures, trace coarse mica (muscovite) flakes, trace disseminated and coarse pyrite nodules, no fluorescence or cut.
Coal: brownish black to black, moderately firm, sub blocky, laminated in part, earthy to sub vitreous lustre.

Lithology (ZaneGrey-1/ST1/ST2)

2554-2729.5m (175.5m): *Sandstone with rare to common interbedded Claystone and Siltstone.*
ROP range (average): 4-103 (57) m/hr

Sandstone (30-100%): loose quartz grains, predominantly translucent-frosted, common clear, very light grey, trace yellowish orange stain, fine to very coarse (fL-vcU), predominantly (mL-cU), moderately sorted, sub rounded to rounded, becoming increasingly sub angular to angular from 2620m, moderate to high sphericity, trace coarse pyrite nodules, very good inferred porosity, no show.
Claystone: white to light grey, light brownish grey to dark yellowish brown, soft, amorphous, (washing out), trace-20% quartz silt and trace to rare very fine to fine quartz, grading to *Siltstone* in part, non-calcareous.
Siltstone: argillaceous, dark yellowish orange, moderate yellowish brown, brownish grey, greyish brown, very soft-soft, amorphous, (washing out), occasionally sub blocky, friable and crumbly in places, nil to slightly calcareous cement/matrix, 5-30% detrital clay matrix, grading to *Silty Claystone* in places, arenaceous with trace-20% very fine to fine quartz, grading to *Argillaceous Sandstone* in part, trace to abundant carbonaceous material and laminae.

2729.5-2765.4m (35.9m): *Siltstone with common thinly interbedded Claystone and Sandstone and Coal seams.*
ROP range (average): 13-57 (32) m/hr

Siltstone (10-70%): argillaceous, moderate to dark yellowish brown**,** light brownish grey, pale yellowish brown, soft, sub-blocky, commonly amorphous and dispersive, (washing out), 20-30% detrital clay matrix, micaceous, trace-abundant carbonaceous material and laminae, trace coarse pyrite nodules, non calcareous.

Claystone: white, moderate to dark yellowish brown, soft, dispersive, (washing out), silty with trace–15% quartz silt, trace pyrite, trace very fine to fine quartz, non calcareous.
Sandstone: loose quartz grains, translucent-frosted, very light grey, occasionally clear, trace opaque, isolated very pale orange (stain), fine to coarse (fU-cU), predominantly (mL-cU), very finer grained (vfL) at the base of interval, moderately well sorted, angular-sub angular, common sub rounded to rounded coarse grains with angular fractures, trace disseminated and coarse pyrite nodules, fair-good inferred porosity, no fluorescence or cut.
Coal: brownish black to black, firm, occasionally soft, sub blocky-sub-fissile, sub-vitreous lustre, earthy in places.

2765.4-2787.5m (22.1m): *Sandstone with rare to common interbedded Siltstone and Claystone*
ROP range (average): 8-50 (29) m/hr

Sandstone: (20-65%): loose coarse quartz grains, transparent-translucent-frosted, very fine to pebble, (vfL-pebble), predominantly (fU-cL), well to moderately sorted, locally poorly sorted, sub rounded to sub angular, common angular fractures, trace pyrite nodules, very good visual porosity, no shows.
Siltstone: argillaceous, moderate to dark yellowish brown**,** light brownish grey, pale yellowish brown, soft-firm, sub-blocky, amorphous in places, 20-30% detrital clay matrix, grading to *Claystone* in places, interlaminated with *Claystone*, arenaceous with trace-20% very fine to medium quartz, grading to *Argillaceous Sandstone* , micaceous, trace to abundant carbonaceous material and laminae, trace coarse pyrite nodules, non calcareous.
Claystone: white-greyish white, pale yellowish brown, soft, commonly amorphous, dispersive, (washing out), very arenaceous with trace – 40% very fine to fine (vfL-fL) quartz, sub rounded, well sorted, commonly grading to *Argillaceous Sandstone*, trace carbonaceous specks and micro-mica, trace disseminated pyrite, non calcareous.

2787.5 – 2881m (93.5m): *Siltstone and Claystone with rare to abundant interbedded Sandstone and common thin Coal*
ROP range (average): 15-107 (38) m/hr

Siltstone (0-75%): argillaceous, moderate to dark yellowish brown**,** light brownish grey, pale yellowish brown, soft-firm, sub-blocky, amorphous in places, 20-30% detrital clay matrix, locally grading to *Claystone*, interlaminated with claystone, arenaceous with trace-20% very fine to medium quartz, grading to *Argillaceous Sandstone*, micaceous, trace to abundant carbonaceous material and laminae, trace coarse pyrite nodules, non calcareous
Claystone: white-greyish white, pale yellowish brown, soft, commonly amorphous, dispersive, (washing out), very arenaceous with trace–40% very fine to fine (vfL-fL) quartz, sub rounded, well sorted, commonly grading to *Argillaceous Sandstone*, trace carbonaceous specks and micro-mica, trace disseminated pyrite, non calcareous.
Sandstone: loose coarse quartz grains, transparent-translucent-frosted, very fine to pebble (vfL-pebble), predominantly fine to coarse (fU-cL), well to moderately sorted, sub rounded-sub angular, common angular fractures, trace pyrite nodules, very good poor visual porosity, no shows.
Coal: black to brownish black, firm-moderately hard, sub splintery to sub-fissile, sub bituminous.

2881-2900m (19m): *Sandstone with rare Argillaceous Siltstone and rare Silty Claystone*
ROP range (average): 25-73 (48) m/hr

Sandstone (80-100%): loose quartz, transparent-translucent, very light grey, fine to very coarse (fU-vcU), predominantly medium to coarse (mU-cL), sub-angular to angular (very coarse grains broken), trace carbonaceous partings, moderately well sorted, good visual porosity, no fluorescence, no cut.
Siltstone: argillaceous, white-greyish white, light to medium brownish grey and brownish black in part, soft, amorphous, to firm in part, 15-30% detrital clay matrix, grading to *Silty Claystone* in part, trace-rare micro-micaceous, common-abundant carbonaceous specks, laminae and partings, trace coarse pyrite nodules, non calcareous.

2900-3010m (114.5m): *Argillaceous Siltstone interbedded with Silty Claystone, common Sandstone and Coal*
ROP range (average): 8-78 (37) m/hr

Siltstone (20-75%): argillaceous, predominantly greyish orange, white-greyish white at the top, becoming light grey with depth, dark yellowish orange and moderate yellowish brown, light to medium brownish grey, brownish grey, brownish black in part, soft, amorphous, firm in part, 15-40% detrital clay matrix, grading to *Silty Claystone* in part, common to abundant (5-15%) micro-mica in part, trace-abundant carbonaceous specks, fragments, laminae and partings, grading to *Carbonaceous Siltstone* in part, trace coarse pyrite nodules, non calcareous.
Claystone: silty, predominantly white to greyish white, trace light brownish grey and dark yellowish orange, finely laminated in part, soft, dispersive, amorphous to slightly firm, sub blocky, 10-35% quartz silt to very fine (vfL) quartz, grading to *Argillaceous Siltstone* and *Claystone* in part, trace-common carbonaceous specks and laminae, trace micro-mica, nil-trace disseminated pyrite, non calcareous.
Sandstone: predominantly loose quartz, transparent-translucent, very light grey, fine to coarse (fU-cU), predominantly medium (fU-mU), sub-angular to angular, moderately well sorted, isolated pyrite cemented, good visual porosity, no show.
Occasionally consolidated in part, firm, friable, fine to medium grained (fU-mU), predominantly fine to medium (fU-mL), sub-rounded to angular, moderately well sorted, locally well sorted, good visual porosity. **Show:** @ 2960m: nil direct fluorescence, very slow, faint yellowish-blue cut, very faint trace bluish yellow residual residue.
Coal: black to brownish black, firm to hard, brittle, splintery-sub-fissile, blocky, sub bituminous.

3010-3121.5m (111.5m): *Sandstone with abundant interbedded Argillaceous Siltstone and Silty Claystone, rare to abundant Claystone and common thin Coal*
ROP range (average): 2-93 (41) m/hr

Sandstone (20-100%): quartzose, transparent-translucent, very light grey, pale to dark yellowish orange (stained), predominantly loose, consolidated in part, soft-friable, very fine to coarse grained (vfL-cU), locally very coarse to pebble (vcU-pebble), predominantly fine to medium (fU-mU), sub-rounded to angular, poorly to moderately sorted, good visual porosity, no fluorescence or cut. Locally trace poorly consolidated aggregates, soft-friable, quartz silt to very fine quartz (vfL), sub-rounded, well sorted, trace-20% detrital clay matrix, grading to *Siltstone* in places, fair to good visual porosity, no fluorescence, no cut.
Siltstone: argillaceous, predominantly white to light grey, greyish orange, dark yellowish orange to moderate yellowish brown and dusky yellow brown, olive black to brownish black in part, soft, amorphous, to firm in part, 15-40% detrital clay matrix, grading to *Silty Claystone* in part, trace micro-mica, trace carbonaceous specks, fragments laminae and partings in part, grading to *Carbonaceous Siltstone* in part.

Claystone: silty, white to greyish white, light brownish grey to dark yellowish brown, soft, dispersive, amorphous, to slightly firm, sub blocky, 10-35% quartz silt to very fine (vfL) quartz, grading to *Argillaceous Siltstone* and *Claystone* in part, trace to common carbonaceous specks and laminae, trace micro-mica, nil-trace disseminated pyrite.
Claystone: light brownish grey to dark yellowish brown, soft to slightly firm, sub blocky, arenaceous with trace-20% quartz silt to very fine quartz, grading to *Argillaceous Siltstone* in part, trace-abundant (trace-20%) carbonaceous specks, laminae and partings grading to *Carbonaceous Claystone* in part, trace micro-mica, nil-trace disseminated pyrite.
Coal: black to brownish black, firm to hard, brittle, splintery-sub fissile, blocky, sub bituminous.

3121.5-3193m (71.5m): *Claystone with abundant interbedded Sandstone and rare Argillaceous Siltstone and common thin Coal*
ROP range (average): 6-117 (49) m/hr

Claystone (0-40%): silty, white to greyish white, light to dark brownish grey, soft to firm, dispersive, amorphous, sub-blocky, arenaceous with 20-35% quartz silt to very fine (vfL) quartz, trace – 5% carbonaceous specks and partings, trace micro-mica, nil-trace disseminated pyrite.
Claystone (0-50%): light brownish grey to brownish grey and moderate to dark yellowish brown, soft to firm, sub-blocky, trace-20% quartz silt, grading to *Argillaceous Siltstone* in part, trace-abundant (trace-20%) carbonaceous specks, laminae and partings grading to *Carbonaceous Claystone* in part, trace micro-mica, nil-trace disseminated pyrite.
Sandstone: firm, friable, loose quartz grains, translucent to very light grey, clear, very fine to coarse (vfL-cU), predominantly very fine to fine (vfU-fU), sub-angular-rounded, poorly sorted, nil-5% detrital clay matrix, trace micro-mica, moderately good visible porosity, no fluorescence, no cut.
Siltstone: argillaceous, white to greyish white, light to medium brownish grey, soft to occasional firm, sub-blocky to locally sub-splintery, commonly amorphous (washing out), quartz silt to fine quartz, 15-35% detrital clay matrix, grading to *Silty Claystone* in part, common micro-mica, trace to abundant carbonaceous specks, fragments and laminae.
Coal: black to brownish black, firm-moderately hard, sub splintery-sub fissile, sub bituminous, as thin laminae in claystone in part, very slow yellowish-blue cut, bright, solid bluish yellow residual ring residue.
Amber: light to moderate reddish orange to reddish brown nodular fragments, translucent to slightly transparent, coarse, angular, broken fragments, resinous, interbedded with coal and sandstone (sandstone grains adhering), bright yellowish white fluorescence, no cut.

3193-3233m (40m): *Interbedded Claystone and Sandstone with rare Coal*
ROP range (average): 27-98 (54) m/hr

Claystone (20-50%): silty, dominantly as for interval 3121.5-3193m, medium to dark brownish grey, firm, carbonaceous with fine coaly laminae.
Claystone (10-30%): dominantly as for interval 3121.5-3193m, white-greyish white, light brownish grey, as above, with rare fine carbonaceous laminae.
Sandstone: translucent to very light grey, clear, very fine to coarse quartz (vfL-cL), predominantly very fine to fine (vfU-fL), sub-rounded to rounded, poorly sorted, dominantly as for interval 3121.5-3193m, no cut

Coal: black to brownish black, firm to moderately hard, sub-splintery-sub-fissile, sub bituminous, as thin laminae in claystone in part. **Show**: very slow yellowish-blue cut, bright, solid bluish yellow residual ring residue.

3233-3376m (143m): *Sandstone with interbedded Argillaceous Siltstone and Claystone and rare thin Coal*
ROP range (average): 6-100 (53) m/hr

Sandstone (5-95%): loose quartz grains, translucent to very light grey, clear, very fine to coarse grained (vfL-cU), predominantly medium to coarse (fL-mU), poorly sorted, consolidated in part, light grey to brownish grey, soft-firm, friable, silt-medium grained (silt-fU), predominantly fine grained (fL), well sorted, sub-angular, with trace-20% argillaceous matrix, trace micro-mica, nil-trace carbonaceous flakes and laminae, poor to good visual porosity. **Show: (3300-3310m):** consolidated grains show slow, faint bluish yellow cut, faint patchy bluish yellow ring residue.
Siltstone: argillaceous, white, light to medium grey, soft, dispersive, (washing out) to slightly firm, quartz silt to very fine quartz, 10-30% detrital clay matrix, grading to *Silty Claystone* in part.
Claystone: silty, white to greyish white, medium to dark brownish grey, firm, arenaceous with 20-35% quartz silt to very fine (vfL) quartz, carbonaceous with fine coaly partings and laminae.
Claystone: brownish grey to brownish black, firm, blocky, trace-20% quartz silt in part grading to *Argillaceous Siltstone*, trace-abundant (trace-20%) carbonaceous specks, laminae and partings grading to *Carbonaceous Claystone*, trace micro-mica, nil-trace disseminated pyrite.
Coal (0 – 10%; 40% at 3330 – 3335m): black to brownish black, firm-moderately hard, sub splintery-sub-fissile, sub-bituminous, as thin laminae in claystone in part. **Show:** very slow yellowish-blue cut, bright, solid bluish yellow residual ring residue.

3376-3465m (89m): *Silty and Carbonaceous Claystone with common to abundant interbedded Sandstone and rare Siltstone and Coal*
ROP range (average): 14-106 (38) m/hr

Claystone (Trace–20%): silty, white to greyish white, moderate to dark yellowish brown and medium to dark brownish grey in part, soft, dispersive to firm, sub blocky, arenaceous with 20-30% quartz silt to very fine (vfL) quartz, carbonaceous in part with fine coaly partings and laminae.
Claystone: carbonaceous, as for interval 3233-3376m
Sandstone: loose quartz grains or consolidated, soft to firm, friable, clear to translucent, very to light grey, pale to dark yellowish orange, fine to medium grained (fL-mU), predominantly (fU-mL), moderate to well sorted, sub-angular, trace-25% detrital clay matrix, trace micro-mica, nil-trace carbonaceous flakes and laminae, good visible porosity, no fluorescence, no cut.
Siltstone: as for interval 3233-3376m
Coal: black to brownish black, firm-moderately hard, sub splintery-sub-fissile, sub-bituminous, as thin laminae in claystone in part. **Show**: very slow yellowish-blue cut, slow bluish yellow cut, strong bluish yellow ring residue.

3465-3508.1m (43.1m): *Sandstone with minor interbedded Claystone*
ROP range (average): 7-36 (26) m/hr

Sandstone (30-100%): white to light grey, translucent-transparent, as loose grains, very fine to very coarse (vfU-vcU) sub-rounded to rounded, poorly sorted, as above, no fluorescence, no cut.
Claystone: brownish grey to brownish black, firm, blocky, trace-20% quartz silt in part grading to *Argillaceous Siltstone*, trace-abundant (trace-20%) carbonaceous specks, laminae and partings grading to *Carbonaceous Claystone*, trace micro-mica, nil-trace disseminated pyrite

3.3.5 Kate Shale — 3508.1-3546.7mMDRT (3042.1 – 3078.8mTVD SS)

True Vertical Thickness	36.7m
Age:	'basal' Paleocene
Palynozone:	Lower *Lygistepollenites balmei*
Depositional Environment:	Shallow marine
Seismic Time:	2.058 Sec. TWT

The Kate Shale consists of an interbedded sequence of claystone, commonly silty with rare accessory glauconite pellets and argillaceous, and very fine to fine grained sandstone, also with rare accessory glauconite. The sequence is characterised by a serrate gamma ray response between 60 and 250 API units, although the upper part of the unit is fining-upward with a bell-shaped gamma ray response.

The Kate Shale overlies the Roundhead Member of the Volador Formation with apparent conformity at 3546.7mMD RT (-3078.8mTVD SS), at a seismic time of approximately 2.058 seconds TWT. The contact is defined on wireline logs, most notably with a decrease in gamma ray response from 120 API units above 3546.7mMD RT to 55 API units below. The other log curves display little evidence of this conformable contact at 3546.7mMD RT.

Palynological age dating of three drilled ditch cuttings over the gross interval 3510-3545mMD RT, places this unit within the Lower *Lygistepollenites balmei* palynozone of basal Paleocene age. The Upper *Forcipites longus* palynozone of late Maastrichtian age which is commonly known to occur at the base of the Kate Shale was not identified in the ditch cutting assemblages.

Lithology (ZaneGrey-1/ST1/ST2)

3508.1-3546.7m (38.6m): *Claystone with common interbedded Argillaceous Sandstone*
ROP range (average): 9-43 (19) m/hr

Claystone (70-90%): white to yellowish grey, pale yellowish brown, light to dark grey, dark brownish black, trace moderate green, speckled in part, very soft, amorphous, silty in part with 10-20% quartz silt, grading to *Silty Claystone*, trace carbonaceous flakes, rare glauconite as interspersed medium to coarse grains.

Sandstone: argillaceous**,** white to light grey, trace moderate green, speckled in part, soft, amorphous – (washing out), very fine to fine quartz (vfU-fL), sub-rounded, abundant detrital clay matrix (20-35%), rare glauconite.

3.3.6 Volador Formation (Roundhead Member) 3546.7-3581.5mMDRT (3078.8-3111.0mTVD SS)

True Vertical Thickness	32.2m
Age:	Late Cretaceous (late Maastrichtian)
Palynozone:	Upper *Forcipites longus*
Depositional Environment:	Shoreface
Seismic Time:	2.075 Sec. TWT

The Roundhead Member of the Volador Formation consists predominantly of an amalgamated sequence of porous, medium to coarse quartzose sandstone, locally argillaceous and with a rare thin streak of claystone. The sequence is characterised by a number of depositional cycles, mainly prograding, with a slight funnel-shaped gamma ray response and which typically characterises the uppermost part of the Volador Formation in the southeastern part of the Gippsland Basin.

The base of the Roundhead Member of the Volador Formation occurs at a depth of 3581.5mMD RT (-3111.0mTVD SS) at a seismic time of approximately 2.090 sec TWT and is well defined on wireline logs. The gamma ray exhibits an increase from 60 API units above 3581.5mMD RT to 100-200 API units below, while the sonic log displays an increase in interval transit time from 65 msec/ft above 3581.5mMD RT to 70-75 msec/ft below. These log changes coincide with a lithological change from mainly sandstone above 3581.5mMD RT to claystone with interbedded sandstone below.

No palynological analysis was performed on the sand-rich Roundhead Member of the Volador Formation in Zanegrey-1ST1/ST2, however by correlation with offset wells and regional analysis, it is considered to be Late Cretaceous (late Maastrichtian) in age.

Lithology (ZaneGrey-1/ST1/ST2)

3546.7-3581.5m (34.8m): *Sandstone with rare interbedded and interstitial Claystone*
ROP range (average): 7-30 (17) m/hr

Sandstone (70-80%): translucent to transparent, pale yellowish orange in part, white to light grey in part, quartzose, predominantly loose, soft, poorly consolidated in part, fine to very coarse (fU-vcL), pebbly in part, predominantly medium to coarse (mL-cL), rounded to sub angular, angular fractured grains in part, poorly sorted, argillaceous matrix (10-35%), no fluorescence, no cut.
Claystone: white to light grey, occasional brownish grey, very soft, amorphous, occasionally slightly firm, silty in part with 5-20% quartz silt, trace brown mica flakes (biotite), trace fine carbonaceous flakes.

3.3.7 Volador Formation 3581.5-3675mMDRT (3111.0-3198.3mTVD SS)

True Vertical Thickness	87.3m
Age:	Late Cretaceous (late Maastrichtian)
Palynozone:	Upper *Forcipites longus*
Depositional Environment:	Coastal Plain
Seismic Time:	2.090 Sec. TWT

The Volador Formation consists of claystone, commonly carbonaceous and silty, with interbedded sandstone and rare thin coal beds that overall occur in both prograding or coarsening-upward sequences or fining-upward sequences as defined by the gamma ray response.

ZaneGrey-1/ST1/ST2 reached a total depth within the Volador Formation at a depth of 3675mMD RT (-3198.3mTVD SS) at a seismic time of approximately 2.131msec TWT. This depth is some 40m+ on a vertical basis below the original programmed total depth of the well.

Lithology (ZaneGrey-1/ST1/ST2)

3581.5-3675m (93.5m) Total Depth: *Interbedded Claystone and Sandstone with rare Coal*
ROP range (average): 5-40 (16) m/hr

Claystone (5-95%): dark yellowish brown to brownish grey and brownish black, white to off-white, soft to firm, hard in part, silty in part (5-20%) grading to *Silty Claystone,* slightly to moderately carbonaceous, occasionally highly carbonaceous grading to *Carbonaceous Claystone* with fine black carbonaceous flakes and wispy laminae.
Claystone (0-70%): silty**,** white to off-white, soft, amorphous, silty (20-30%), slightly carbonaceous in part with fine black carbonaceous flakes and wispy laminae.
Sandstone: translucent to transparent, white to light grey in part, predominantly loose, quartzose, soft to locally firm/hard, poorly consolidated in part, very fine to coarse quartz, (vfU-cL), predominantly fine to medium (fU-mL), sub-rounded to rounded, rarely angular, fractured grains in part, moderate to poorly sorted, trace-20% detrital clay matrix in part, trace carbonaceous flecks, no fluorescence, no cut.
Coal (0-20%): black, hard, brittle, blocky, sub bituminous.

3.4 STRUCTURE AND SEAL

The ZaneGrey-1/ST1/ST2 well was designed to test the ZaneGrey Prospect, primarily to target a faulted anticline up-dip of Nannygai-1. This well encountered good hydrocarbon shows in sandstone over the interval 2898 -2914m within the Kingfish Formation (*L. balmei* zone) sediments. Log analysis interpreted some 6m of live oil in the interval 2898-2904m (Phillips 1994) and was used to demonstrate structural closure. Nannygai-1 was drilled in 1972 on a TWT structure beneath a 'high velocity' submarine canyon. This well had an interpreted low relief closure at Top Latrobe level, valid in time.

The acquisition of the GBA02B 3D survey in 2002 over the area recognised a significant up-dip component to Nannygai-1 at the level of the interpreted pay zone and at deeper and shallower horizons in both time and depth. Detailed velocity information through the high velocity submarine canyon sequence was derived from advanced geophysical processing

techniques, although a significant depth conversion risk remained pre-drill. A minor laterally discontinuous normal fault was identified at intra-Latrobe Group levels, down-throwing the Nannygai-1 area close to the well location, from a significant area up-dip (in TWT and depth) to the southwest. This and the interpreted closure at the level of the pay zone, was the primary consideration of the ZaneGrey Prospect being up-dip and within depth closure at intra-Kingfish and Volador formation levels. The deeper Roundhead Member formed a primary objective in the ZaneGrey Prospect. Seal for the Roundhead Member was inferred by the shallow coastal marine shales of the overlying Kate Shale. A smaller areal anticlinal closure at Top Latrobe Group formed a secondary objective.

Whilst ZaneGrey is predominantly a faulted anticlinal closure, lateral fault seal on the major basin forming fault to its southwest was also considered to enhance structural closure, albeit with a higher risk. Lateral juxtaposition of high net to gross sequences in this downthrown block, with lower net to gross sequences of the deeper Volador Formation in the ZaneGrey South fault block, augured well for any cross fault seal.

The main risks for the ZaneGrey Prospect related to the mapped depth closure and hence the depth conversion. A strong lateral velocity variation in the overburden made the depth conversion problematic and the single greatest geological risk.

The stratigraphic section encountered in ZaneGrey-1/ST1/ST2 was essentially as predicted pre-drill, with all of the formation tops encountered slightly high to prognosis.

Based on the available petrophysical data and occurrence of hydrocarbon shows, a gas-condensate hydrocarbon accumulation would seem to exist up-dip from the ZaneGrey-1ST2 intersection and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence in the well to support hydrocarbons below the lowest net pay interpretation at 2882mTVD SS.

While it is possible that the ‘live oil shows’ interpreted in the offset Nannygai-1 well do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZaneGrey-1ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZaneGrey-1ST2. Also a 30m hydrocarbon column (if present) should have provided enough buoyancy to give higher oil saturations than those observed in ZaneGrey-1ST2. This interpretation also seems to contradict the indirect evidence of water from the failed RCI sampling attempts.

A post-drill structural interpretation of the ZaneGrey-1/ST1/ST2 fault block is included as Figure 5 and a post-drill interpretation of the 3D seismic Inline2095 through the ZaneGrey-1/ST1/ST2 well is included as Figures 6 and 7.

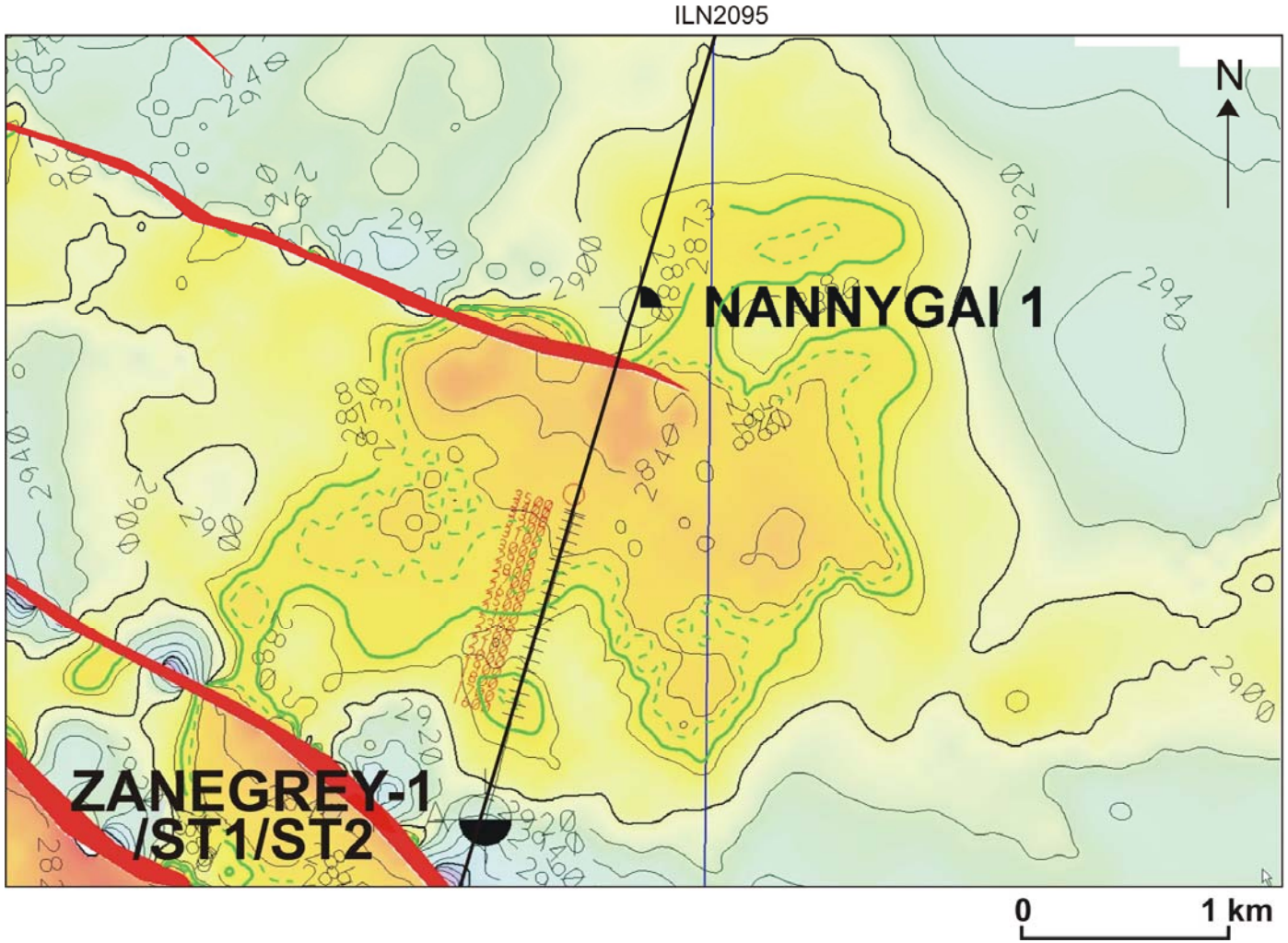


FIGURE 5: POST-DRILL STRUCTURAL INTERPRETATION OF ZANEGREY FAULT BLOCK & STRUCTURE

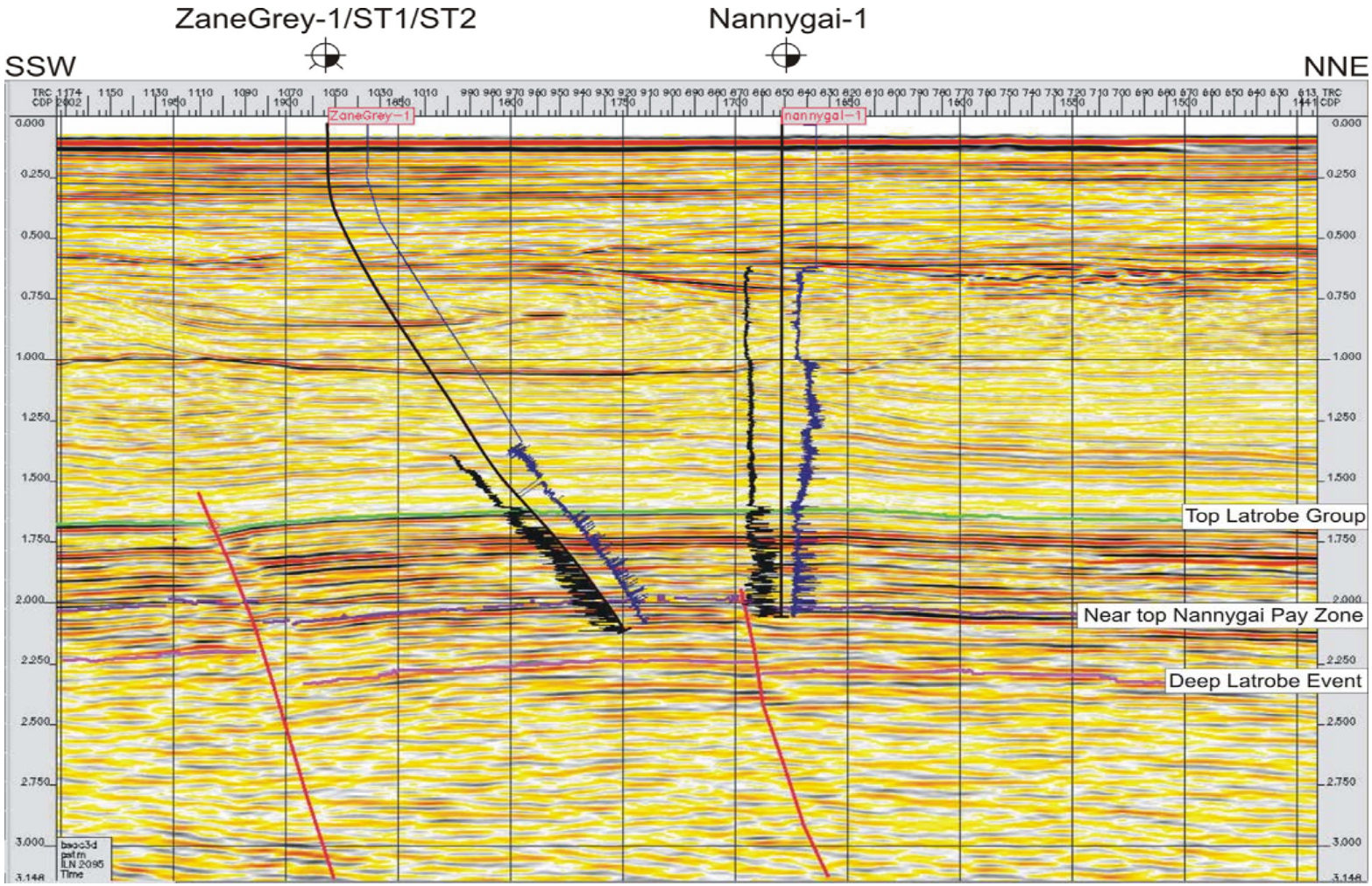


FIGURE 6: SEISMIC INLINE 2095 DISPLAYING POST-DRILL INTERPRETATION AND HIGHLIGHTING STRUCTURAL RELATIONSHIP BETWEEN ZANEGREY-1/ST1/ST2 AND NANNYGAI-1

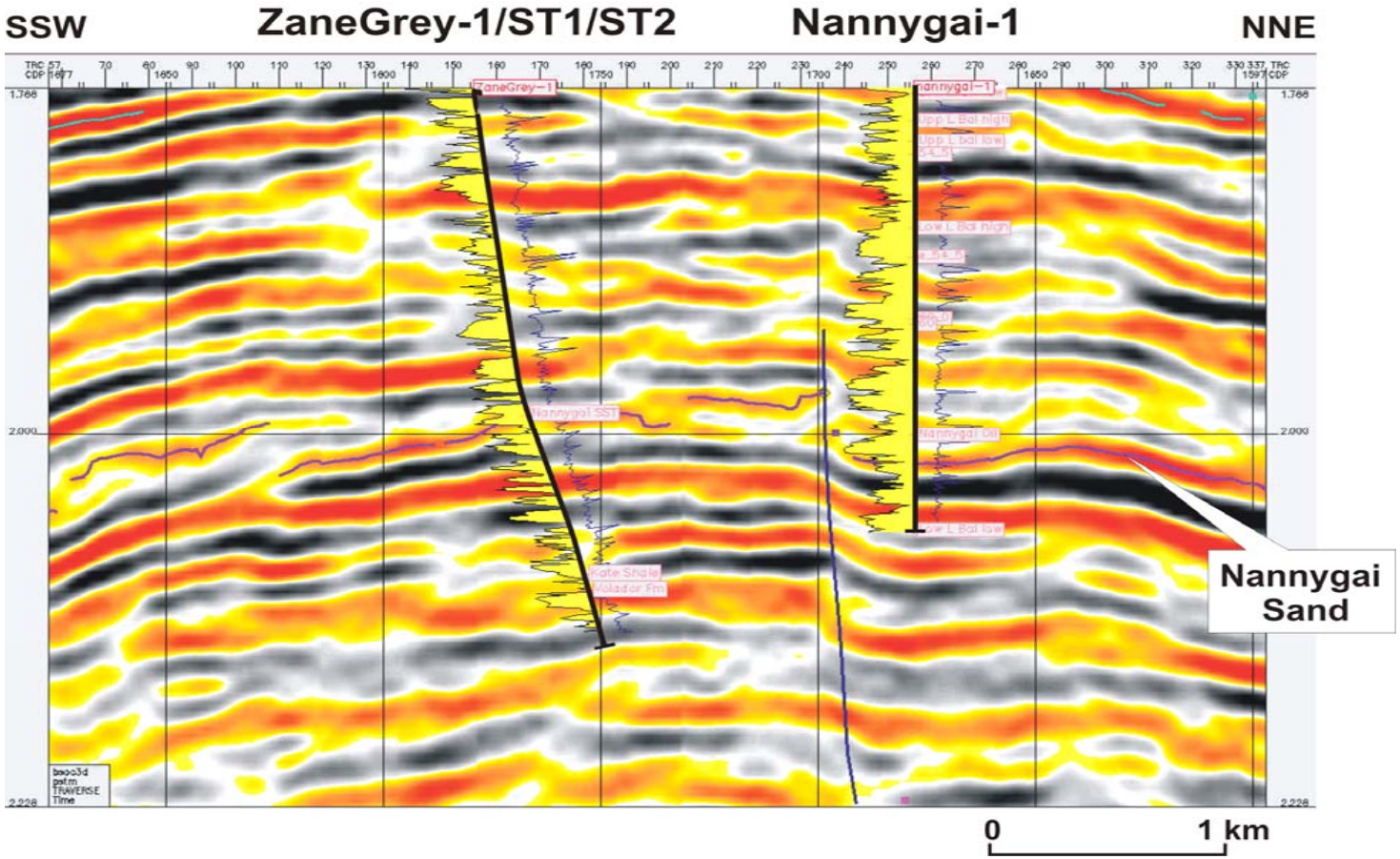


FIGURE 7: SEISMIC INLINE 2095 DISPLAYING POST-DRILL INTERPRETATION AND HIGHLIGHTING LEVEL OF NANNYGAI SAND

3.5 SOURCE AND MIGRATION

ZaneGrey-1/ST1/ST2 lies immediately to the west-northwest of the once giant Kingfish Oilfield and to the east-southeast of the Bream oil and gas Field and therefore well positioned to trap oil and gas that migrated from the same rich source rocks that generated each of these hydrocarbon accumulations; ie within the Central Deep of the Gippsland Basin to the north, northeast and east of the ZaneGrey prospect.

ZaneGrey-1/ST1/ST2 did encounter anomalous gas readings while drilling through the Kingfish Formation, with a prominent gas peak of 18.08% total gas (above a background of 0.5%) and C_1-C_5 chromatographic gas recorded over the interval 3306-3319mMD RT. The gas peak occurred in association with a sandstone that exhibited nil direct fluorescence, however displayed a slow, faint bluish yellow cut fluorescence with a faint patchy bluish yellow residual ring fluorescence. Consequently, direct evidence of migrated hydrocarbons did occur in ZaneGrey-1/ST1/ST2.

ZaneGrey-1/ST1/ST2 is located on the flanks of a structural closure on which one earlier well, namely Nannygai-1 was drilled on the northern flank of the same structure and which also recorded an anomalous hydrocarbon occurrence at the same stratigraphic level, albeit slightly down-dip. This data supports ZaneGrey-1/ST1/ST2 being located on a migration pathway from a proven hydrocarbon kitchen to the north and northeast within the deeper parts of the Central Deep of the Gippsland Basin.

3.6 RELEVANCE TO THE OCCURRENCE OF HYDROCARBONS

3.6.1 Gas Readings

During the drilling of ZaneGrey-1/ST1/ST2, a continuous record of ditch gas was made using an automatic FID total gas and chromatograph detector. Ditch gas readings are summarised in Tables 2-6 below. No cuttings gas analyses or headspace gas analyses were undertaken.

Total gas, chromatographic breakdown of the ditch gas and trip gas was recorded from 1095m to 3675mMD RT throughout the 311mm (12 ¼”) and 216mm (8 ½”) hole sections. Trace to minor amounts of total gas consisting predominantly of methane (C_1), together with trace to minor amounts of ethane (C_2), propane (C_3) and butane (iC_4 & nC_4) was recorded upon commencement of first drilling returns in the 311mm (12 ¼”) hole section below 1095mMD RT. Below approximately 1800mMD RT, nil to trace amounts of pentane (iC_5 & nC_5) were also recorded. Background gas levels remained at these levels throughout the remainder of the 311mm (12 ¼”) hole section to section TD at 2772.5mMD RT in ZaneGrey-1. Maximum gas recorded in ZaneGrey-1 was 1.0% total gas which consisted of 11,000ppm (C_1), 266ppm (C_2), 108ppm (C_3), 26ppm (iC_4) and 16ppm (nC_4). A number of slightly higher levels of total gas to 1.07% were recorded between 1800m and 2034mMD RT, however the chromatograph was malfunctioning during these intervals and no chromatographic data was recorded. The 244mm (9 ⅝”) casing was subsequently set at 2184.1mMD RT after failing to reach section TD and ZaneGrey-1ST1 was commenced in sidetrack hole at this depth in 216mm (8 ½”) hole.

Background gas levels were moderately uniform throughout the drilling of ZaneGrey-1ST1 over the gross interval 2184-3107mMD RT and consisted of trace to minor amounts of

total gas, composed mainly of methane (C_1) and ethane (C_2) along with low levels of propane (C_3), butane (iC_4 & nC_4) and pentane (iC_5 & nC_5). Maximum gas recorded in ZaneGrey-1ST1 was 1.59% total gas at 2751mMD RT and consisted of 6,895ppm C_1, 2,036ppm C_2, 71ppm C_3, 177ppm iC_4, 255ppm nC_4 and 910ppm iC_5.

ZaneGrey-1ST2 commenced after kicking off in 216mm (8 ½") hole at 3075mMD RT. Background gas levels recorded initially were low to moderate and locally increased in response to the volume of coal being cut in the stratigraphic section. Background levels consisted of trace to minor amounts of C_1 to C_5 from 3075m to 3306mMD RT. Below this depth, a prominent gas peak of 18.08% total gas (above a background of 0.5%) was recorded over the interval 3306-3319mMD RT and consisted of 84,479ppm C_1, 11,492ppm C_2, 6,960ppm C_3, 84ppm iC_4, 1,517ppm nC_4, 639ppm iC_5 and 542ppm nC_5. The centre of the gas peak occurred at 3314mMD RT in association with a sandstone that exhibited nil direct fluorescence, however displayed a slow, faint bluish yellow cut fluorescence with a faint patchy bluish yellow residual ring fluorescence. An isotube gas sample was also collected from this gas peak, however at the time of writing this report no further analyses have been attempted on this sample. Below 3319m to total depth at 3675mMD RT (total depth), gas levels were moderately uniform and consisted of low to minor amounts of total gas consisting of C_1-C_5. No further significant gas peaks were recorded.

No H_2S was detected while drilling. Eighteen (18) Isotube gas samples were collected in ZaneGrey-1/ST1/ST2, however at the time of writing this report no analyses have been performed.

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
1098-1200	0.10	1589	34	16	5	4	0	0
1200-1250	0.01	267	7	7	4	5	0	0
1250-1320	0.10	4212	57	29	7	5	0	0
1320-1385	0.20	9000	120	35	10	8	0	0
1385-1560	1.00	11000	266	108	26	16	0	0
1560-1660	0.85	8164	94	37	9	8	0	0
1660-1800	0.92		No data – chromatograph not functioning					
1800-1955	1.05	10117	260	73	17	11	9	16
1955-2034	1.07		No data – chromatograph not functioning					
2034-2103	0.98	5870	244	60	19	14	10	15
2103-2150	0.25	2565	50	14	2	0	0	0
2150-2315	0.55	5106	106	31	8	0	2	0
2315-2350	0.70	8458	203	68	24	10	9	0
2350-2475	0.52	6823	212	149	36	16	17	2
2475-2521	0.25	2237	110	49	15	7	11	0
2521-2580	0.33	2754	235	121	17	26	8	1
2580-2697	0.22	1050	164	76	13	26	5	5
2697-2741	0.15	713	81	26	1	2	0	0
2741-2772	0.20	2412	381	201	22	42	5	3

TABLE 2: SUMMARY OF AVERAGE DITCH GAS READINGS RECORDED IN ZANEGREY-1

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
2184-2232	0.03	183	20	3	1	1	1	2
2232-2291	0.08	628	14	6	3	1	1	2
2291-2330	0.10	975	22	5	2	0	0	0
2330-2575	0.17	1359	100	8	14	19	6	0
2575-2629	0.24	1587	293	10	27	41	16	0
2629-2665	0.15	1500	180	13		46	20	0
2665-2710	0.25	1730	382	24	45	60	29	0
2710-2740	0.17	1163	157	12	14	19	8	0
2740-2760	0.83	5412	1546	54	138	200	74	0
2760-2793	0.36	2027	438	48	4	12	17	10
2793-2854	0.09	1287	137	67	12	16	2	6
2854-2886	0.08	393	80	62	15	22	5	5
2886-2920	0.22	752	91	128	9	16	7	17
2920-2990	0.18	1424	461	242	39	53	9	16
2990-3030	0.10	353	69	58	20	41	12	20
3030-3046	0.39	2702	699	365	57	88	24	24
3046-3107	0.14	600	138	103	16	30	13	14

TABLE 3: SUMMARY OF AVERAGE DITCH GAS READINGS RECORDED IN ZANEGREY-1/ST1

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
2593	0.66	5421	1115	23	77	102	28	0
2672	0.50	4501	958	39	81	110	43	0
2751	1.59	6895	2036	71	177	255	910	0
2800	0.30	2564	450	182	24	30	4	9
2940	0.62	4247	1067	972	157	252	47	14
3043.5	0.63	5131	1450	663	86	123	32	30
3083	0.66	6190	937	443	20	63	29	30

TABLE 4: SUMMARY OF GAS PEAKS RECORDED IN ZANEGREY-1/ST1

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
3075-3079	0.03	204	48	31	7	16	5	10
3080-3098	0.06	329	38	18	5	8	2	3
3099-3126	0.24	1589	166	63	12	19	7	8
3128-3134	0.56	6325	794	301	43	60	20	18
3144-3164-	0.81	7582	734	231	35	44	17	14
3173-3231	0.30	2659	323	173	454	23	18	7
3231-3240	0.11	794	107	59	17	7	8	2
3240-3306	0.29	2421	321	141	5	24	13	11
3319-3329	1.0	3050	380	169	11	18	10	15
3336-3359	1.53	3286	482	253	11	55	41	48
3359-3463	0.52	6216	628	301	26	49	31	40
3468-3533	0.30	1759	264	81	18	15	12	22
3533-3609	0.45	2324	303	133	5	23	12	10
3609-3675	0.90	5426	944	284	126	38	25	85

TABLE 5: SUMMARY OF AVERAGE DITCH GAS READINGS RECORDED IN ZANEGREY-1/ST2

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
3078-3080	0.45	2326	383	220	37	90	25	41
3126-3128	0.98	9778	1130	423	67	94	29	26
3134-3144	2.95	22369	2782	759	118	104	57	32
3164-3173	2.62	22880	1739	516	142	93	36	24
3306-3319	18.08	84479	11492	6960	84	1517	639	542
3329-3336	4.81	22164	3135	1843	33	401	177	159
3463-3468	2.19	21565	1853	675	49	150	77	86
3511-3513	0.58	5422	566	152	54	23	19	39

TABLE 6: SUMMARY OF GAS PEAKS RECORDED IN ZANEGREY-1/ST2

3.6.2 Hydrocarbon Shows Recorded in Ditch Cuttings

All ditch cuttings were examined for direct, cut and crush cut fluorescence and residues while drilling ZaneGrey-1/ST1/ST2. No evidence of direct sample fluorescence was observed in cuttings during the drilling of ZaneGrey-1 over the gross interval 1095-2772.5mMD RT. The only sample show recorded in ZaneGrey-1/ST1 occurred at a depth of 2960mMD RT (~ 2559mTVD SS) in which a coal displayed nil direct fluorescence, however it exhibited a very slow yellowish-blue cut with a bright, solid bluish yellow residual cut fluorescence. This show represents the shallowest recording of any evidence of possible hydrocarbons recorded in the ZaneGrey well. The only sample show associated with reservoir sandstone occurred in ZaneGrey-1/ST2 where aggregates of sandstone over the interval 3300–3310mMD RT (~2854-2863mTVD SS) exhibited slow, faint bluish yellow cut fluorescence and faint patchy bluish yellow residual cut fluorescence. The only other sample shows evident during the drilling of ZaneGrey-1/ST2, also occurred in association with coals over the gross interval 3092-3470mMD RT (~2671-3008mTVD SS). These shows typically consisted of very slow yellowish blue cut fluorescence with bright, solid bluish yellow residual cut fluorescence. Trace evidence of amber also occurred in

association with coal and sandstone aggregates which exhibited bright yellow white direct fluorescence and nil cut fluorescence.

3.7 FORMATION EVALUATION

3.7.1 Borehole Temperature Data

There were no temperature surveys run in ZaneGrey-1/ST1/ST2. Three maximum recording thermometers were used on all wireline logging runs to record the borehole temperature. The following temperatures were recorded on the two open hole logging runs conducted at final TD (3675mMD RT).

Run No.	Wireline Log	Max. Recorded Temperature (^{O}C)	Depth (mTVD SS) (corrected to top of tool string	Hours Since Last Circulation	t/(Tx+t)
1	DLL-MLL-MAC-ZDL-CN-GR-TTRM	121.7°C	3169m	16.63 hrs	0.938
2	RCI-GR (Pressure & Samples)	135.3°C	3154m	72.5 hrs	0.985

Note: t = Time Since Circulation Stopped; Tx=Last Circulation

TABLE 7: WIRELINE RECORDED TEMPERATURE DATA

There is a growing database of evidence to suggest that the standard Horner calculated derivation for a static bottom hole temperature (SBHT) underestimates the true SBHT in many Australian offshore basins. Consequently, the Horner derived SBHT is herein modified by a factor of 1.09 which was established by Doug Waples (pers. comm.), so something of the order of 10% above Horner has been a conventional rule of thumb commonly used. This is herein referred to as the Modified Horner Technique.

Another method of calculating SBHT is the Shell Technique. This technique utilises a simple relationship that involves the proportional addition of 15°C, 30°C or 35°C to the BHT recorded on the first logging run only when measured as 50°C, 100°C or 150°C. This technique approximately coincides with a modified Horner technique (ie 1.09 x Horner) calculated temperature, however data suggests that use of this technique may slightly over-estimate the SBHT.

In ZaneGrey-1/ST1/ST2, the Horner derived SBHT is calculated as 139.5^{O}C (Figure 8), the Modified Horner SBHT is 152.1^{O}C and the Shell Technique derived SBHT is 153.9^{O}C. Assuming a seabed measured temperature of 15°C, the present day geothermal gradient using the Horner SBHT is 3.98^{O}C/100m, using the Modified Horner SBHT is 4.38^{O}C/100m and using the Shell derived SBHT is 4.44^{O}C/100m (refer Figures 8 and 9).

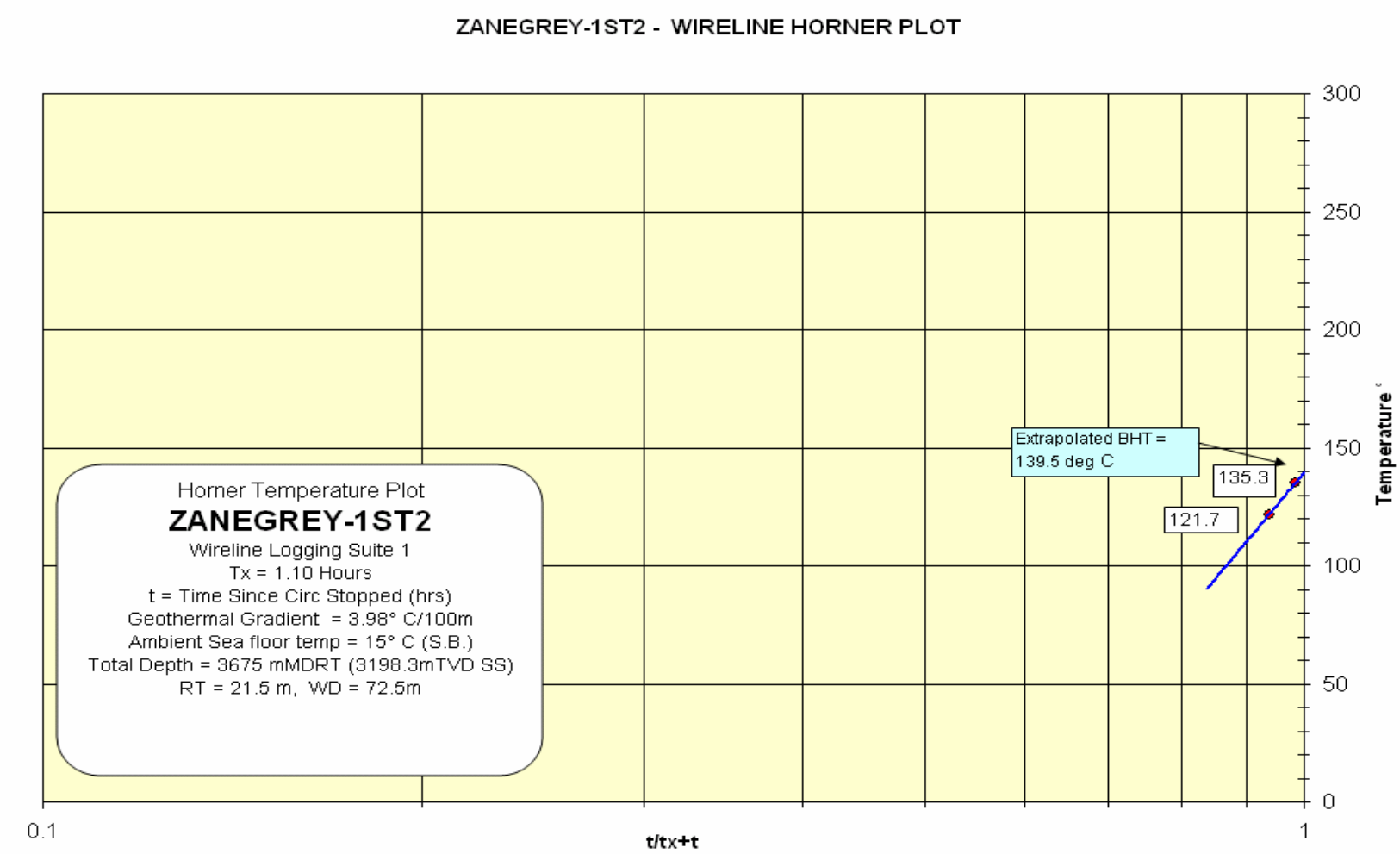


FIGURE 8: HORNER EXTRAPOLATED BHT

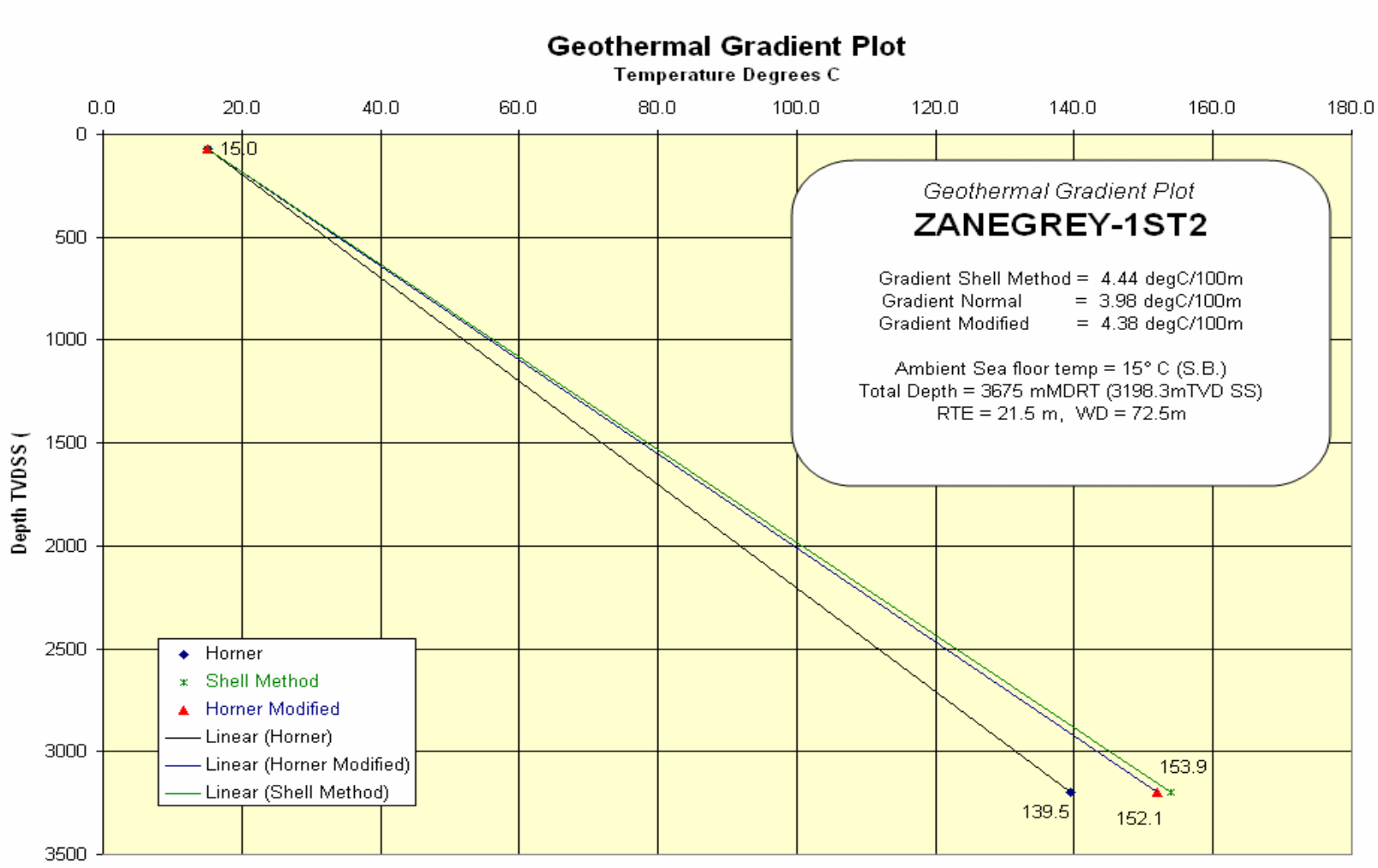


FIGURE 9: GEOTHERMAL GRADIENT PLOT

3.7.2 Wireline Testing

One run was made with the BakerAtlas Reservoir Characterization Instrument (RCI) in ZaneGrey-1/ST1/ST2, the results of which are presented in Section 2.2.8 of the ZaneGrey-1/ST1/ST2 Well Completion Report - Basic Data issued under separate cover. Pressure data was acquired over the gross interval 3179.6-3622.8mMD RT across potential reservoir zones within the Kingfish Formation and Volador Formation. A total of 55 pressure drawdown pre-tests were attempted, the results of which are illustrated in Figure 10 below.

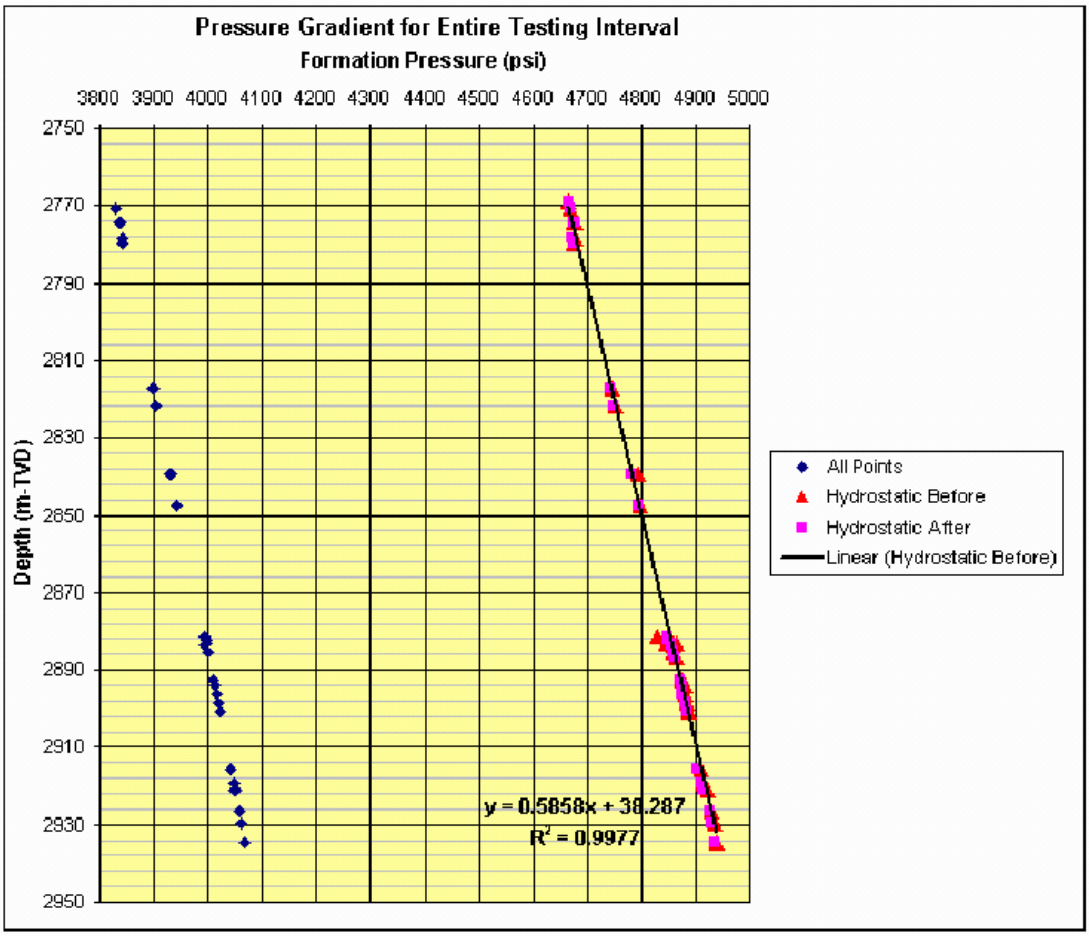


FIGURE 10: RCI PLOT OF PRESSURE DATA IN ZANEGREY-1/ST1/ST2

For further detailed discussion and analysis of the RCI data, refer to the Petrophysical Evaluation included herein as Appendix 2 and the BakerAtlas RCI Pressure, Mobility and Gradient Report included herein as Appendix 4.

3.7.3 DST Testing

No drill stem test was performed on ZaneGrey-1/ST1/ST2.

3.7.4 Porosity, Permeability and Formation Fluids

The Kingfish Formation (2554.4 – 2772.52mMD RT in ZaneGrey-1) and (2554.4 – 3508.1mMD RT in ZaneGrey-1/ST1/ST2) which incorporated the primary reservoir objective in ZaneGrey-1/ST1/ST2 consists of an interbedded sequence of thick amalgamated, predominantly quartzose sandstone, with argillaceous siltstone and siltstone and claystone and common to abundant thin coal beds. The latter are generally less than 3m in thickness and commence below 2740mMD RT. The sequence has a very high net:gross (>95%) in the topmost 200m of the sequence (2554.4 – 2740mMD RT), with log derived porosity in the range of 12-27% (average ~ 23%), while in the middle and lower part of the Kingfish Formation, the net:gross is generally < 50% with thick interbedded claystone and siltstone occurring in addition to the abundant coal beds. Overall, the reservoir potential decreases with increasing depth, coincident with increased potential for developing reservoir/seal pairs and increased opportunity to seal hydrocarbons intra-formationally. Log derived porosity decreases to an average 17% in the lower part of the sequence.

The primary reservoir objective in ZaneGrey-1, which consists of quartzose sandstone, was intersected over the interval 3306-3319mMD RT within the Kingfish Formation, approximately correlative with the zone of anomalous hydrocarbon saturation identified in Nannygai-1 and sealed below a 6m thick claystone and siltstone sequence. The sandstone is defined as being predominantly loose quartz grains, translucent to very light grey, clear, very fine to coarse grained (vfL-cU), predominantly medium to coarse (mL-cL), poorly sorted, consolidated in part, light grey to brownish grey, soft-firm, friable, quartz silt to medium grained (silt-mL), predominantly fine grained (fL), well sorted, sub-angular with trace to 20% detrital clay matrix, trace micro-mica, nil to trace carbonaceous flakes and laminae with poor to good visible porosity. The sandstone was associated with nil direct fluorescence, however several consolidated grains show a slow, faint bluish yellow cut with a faint solid bluish yellow ring residue. A prominent gas peak of 18.08% total gas (above a background of 0.5%) and consisting of C_1-C_5 was recorded while drilling this reservoir unit. Wireline log interpretation of this zone indicates the potential presence of a thin hydrocarbon column (1.3–2.5 m in thickness) over the interval 3305.7 – 3308mMD RT (2880 – 2882mTVD SS). Light hydrocarbons were successfully recovered from 3307mMD RT, however there is no data to determine if the in-situ fluids are fully saturated or not. PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. Furthermore, the absence of a definable hydrocarbon pressure gradient in combination with the thin pay zone identified from log analysis supports the theory that ZaneGrey-1/ST2 intersected the base of a rich gas/condensate accumulation, with a gas-water contact close to 3307mMD RT (or 2882mTVD SS). Average porosity in this interval is 17% and average water saturation is interpreted to be between 53 and 63%.

All other potential reservoir units within the Kingfish Formation are interpreted as 100% water saturated.

The Roundhead Member of the Volador Formation (3546.7 – 3581.5mMD RT) which was also a primary reservoir objective in ZaneGrey-1 was intersected close to prognosis and consists predominantly of an amalgamated sequence of porous, medium to coarse quartzose sandstone, locally argillaceous and with a rare thin streak of claystone. The sandstone has fair reservoir potential with a log interpreted porosity of 3-16% (average ~12%) and the sequence is interpreted to be 100% water saturated. No hydrocarbon shows were recorded throughout this stratigraphic interval.

The remainder of the Volador Formation (3581.5 – 3675.0mMD RT) which consists of interbedded sandstone, commonly argillaceous, and claystone, was devoid of any hydrocarbon shows. All sands are interpreted to be 100% water saturated. Log derived porosity varies from 9% to 22% (average <15%).

A Petrophysical Evaluation of ZaneGrey-1/ST1/ST2 is included herein as Appendix 2 and a Petrophysical Summary Plot is included as Enclosure 1 of this Appendix.

3.7.5 Geochemical Analysis

No geochemical analyses were undertaken on samples from ZaneGrey-1/ST1/ST2.

3.8 CONCLUSIONS AND CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

- The stratigraphic section encountered in ZaneGrey-1/ST1/ST2 was essentially as predicted with all of the formation tops close to their prognosis, thereby confirming the pre-drill seismic interpretation and velocity modeling used to establish the structural integrity of the ZaneGrey Prospect.

- The stratigraphic, non-reservoir objective Middle to Late Eocene Gurnard Formation was intersected at 2513.3mMD RT (-2194mTVD SS), 10m high to prediction.

- A prominent gas peak of 18.08% total gas (above a background of 0.5%) and consisting of C_1-C_5 was recorded over the interval 3306-3319mMD RT within the Kingfish Formation, approximately correlative with the zone of anomalous hydrocarbon saturation identified in Nannygai-1. The gas peak occurred in association with sandstone that exhibited nil direct fluorescence, however displayed a slow, faint bluish yellow cut fluorescence with a faint patchy bluish yellow residual ring fluorescence.

- Wireline log interpretation of ZaneGrey-1/ST2 indicated the potential presence of a thin hydrocarbon column (1.3–2.5 m) over the interval 3305.7 – 3308mMD RT (2880 – 2882mTVD SS) in the Kingfish Formation. Average porosity in this interval is 17% and average water saturation is interpreted to be between 53 and 63%.

- Gas/condensate was successfully recovered using the RCI sampling tool from 3307 mMD RT. There is no data to determine if the in-situ fluids are fully saturated or not, however PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. This data is supportive, but not in itself proof of a down dip oil leg.

- The absence of a definable hydrocarbon pressure gradient from RCI pressure data, in combination with the thin pay zone identified from log analysis supports the theory that ZaneGrey-1/ST2 intersected the base of a rich gas/condensate accumulation, with a gas-water contact close to 3307mMD RT (or 2882mTVD SS). Depth uncertainty should be considered, however from the RCI data, the lowest known gas (LKG) is at 2881.5mTVD SS, whilst the most likely highest known water (HKW) occurs at 2883.4mTVD SS. Wireline log interpretation indicates possible net pay down to 2882mTVD SS.

- Based on the available data, a gas-condensate hydrocarbon accumulation may exist up-dip from the ZaneGrey-1/ST2 intersection, and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence in the well to support hydrocarbons below the lowest net pay interpretation (-2882mTVD SS).

- While it is possible that the ‘live oil shows’ interpreted in the offset Nannygai-1 well do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZaneGrey-1/ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZaneGrey-1/ST2. Also, a 30m hydrocarbon column (if present) should have provided enough buoyancy to give

higher oil saturations than those observed in ZaneGrey-1/ST2. This interpretation also seems to contradict the indirect evidence of water from the failed RCI sampling attempts.

- The Early Paleocene Kate Shale was intersected at 3508.1mMD RT (-3043.1mTVD SS), 1.9m high to prognosis.

- The Roundhead Member of the Late Cretaceous (Maastrichtian) Volador Formation, which was a primary reservoir objective, sealed beneath the overlying Kate Shale, was intersected at 3546.7mMD RT (-3078.8mTVD SS), 6.8m low to prognosis and consisted of an amalgamated sequence of porous, medium to coarse quartzose sandstone of good reservoir quality.

- The well reached TD within the Late Cretaceous Volador Formation at 3675mMD RT (-3198.3mTVD SS), some 43 metres below the originally programmed total depth of the well. The well was subsequently plugged and abandoned as a non-commercial gas/condensate discovery in the Kingfish Formation.

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APPENDIX 1

Well Card

Well Card: ZANEGREY-1/ST1/ST2

Location	Latitude	38° 34' 31.64" S		**Participating Interests**		
	Longitude	147° 59' 16.27" E		Bass Strait Oil Company Ltd (Operator)		50%
	UTM Co-ordinates (Zone 55S)	586,049.89m E 5, 729,856.42m N		Inpex Corporation		50%
	Datum	AGD 84				
	Elevation	+21.5m				
	Water Depth	72.5m (MSL)				
Permit	VIC/P42			Primary Objective		Kingfish Fm (Nannygai Zone)
Rig on Contract	27th January 2005; 05:00 hours			Secondary Objective		Volador Fm (Roundhead Mbr)
Spudded	29th January 2005; 14:30 hours			Tertiary		Gurnard Fm
Reached T.D.	10th March 2005; 17:00 hours			**Completion Details/Plugs**		
Rig Released	18th March 2005; 19:20 hours			Plug # 1	660 – 505m	42.8 bbls of 15.8 ppg Class G
Structure Type		Faulted 4-way dip anticline		Plug # 2	370 – 270m	43 bbls of 15.8 ppg Class G
Rig	DOGC Semi-Submersible	"Ocean Patriot"		Plug # 3	160 - 100	30 bbls of 15.8 ppg Class G
Status	P & A	Non-commercial gas/condensate discovery		**Casing Details**		
Hole Size (mm)	660 x 914	445	311	Size (mm)	Wt (ppf)	Depth (m)
Depth (m)		325	328	508 x 762	133 x 330	127.8
Hole Size (mm	311mm			340	68	1090.6
Depth (m)				244		2184
Hole Size (mm	216mm					
Depth (m)						
Total Depth	3675mMD	3198.3mTVDSS				

Formation	**Depth (mMD RT)**	**Depth (mTVD SS)**	**Thickness TVD (m)**	**TWT (ms)**	**Remarks**
Gippsland Limestone (Seafloor)	94.0	72.5	1324.0	95	
Lakes Entrance Fm	1560.0	1396.5	797.5	1054	
Gurnard Fm	2513.3	2194.0	33.8	1612	
Kingfish Fm	2554.4	2227.8	815.3	1626	
Kate Shale	3508.1	3043.1	35.7	2058	
Volador Fm	3546.7	3078.8	119.5	2075	
Top Roundhead Mbr	3546.7	3078.8	32.2	2075	
Base Roundhead Mbr	3581.5	3111.0		2090	
TOTAL DEPTH	**3675.0**	**3198.3**		2131	Approx. TWT

WIRELINE LOGGING SUMMARY

RUN	TOOL STRING	INTERVAL (M)	BHT (C)/TIME SINCE CIRC.	PLAYBACK SCALES	
1	DLL-MLL-MAC-ORIT-ZDL-CNL-DSL-TTRM	659 – 321.5m (MAC to 1983m & GR to 94m)	121.7^{O} C @ 3216.1mTVD RT / 16.63 Hrs	1:200	1:500
2	RCI-GR	3179 – 3185m; 3 P/T(2 good, 1 tight, 2 repeats); tool stuck at 3185m; stripped over cable and continued LWF; 3190-3622m; 29 P/T (26 good, 1 tight, 14 repeats) and 2 x 840cc samples @ 3307m. Rec. 115.68 litres gas & 124ml condensate & 140ml aqueous fluid (filtrate)	135.3^{O} C @ 3170.9mTVD RT / 72 Hrs	1:200	1:500

CORE SUMMARY

Core	Interval	Cut	Recovered	%
NO CONVENTIONAL CORES WERE CUT				

SIDEWALL CORES

SWC No.	DEPTH (mRT)	REC (cm)	Actual Lithology	SWC No.	DEPTH (mRT)	REC (cm)	Actual Lithology
NO SIDEWALL CORES WERE CUT							

WELL TESTING SUMMARY

DRILL STEM TESTS (DSTs) No DSTs were conducted

Test No.	Formation	Perforation Interval (m)	Flow Min	Shut Min	Ship Psig	Fthp Psig	Chokes	Remarks

DRILLING SUMMARY

ZaneGrey-1 operations commenced at 05:00 Hrs 27th January 2005 when towing of the Diamond Offshore General Company MODU "Ocean Patriot" commenced with two AHSV's (Far Grip & Pacific Wrangler) from the Apache Energy's Grayling-1 location. The MODU was towed to the ZaneGrey-1 location at an average speed of 6.1 k/hr (3.3 knots), a distance of 72km (39nm). The MODU arrived on location at 15:30 Hrs 27th January 2005 when anchor handling operations commenced, with first anchor down at 16:55 Hrs. Positioning the rig on location was completed by 04:20 Hrs 28th January 2005 at which time the rig was ballasted down to drilling draft at 23:00 Hrs. The final location for ZaneGrey-1 was confirmed as being 1.7m from the proposed location on a bearing of 216.2° Grid. The final fix for ZaneGrey-1 was:

Latitude: 38° 34' 31.64" S

Longitude: 147° 59' 16.27" E

Easting: 586,049.89m

Northing: 5, 729,856.42m

Rig Heading: 43.2° (True)

DATUM: AGD 84; Zone 55S; Central Meridian 147° East.

Made up 914mm (36") BHA and ran in hole tagging seafloor at 94m corrected to Mean Sea Level (MSL). The water depth at MSL was recorded as 72.5mMD RT, with a drill floor elevation of 21.5m. ZaneGrey-1 was spudded at

14:30 hrs on 29th January 2005 with a 914mm (36") hole drilled from seafloor (94mMD RT) to a depth of 129.5mMD RT, pumping 200 bbl guar gum and 50 bbl hi-vis mud on connection. Conducted wiper trip to 96mMD RT. Pumped 200 bbl gel mud and dropped TOTCO survey and pulled out of hole. Made up 762mm (30") housing running tool to 762mm (30") casing and PGB in moonpool. Ran 762mm (30") casing with ROV assistance placing the shoe at 127.75mMD RT and which was cemented in place using 792 sacks (168 bbls) of cement slurry at 15.8 ppg, returns to seafloor.

Made up 406mm (16") BHA orienting mud motor and programming LWD tools. Ran in hole using ROV to assist entering the hole. Cement was tagged at 124.7mMD RT. Cleaned out shoe track and rathole from 124.7 to 129.5mMD RT. Continued drilling ahead to 486mMD RT at which point the well was kicked off. Directionally drilled from 486m to 1095mMD RT (section TD), building inclination to maximum 34.99° with an azimuth of 14.71° at 1080.74mMD RT. Pumped 150 bbl hi-vis pill and circulated this out of the hole. Pumped 1000 bbl hi-vis pill followed by 200 bbls of 9.6 ppg KCl mud. Pulled out of hole with 406mm (16") BHA and racked same prior to downloading LWD tools. Ran 340mm (13 ⅜") casing, setting shoe at 1090.61mMD RT and cemented with 417 sacks (166 bbls) of 12.5 ppg lead slurry and 327 sacks (67 bbls) of 15.8 ppg tail slurry. No surface indication of top plug shearing. Displaced cement using rig pump, bumping plug early at 3862 strokes and 15858kPa (2300 psi). Ran BOP's and marine riser. Waited on weather for 22.5hrs before successfully landing BOP stack. Ran diverter and tested BOP's.

Made up 311mm (12 ¼") BHA orienting mud motor and programming LWD tools. Ran in hole to 251mMD RT, shallow pulse tested the LWD tools. LWD tools failed shallow pulse test. Performed 4,500 psi connector test. Pulled out of the hole laid out LWD tools and picked up new LWD tools. Ran in hole and successfully shallow pulse tested LW tools. Continued to run in hole tagging cement at 1058.77mMD RT. Drilled cement, shoe track and shoe from 1058.77 to 1095mMD RT and then 3m of new hole to 1098mMD RT. Circulated hole clean and conducted Formation Integrity Test (FIT) with 1.03sg (8.6 ppg) mud against lower pipe rams to 815 psi (1.6 SG) equivalent. Directionally drilled ahead to 2103mMD RT. Incident with top drive system caused a stand of drill pipe to bend. This stand was racked back and the motor alignment cylinder on the top drive system was replaced. Pulled out of hole inspecting all drill pipe on the way out. On surface the LWD pulser was changed out and the bend in the motor adjusted. Surface tested MWD, motor and adjustable gauge stabiliser. Ran in the hole to the 340mm (13 ⅜") casing shoe. Circulated and conditioned the mud. Continued to run in the hole having to wash and ream down from 1916 to 2103mMD RT due to tight hole. Drilled ahead to 2702mMD RT and due difficult drilling with high torque on bottom, the BHA was pulled out of the hole to be changed. On surface the motor was laid out to run in hole with a rotary drilling assembly. Ran in hole having to wash and ream from 1767 to 2702mMD RT due to tight hole. Drilled ahead from 2702 to 2725mMD RT. Repaired swivel packing and pumps. Drilled ahead from 2725 to 2772mMD RT which was reached at 09:00 hrs on the 11th February 2005. Pulled out of the hole performing a short wiper trip from 1968mMD RT back to bottom due to tight hole conditions. Pulled out of hole racking back BHA in the derrick. ROV observed traces of fluid seeping from the wellhead.

Ran 244mm (9 ⅝") casing down to 1776mMD RT (127 joints). Unable to wash through this point, so 127 mm (5") drill pipe handling gear was rigged up. Circulated and reamed from 1776 to 1778mMD RT. Casing was then pulled out of the hole. Ran in hole with a 311mm (12¼") rotary clean out assembly. Washed and reamed down from 1777 to 2284mMD RT. Circulated and back reamed out of the hole from 2284 to 1740mMD RT. Circulated bottoms up and commenced washing and reaming back in the hole to 2283mMD RT. Circulated while raising the mud weight to 1.20sg (10.0ppg). Washed and reamed back into the hole to 2735mMD RT. Circulated hole clean and pulled out of hole. Ran 244mm (9 ⅝") casing down to 2194mMD RT washing down past tight spots. Unable to get casing beyond this depth, so 8 joints were pulled back out of the hole and the casing hanger was run. The casing shoe was set at 2184mMD RT and cemented with 321 sacks (128 bbls) of 12.5 ppg lead slurry and 249 sacks (51 bbls) of 15.8 ppg tail slurry. No surface indication of top plug shearing. Top and bottom plugs were observed shearing, however plug being bumped was not observed.

Made up 216mm (8½") BHA orienting mud motor and programming LWD tools. Ran in hole to 251mMDRT, successfully shallow pulse tested the LWD tools. Continued to run in hole tagging the float at 2158mMD RT. Drilled float, plugs, cement and shoe track from 2158 to 2184mMD RT. Drilled to 2192mMD RT and then washed down to 2260mMD RT (in the original 311mm (12¼") hole). Circulated hole clean and pulled into the shoe conducting a Formation Integrity Test (FIT) with 1.1sg (9.2 ppg) mud resulting in an FIT of 1.65sg (13.7ppg). Pulled out of the hole to set a kick off plug. Pumped a 54m (203 sacks) balanced cement plug. At this point ZaneGrey-1ST1 was commenced. Ran in hole with 216mm (8½") BHA and tagged firm cement at 2184mMDRT. Time drilled to kick off well and directionally drilled ahead to 3107mMDRT at which point the BHA was pulled out of the hole due to poor rate of penetration. On surface it was found that the bit, motor bit box and motor drive shaft were left in the hole. An 80m (97sacks) balanced plug was set from 3106 to 3026mMDRT to kick off and sidetrack around the fish. At this point ZaneGrey-1ST2 was commenced. Ran in hole with 216mm (8½") BHA washing and reaming from 2996 to 3075mMD RT with no hard cement being tagged. Eventually tagged the fish at 3107mMD RT and pulled out of the hole to set another cement plug. A 160m (195sacks) balanced plug was set from 3106 to 2946mMD RT. The bend on the motor was increased to 1.5° and the bit changed to aid kick off. Unable to kick off due to cement not being hard enough. Attempted to open hole sidetrack. This BHA was then pulled out of the hole and the bit and BHA changed to aid kicking off. This new BHA was then run in the hole and the cement was still not hard enough to sidetrack. This BHA

was then pulled out of the hole a sidetracking bit was placed in the BHA. The well was successfully kicked off with this BHA and then this BHA was pulled out of the hole. A conventional directional BHA was then run in the hole and drilled to 3162 mMD RT at which point the top drive system (TDS) on the rig failed. A short trip to the casing shoe was performed and the TDS was repaired for the next three days. After repairing the TDS the BHA was tripped back to bottom and drilled ahead to well TD at 3675mMD RT which was reached at 17:00 hrs on the 10th March 2005. The BHA was then pulled out of hole.

Rigged up BakerAtlas for running wireline logs and ran the following logs; RUN#1: DLL-MLL-MAC-ORIT-ZDL-CNL-DSL-TTRM over the interval 3764 to 2184m with MAC pulled through casing to 1983m and GR through casing to 94mMD RT and RUN#2: RCI-GR over the gross interval 3179.6 to 3622.8mMD RT for pressures and samples; while logging with the RCI-GR tool string, the tool became stuck at 3185mMD RT and unable to free; pulled 80% of weak point and tool came out of rope socket; rigged down BakerAtlas. Tensioned wireline and cut cable. Made up and tested wireline surface latching equipment. RIH with 86mm (3 ⅜”) grapple on drill pipe, stripping over wireline to top of ‘fish’; circulated above and latched onto ‘fish’; rigged up for ‘logging while fishing’ and resumed RCI-GR programme on drill pipe; RCI tool failure occurred when on depth at 3627m due to overheating of electronics in gamma ray, resulting in no further communications with the tool; aborted remainder of tests and POOH with wireline tool on drill pipe; rigged down BakerAtlas.

Commenced plug and abandonment operations at 15:30 Hrs 14th March 2005. Picked up and ran in hole with 73mm (2 ⅞”) tubing cement stinger on 127mm (5”) drill pipe to 3390 mMD RT and pumped 30 bbls of 15.8 ppg Class G cement slurry setting Plug#1 from 3350mMD RT to 3250mMD RT. Tagged top of cement plug at 3203mMDRT with 0.9Mt (2klbs) Pulled out of hole to 2230mMDRT and pumped 30 bbls of 15.8 ppg Class G cement slurry setting Plug#2 from 2230mMDRT to 2130mMD RT. Tagged top of cement Plug#2 at 2153mMD RT with 0.9Mt (2klbs). Pulled out of hole. Cut 244mm (9 ⅝”) casing, retrieving and laying out same. Picked up 340mm (13 ⅜”) bridge plug and ran in hole to 176mMD RT and set same. Displaced the hole to 1.15sg (9.6ppg) inhibited mud. Set cement Plug#3 from top of the bridge plug to 125mMD RT. Picked up wellhead jetting tool and ran in hole to clean stack and wellhead. Pulled riser and BOP’s and secured same. Picked up 508mm x 762mm (20” x 30”) spear and cutting assembly and ran in hole stabbing into 18 ¾” wellhead and cut 508mm (20”) casing at 96.42mMD RT and pulled out of hole with casing cut-off stub and housing. Re-dressed spear and RIH, stabbing into 762mm (30”) housing, cutting 762mm (30”) casing at 95.94mMD RT. Conducted final seabed survey.

Commenced anchor handling operations at 03:40 Hrs 18th March 2005. Last anchor racked at 19:20 Hrs 18th March 2005 and the rig released to Woodside Energy Ltd. Total time on ZaneGrey-1/ST1/ST2 location was 50.52 days.

GEOLOGICAL SUMMARY

ZaneGrey-1 was spudded at 14:30 hrs on 29th January 2005 and penetrated a sedimentary section ranging in age from Tertiary to Late Cretaceous (Maastrichtian). The stratigraphic section encountered was essentially as predicted with all of the formation tops close to their prognosis. A comparison of the Actual and Predicted section drilled in ZaneGrey-1/ST1/ST2, including a brief summary of drilling and formation evaluation data is included in Enclosure 2 in the Well Completion Report – Interpretive Data. The geological formations and data encountered for each hole section are discussed below.

The Miocene to Pliocene Gippsland Limestone was encountered at seafloor (covered by a veneer of Recent sediments) at 94mMD RT (-72.5mTVDSS), the upper part of which down to a depth of 1095mMD RT was drilled riserless in the 914mm (36”) and 406mm (16”) hole sections with the benefit of LWD gamma ray and resistivity. The 406mm (16”) hole section was directionally drilled below 486mMD RT, reaching a deviation/azimuth of some $34^{O}/15.1^{O}$ by 1009mMD RT. Intermediate 340mm (13 ⅜”) casing was subsequently run to 1090.61mMD RT and the BOP’s and marine riser nippled-up. The 311mm (12 ¼”) hole was drilled with the benefit of LWD gamma ray, resistivity and directional control to 2772.5mMD RT in the ZaneGrey-1 wellbore before setting an intermediate string of 244mm (9 ⅝”) casing to 2184.1mMD RT, abandoning some 588m of drilled hole and commencing ZaneGrey-1ST1 and sidetracking in 216mm (8 ½”) hole from 2190mMD RT to 3107mMD RT. This hole section was also drilled with the benefit of LWD gamma ray, resistivity and directional control. After losing a “fish” in the hole at 3107mMD RT, commenced ZaneGrey-1ST2 from 3075mMD RT and drilled 216mm (8 ½”) hole to total depth at 3675mMD RT (-3198.3mTVDSS). The main 216mm (8 ½”) hole section to total depth was wireline logged after reaching TD and this provides the depth control for the stratigraphic sub-divisions included herein, in combination with LWD logs in the upper hole sections, together with the assistance of biostratigraphic control.

The lower part of the Gippsland Limestone below 1095mMD RT consists of argillaceous calcilutite with calcisiltite and minor calcarenite. The base Gippsland Limestone/Top Lakes Entrance Formation is identified at 1560mMD RT (-1396.5mTVDSS). It was encountered 11.5 metres low to prognosis, based upon the appearance of calcareous claystone and marl in the section. The Oligocene to early Miocene Lakes Entrance Formation consists of

interbedded calcareous claystone and claystone with minor marl, sandstone and siltstone.

The Middle Eocene Gurnard Formation, a tertiary objective, was intersected at 2513.3mMD RT (2194.0mTVVDSS), 10m low to prediction and consists of calcareous claystone, claystone, argillaceous sandstone, siltstone and greensand. All lithologies are generally rich in glauconite. The Paleocene to Early Eocene Kingfish Formation was intersected at 2554.4mMD RT (-2227.8mTVDSS), 9.2m high to prognosis. The sequence consists of interbedded quartzose sandstone, siltstone and claystone with common thin coal beds.

While drilling the Kingfish Formation at a depth of 3107mMD RT, the BHA parted, leaving the bit and bottom of the motor in the hole. After setting cement above the 'fish', the well was sidetracked from a depth of 3075mMD RT and ZaneGrey-1ST2 commenced and drilling resumed in 216mm (8 ½") hole through the Kingfish Formation.

The hydrocarbon zone, approximately equivalent to the Nannygai zone of interpreted hydrocarbons in the Nannygai-1 well was intersected at 3304mMD RT (2855.5mTVD SS). The Early Paleocene Kate Shale was intersected at 3508.1mMD RT (-3043.1mTVDSS), 1.9m high to prognosis. The Kate Shale consists predominantly of claystone grading to silty claystone with rare accessory glauconite and minor argillaceous sandstone.

The well reached TD within the Volador Formation at 3675mMD RT (-3198.3mTVDSS), which was reached at 20:34 Hrs 11th October 2004. Baker Atlas wireline logs were run at this depth. The primary wireline log recorded was the DLL-MLL-MAC-DSL-ZDL-CN-TTRM-4401 which was logged from 659m to 321.5mMD RT, after which the GR-MAC was logged up through casing to the seafloor, although the acoustic signal deteriorated towards the seafloor. This log represents the primary depth control for ZaneGrey-1/ST1/ST2. TD was shallow to driller's TD by 1m owing to possible fill on bottom and the 340mm (13 3/8") casing shoe was found 0.25m shallower than driller's depth. The second logging run was with the RCI-GR tool for formation pressures and samples, which was logged over the gross interval 3179.6 to 3622.8mMD RT; while logging with the RCI-GR tool string, the tool became stuck at 3185mMD RT and unable to free; pulled 80% of weak point and tool came out of rope socket; rigged down BakerAtlas. Tensioned wireline and cut cable. Made up and tested wireline surface latching equipment. RIH with 86mm (3 ⅜") grapple on drill pipe, stripping over wireline to top of 'fish'; circulated above and latched onto 'fish'; rigged up for 'logging while fishing' and resumed RCI-GR programme on drill pipe; RCI tool failure occurred when on depth at 3627m due to overheating of electronics in gamma ray, resulting in no further communications with the tool; aborted remainder of tests and POOH with wireline tool on drill pipe; rigged down BakerAtlas.

Total gas, chromatographic breakdown of the ditch gas and trip gas was recorded from 1095 m to 3675 mMD RT throughout the 311mm (12 ¼") and 216mm (8 ½") hole sections, the results of which are included herein as Appendix 10. Trace to minor amounts of total gas consisting predominantly of methane (C_1), together with trace to minor amounts of ethane (C_2), propane (C_3) and butane (iC_4 & nC_4) was recorded upon commencement of first drilling returns in the 311mm (12 ¼") hole section below 1095mMD RT. Below approximately 1800m MD RT, nil to trace amounts of pentane (iC_5 & nC_5) were also recorded. Background gas levels remained at these levels throughout the remainder of the 311mm (12 ¼") hole section to section TD at 2772m MD RT in ZaneGrey-1. Maximum gas recorded in ZaneGrey-1 was 1.0% total gas which consisted of 11000ppm (C_1), 266ppm (C_2), 108ppm (C_3), 26ppm (iC_4) and 16ppm (nC_4). A number of slightly higher levels of total gas to 1.07% were recorded between 1800m and 2034m MDRT, however the chromatograph was malfunctioning during these intervals and no chromatographic data was recorded. The 244mm (9 ⅝") casing was subsequently set at 2184.1m MD RT after failing to reach section TD and ZaneGrey-1ST1 was commenced in sidetrack hole at this depth in 216mm (8 ½") hole.

Background gas levels were moderately uniform throughout the drilling of ZaneGrey-1ST1 over the gross interval 2184-3107m MD RT and consisted of trace to minor amounts of total gas, composed mainly of methane (C_1) and ethane (C_2) along with low levels of propane (C_3), butane (iC_4 & nC_4) and pentane (iC_5 & nC_5). Maximum gas recorded in ZaneGrey-1ST1 was 1.59% total gas at 2751m MD RT and consisted of 6895ppm C_1, 2036ppm C_2, 71ppm C_3, 177ppm iC_4, 255ppm nC_4 and 910ppm iC_5.

ZaneGrey-1ST2 commenced after kicking off in 216mm (8 ½") hole at 3075m MD RT. Background gas levels recorded initially were low to moderate and locally increased in response to the volume of coal being cut in the stratigraphic section. Background levels consisted of trace to minor amounts of C_1 to C_5 from 3075m to 3306m MD RT. Below this depth, a prominent gas peak of 18.08% total gas (above a background of 0.5%) was recorded over the interval 3306-3319m MD RT and consisted of 84,479ppm C_1, 11,492ppm C_2, 6,960ppm C_3, 84ppm iC_4, 1,517ppm nC_4, 639ppm iC_5 and 542ppm nC_5. The centre of the gas peak occurred at 3314m MD RT in association with a sandstone that exhibited nil direct fluorescence, however displayed a slow, faint bluish yellow cut fluorescence with a faint patchy bluish yellow residual ring fluorescence. An isotube gas sample was also collected from this gas peak, however at the time of writing this report, no further analyses have been attempted on this sample.

Below 3319m to total depth at 3675m MD RT, gas levels were moderately uniform and consisted of low to minor

amounts of total gas consisting of C_1-C_5. No further significant gas peaks were recorded.

No evidence of direct sample fluorescence was observed in cuttings during the drilling of ZaneGrey-1 over the gross interval 1095-2772.5mMD RT. The only sample show recorded in ZaneGrey-1/ST-1 occurred at a depth of 2960mMD RT (~ 2559m TVDSS) in which a coal displayed nil direct fluorescence, however it exhibited a very slow yellowish-blue cut with a bright, solid bluish yellow residual cut fluorescence. This show represents the shallowest recording of any evidence of possible hydrocarbons recorded in the ZaneGrey well. The only sample show associated with reservoir sandstone occurred in ZaneGrey-1/ST-2 where aggregates of sandstone over the interval 3300–3310mMD RT (~2854-2863m TVDSS) exhibited slow, faint bluish yellow cut fluorescence and faint patchy bluish yellow residual cut fluorescence. The only other sample shows evident during the drilling of ZaneGrey-1/ST-2, also occurred in association with coals over the gross interval 3092-3470m MDRT (~2671-3008m TVDSS). These shows typically consisted of very slow yellowish blue cut fluorescence with a bright, solid bluish yellow residual cut fluorescence. Trace evidence of amber also occurred in association with coal and sandstone aggregates which exhibited bright yellow white direct fluorescence and nil cut fluorescence.

Wireline log interpretation of ZaneGrey-1/ST2 over the target interval indicated the potential presence of a thin hydrocarbon column (1.3 – 2.5 m) within the upper portion of the target interval from 3305.7 – 3308 mKB (2880 – 2882 mTVD). Average porosity in this interval is 17%, and average water saturation is interpreted to be between 53 and 63% (depending on the resistivity device used). Elevated gas chromatograph readings were recorded across this interval, with minor fluorescence shows as described above.

Based on the results from the initial wireline log analysis, RCI pressure data was acquired through adjacent water sands and through the target interval, and light hydrocarbons were successfully recovered using RCI sampling within the upper portion of the target interval at a measured depth of 3307 mKB. There is no data to determine if the in-situ fluids are fully saturated or not, however PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. This data is supportive, but not in itself proof of a down dip oil leg.

The absence of a definable hydrocarbon pressure gradient from RCI pressure data, in combination with the thin pay zone identified from log analysis supports the theory that ZG-1ST2 has intersected the very base of a rich gas-condensate accumulation, with a gas-water contact very close to 3307 mKB (or 2882 mTVD). Depth uncertainty should be considered, however from the RCI data, the LKG is at 2881.5 mTVD, whilst the most likely HKW is 2883.4 mTVD. Wireline log interpretation indicates possible net pay down to 2882 mTVD.

Based on the available data, a gas-condensate hydrocarbon accumulation would seem to exist up-dip from the ZG-1ST2 intersection, and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence in the well to support hydrocarbons below the lowest net pay interpretation (2882 mTVD).

While it is possible that the 'live oil shows' interpreted in the offset Nannygai-1 well do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZaneGrey-1ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZaneGrey-1ST2. Also a 30m hydrocarbon column (if present) should have provided enough buoyancy to give higher oil saturations than those observed in ZaneGrey-1ST2. This interpretation also seems to contradict the indirect evidence of water from the failed RCI sampling attempts.

ZaneGrey-1/ST1/ST2 was plugged and abandoned as a non-commercial gas condensate discovery and the rig released to Woodside Energy Ltd at 19:20 Hrs 18th March 2005. Total time on ZaneGrey-1/ST1/ST2 location was 50.52 days. A composite well log of the lithology intersected in ZaneGrey-1/ST1/ST2 is included as Enclosure 1 in the ZaneGrey-1/ST1/ST2 Well Completion Report – Interpretive Report.

APPENDIX 2

Petrophysical Report

By The Saros Group Pty Ltd

Petrophysics

ZaneGrey 1-ST2

Prepared for:

Bass Strait Oil Company Ltd.

CONFIDENTIAL

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June, 2005

the saros group
Our experts. Your results.

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EXECUTIVE SUMMARY

The ZaneGrey 1-ST2 (ZG-1ST2) exploration well is located in Vic/P42 approximately 10 km WNW of the Kingfish oil field, within the offshore Gippsland Basin.

MWD gamma ray-resistivity data was acquired during the drilling of the 12 ¼" and 8 ½" hole sections in ZG-1ST2. ZG-1ST2 was logged using the Baker Atlas Grand-Slam suite from TD to the 13 3/8" casing shoe. Hi-Res repeat passes were made over the intervals 3410 – 3290m and 3630 – 3540m. As a result of operational issues, the lower part of the well was logged with the density caliper closed. The borehole condition was very good at the time of logging, resulting in the acquisition of a good quality dataset. The Baker Atlas RCI tool was run to determine reservoir fluid pressure gradients, and to sample the reservoir fluids. A total of 55 pressure tests, including 2 samples were acquired

ZG-1ST2 was interpreted using Geolog6 software. A deterministic approach was used for this analysis of the target formations. The following is a summary of the methodology utilised for this analysis:

- QC and depth match raw log data
- Estimate volume of shale (Minimum of GR-linear and D-N)
- Estimate total and effective porosity (Density-Neutron)
- Estimate total and effective water saturation (Archie)
- Estimate permeability (Free Fluid Index)

Wireline log interpretation of ZG-1ST2 over the target interval indicated the potential presence of a thin hydrocarbon column (1.3 – 2.5 m) within the upper portion of the target interval from 3305.7 – 3308 mKB (2880 – 2882 mTVD). Average porosity in this interval is 17%, and average water saturation is interpreted to be between 53 and 63% (depending on the resistivity device used). Elevated gas chromatograph readings were recorded across this interval, while no fluorescence was observed.

Based on the results from the initial wireline log analysis, RCI pressure data was acquired through adjacent water sands and through the target interval, and light hydrocarbons were successfully recovered using RCI sampling within the upper portion of the target interval at a measured depth of 3307 mKB.

There is no data to determine if the in-situ fluids are fully saturated or not, however PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. This data is supportive, but not in itself proof of a down dip oil leg.

The absence of a definable hydrocarbon pressure gradient from RCI pressure data, in combination with the thin pay zone identified from log analysis supports the theory that ZG-1ST2 has intersected the very base of a rich gas-condensate accumulation, with a gas-water contact very close to 3307 mKB (or 2882 mTVD). Depth uncertainty should be considered, however from the RCI data, the LKG (sample #16) is at 2881.5 mTVD, whilst the most likely HKW (from attempted sample #21 – but no recovery made) is 2883.4 mTVD. Wireline log interpretation indicates possible net pay down to 2882 mTVD.

Based on the available data, a gas-condensate hydrocarbon accumulation would seem to exist up-dip from the ZG-1ST2 intersection, and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence to support hydrocarbons below the lowest net pay interpretation (2882 mTVD), and this LKG should be used as a base case to map out reserves.

While it is possible that the 'live oil shows' interpreted in Nannygai-1 do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZG-1ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZG-1ST2. Also a 30m hydrocarbon column (if present) should have provided enough buoyancy to give higher oil saturations than those observed in ZG-1ST2. This interpretation also seems to contradict the in-direct evidence of water from the failed RCI sampling attempts.

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INTRODUCTION

The ZaneGrey 1-ST2 (ZG-1ST2ST2) exploration well is located in Vic/P42 approximately 10 km WNW of the Kingfish oil field, within the offshore Gippsland Basin (Figure 1).

The geological objectives for ZG-1ST2 were as follows:

- Determine the depth of the top of the Latrobe Group at the well location. This information will enable a decision to abandon the well to be made if it is demonstrated that the depth conversion is invalid and structural closure is unlikely,
- Test Upper Latrobe Group reservoirs within a faulted anticline updip of the Nannygai–1 well,
- If the top of the Latrobe Group is encountered within prognosis the well will be deepened to a TD of 3155mSS to enable evaluation of the Roundhead Member sealed beneath the Kate Shale and significant reservoir seal pairs of the Kingfish Formation, including the reservoir where live oil is interpreted in Nannygai-1.

This report summarises a petrophysical analysis performed on behalf of the operator.

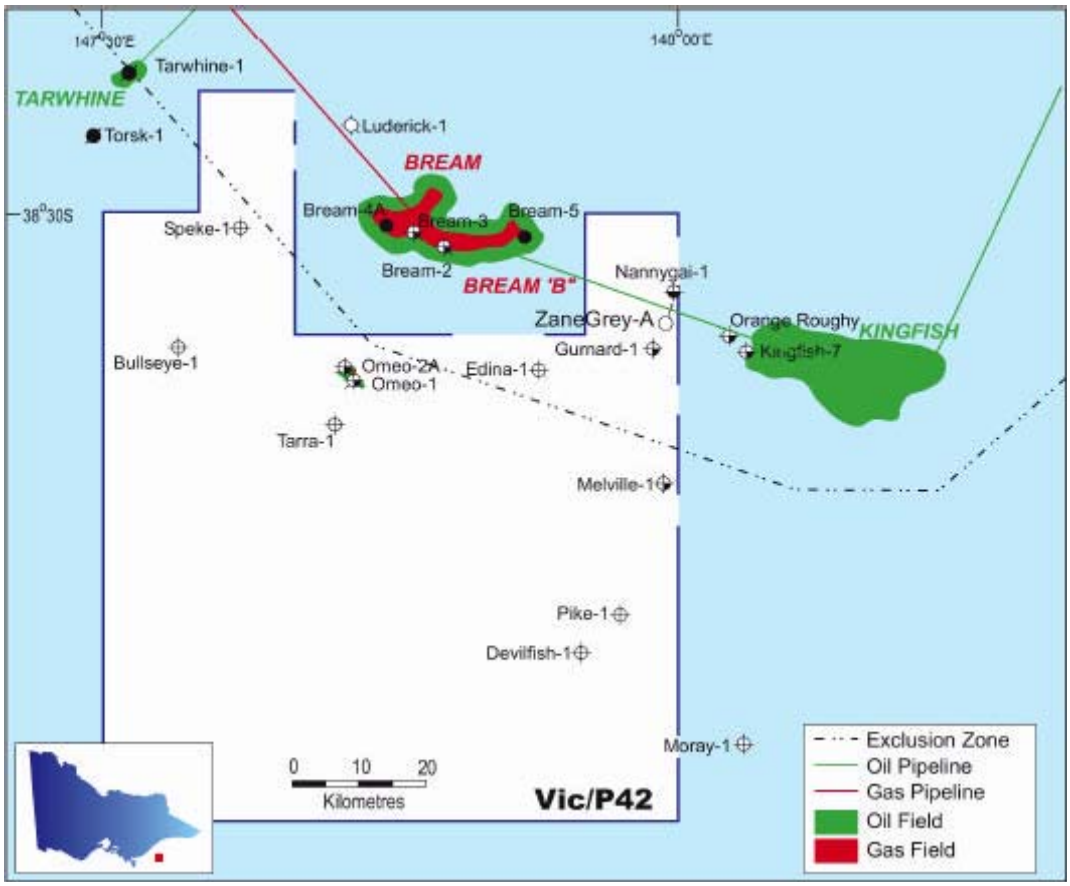


Figure 1. Locality map for ZG-1ST2.

DATA AVAILABILITY AND QUALITY

Mudlog and Drilling Data

ZG-1ST2 was spudded on the 29th January 2004 and was drilled with 36" hole section to a depth of 129.5m after which the 30" casing was set. A 16" hole was then drilled to 486m, at which the hole was kicked off and directionally drilled to 1090.61m upon which 13 3/8" casing was set. The 12 ¼" hole was directionally drilled to 2772m. Casing was then set at 2184m as it was not possible to pass 2194m. ZaneGrey 1-ST1 was kicked off and the 8½" hole was drilled to 3107m when the BHA separated. A balanced plug was set at 3106 – 2946m and ST2 was kicked off and drilled to a TD of 3675m.

Mudlog cuttings descriptions and gas chromatograph readings were recorded through the target intervals.

Figure 2 is the mudlog through the main target interval, the Nannygai Sandstone equivalent. An increase in gas chromatograph readings (above background) was observed together with a minor amount of fluorescence showing a very slow bluish cut, with a patchy bluish-yellow residual ring associated with consolidated grains between 3300 and 3310 m.

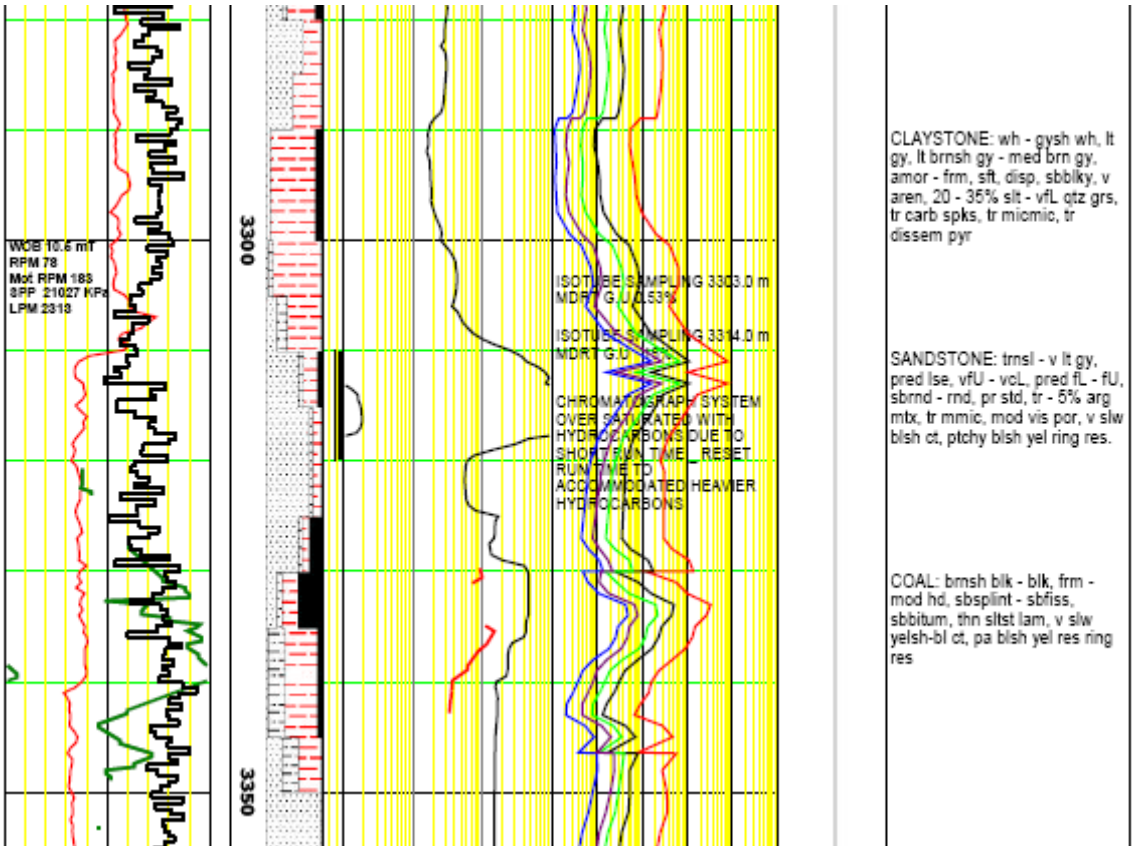


Figure 2. Mudlog observations across the Nannygai Sandstone.

Measurement While Drilling Data

MWD gamma ray-resistivity data was acquired during the drilling of the 12 ¼" and 8 ½" hole sections in ZG-1ST2. Table 1 summarises the LWD log runs.

Run No.	Bit No.	Hole Size (mm)	MWD Service	Start Depth (m)	End Depth (m)	Drill/Wipe Distance (m)	Run Start Date Time	Run End Date Time	BRT Hrs.	Oper. Hrs.	Circ. Hrs.	Max. Temp. (degC)	Serv. Int.	Trip for MWD	Failure Type
0200	2	406.00	DIR-FE	129.50	1095.00	965.50	30-Jan-05 10:46	01-Feb-05 07:05	44.34	44.34	35.15	33.00	No	No	
0300	3	311.00	DIR-FE	1095.00	1095.00	0.00	04-Feb-05 03:32	04-Feb-05 10:54	7.36	7.36	0.96	28.00	Yes	Yes	TM
0400	4	311.00	DIR-FE	1095.00	2103.00	1008.00	04-Feb-05 12:57	07-Feb-05 04:08	63.19	63.19	43.00	65.00	No	No	
0500	5	311.00	DIR-FE	2103.00	2702.00	599.00	07-Feb-05 06:05	09-Feb-05 10:59	52.90	52.90	35.78	77.00	No	No	
0600	6	311.00	DIR-FE	2702.00	2772.50	70.50	09-Feb-05 11:46	12-Feb-05 02:54	63.12	63.18	39.25	76.00	No	No	
0700	7	216.00	DIR-FE	2190.00	3107.00	917.00	21-Feb-05 16:02	26-Feb-05 04:09	108.12	108.12	89.69	82.00	No	No	
0800	8	216.00	DIR-FE	3107.00	3107.00	0.00	27-Feb-05 01:03	28-Feb-05 00:40	23.62	23.62	10.00	96.00	No	No	
0900	9	216.00	DIR-FE	2970.00	3031.00	61.00	28-Feb-05 17:45	03-Mar-05 02:40	56.93	56.93	40.85	91.00	No	No	
1000	10	216.00	DIR-FE	3031.00	3070.00	39.00	03-Mar-05 03:19	04-Mar-05 16:12	36.88	36.88	25.41	94.00	No	No	
1100	11	216.00	DIR-FE	3070.00	3092.00	22.00	04-Mar-05 16:40	05-Mar-05 19:14	26.57	26.57	12.81	96.00	No	No	
1200	12	216.00	DIR-FE	3092.00	3675.00	583.00	05-Mar-05 19:39	11-Mar-05 06:19	130.66	130.66	39.64	104.00	No	No	

Table 1. Summary of LWD runs.

Wireline Logging Data

ZaneGrey 1 ST1-ST2 was logged using the Baker Atlas Grand-Slam suite from TD to the 13 3/8" casing shoe. Hi-Res repeat passes were made over the following intervals:

a. 3410 – 3290m
b. 3630 – 3540m

The hole was then logged up from TD in normal res to 3015m, when it was realised the density caliper was closed. The tools were lowered to 3410 and then logged up in Hi-Res and open caliper to 3250m and then logged from 3250 to 2128 in normal res mode. Table 2 summarises the wireline logs acquired in this well.

It is interesting to note that the SEDP resistivity seems to be significantly, and consistently lower to the RD resistivity, and fairly coincident with the RS lateralog resistivity. It is well known that induction tools have greater accuracy in low resistivity environments (eg <50 ohm.m), whilst lateralog tools are more accurate in higher resistivity zones. It may be that the LWD induction tool is more accurate through the sands in this sequence.

Run #		1	2
Logging Tool		DLL/MLL/MAC/ZDL/CNL/DSL/GR/TTRM	RCI-GR
Date		11 March 2005	12 March 2005
Start Rig Up		08:00 hrs 11/03/2005	02:41 hrs 12/03/2005
Time RIH Start		10:10 hrs 11/03/2005	05:15 hrs 12/03/2005
Time on BTM		15:38 hrs 11/03/2005	n/a
Log Speed (min/m)		n/a	n/a
Time on Surface		00:45 hrs 12/03/2005	12:42 hrs 14/03/2005
Finish Rig Down		2:41 hrs 12/03/2005	13:00 hrs 14/03/2005
Log Hours		18 hrs 41 mins	67 hrs 19 minutes
Logger's TD (m)		3671m	n/a
Logger's CSG Shoe (m)		3184	n/a
Logged (m)	From	3179.6	3179.6
	To	3674m	3622m
	Interval	1490m	442.4m
Max.Temp. (^{o}C) / Thermom. depth (mTVDRT)		121.7° C (3216.1 m)	135.3° C (3170.9m)
Time Since Circ. Stop		16 hrs 38 minutes	72 hrs

Table 2. Wireline log data acquired in ZG-1ST2.

Formation Test Data

The Baker Atlas RCI tool was run to determine reservoir fluid pressure gradients, and to sample the reservoir fluids. A total of 55 pressure tests, including 2 samples were acquired in ZG-1ST2. Hole problems during the RCI data acquisition meant that after acquisition of the first 3 pressure points the RCI tool became stuck at 3185m and had to be fished, and was later run-in-hole on drill pipe after stripping over wireline and latching onto the tool. A GR correlation was made to check correlation, and 30 pressure tests, 16 repeat tests and 2 samples were successfully obtained, during a logging while fishing operation. At a depth of 3622m the GR tool failed due to excessive temperature and communications failure, and the remainder of the programme was aborted.

BOREHOLE DATA

Hole Conditions

The borehole condition was very good at the time of logging, resulting in the acquisition of a good quality dataset. Some minor ovalisation of the hole can be recognised from differences between the X and Y calipers, however use of the X-Y caliper system meant that good quality density data was obtained through the main target intervals. Unfortunately, due to poor logging operations, the density caliper was not open at the time of logging significant parts of the lower section of the well.

Mud Properties

The well was drilled using a 6% KCl-Polymer-Glycol mud through the 12 ¼" and 8 ½" hole sections. Mud density at the time of drilling the primary reservoir interval was 1.17 g/cc.

Bottom Hole Temperature

Formation temperature for the purposes of this analysis was calculated from using the maximum recorded temperature of 121 degC at a depth of 3671 mKB from the Grand-Slam logging run. A surface temperature of 25 degC was assumed in the calculation of borehole temperature. The calculated borehole temperature was checked against that recorded on the tool and the two curves were in close agreement.

LOG ANALYSIS METHODOLOGY

Preparation

Wireline data was loaded from LAS files into Geolog6 software. The logs were checked for depth-matching and general acquisition quality.

Environmental Corrections

Full environmental corrections have been applied to the logs either by the logging contractor or where necessary using Geolog6 software. These corrections are based on the Baker-Atlas Charts and are summarised below.

The GR log was corrected for holesize and mud weight. The neutron log (CNC) was environmentally corrected for borehole size (by Baker) and salinity, temperature and pressure, mud cake, neutron absorber and mud weight using *Geolog6*. The density log (ZDEN) was corrected for borehole size and mud fluid, while the resistivity logs were borehole, however invasion corrections were not made due to the unusual ratio's of RMLL, RS and RD which resulted in commonly unreasonable values of Rt.

Interpretation Technique

ZG-1ST2 was interpreted using Geolog6 software. A deterministic approach was used for this analysis of the target formations. The following is a summary of the methodology utilised for this analysis:

- QC and depth match raw log data
- Estimate volume of shale (Minimum of GR-linear and D-N)
- Estimate total and effective porosity (Density-Neutron)
- Estimate total and effective water saturation (Archie)
- Estimate permeability (Free Fluid Index)

Volume of Shale

The volume of shale (Vsh) was estimated from the Density-Neutron logs using the Bateman & Konen methodology. The parameters used are summarised in Appendix A.

Porosity Determination

Total and effective porosity was estimated from the density and neutron logs incorporating shale corrections. This corrected density porosity was then used the determine water saturation in subsequent analyses. A constant shale dry density of 2.67 g/cc was used which equated to shale porosities between 4 and 9%.

Saturation Evaluation

Water saturation through the target intervals was estimated using the Archie Equation. Intervening shales within the main interval are relatively resistive in nature (RT shale = 15-30 ohmm) likely as a result of a high carbonaceous component. For this reason shale effects within the sands were considered negligible and the Archie equation sufficient to estimate water saturations.

Formation Brine

Formation water resistivity values used in this analysis were based on Rwa analysis of water zones in the Nannygai Sandstone, and the underlying lower water sands (see Figures 3 and 4). A value of 0.55 ohmm @ 25 degC was used for the main target interval (approximately 11 kppm NaCl equivalent) while the lower water sand indicated a water resistivity of 0.45 ohmm @ 25degC (approximately 13 kppm NaCl equivalent).

Using the SEDP results in apparent water resistivity estimates of 0.25 and 0.3 ohmm respectively through the main and lower water sands of the Nannygai Sandstone, which correspond to approximately 30kppm and 20kppm respectively.

Saturation equation parameters

In the absence of special core analysis data, Pickett plots through clean reservoir sands indicate an average m value of 1.8 and an n value of 2 was assumed through the target intervals. These values were used across all intervals analysed.

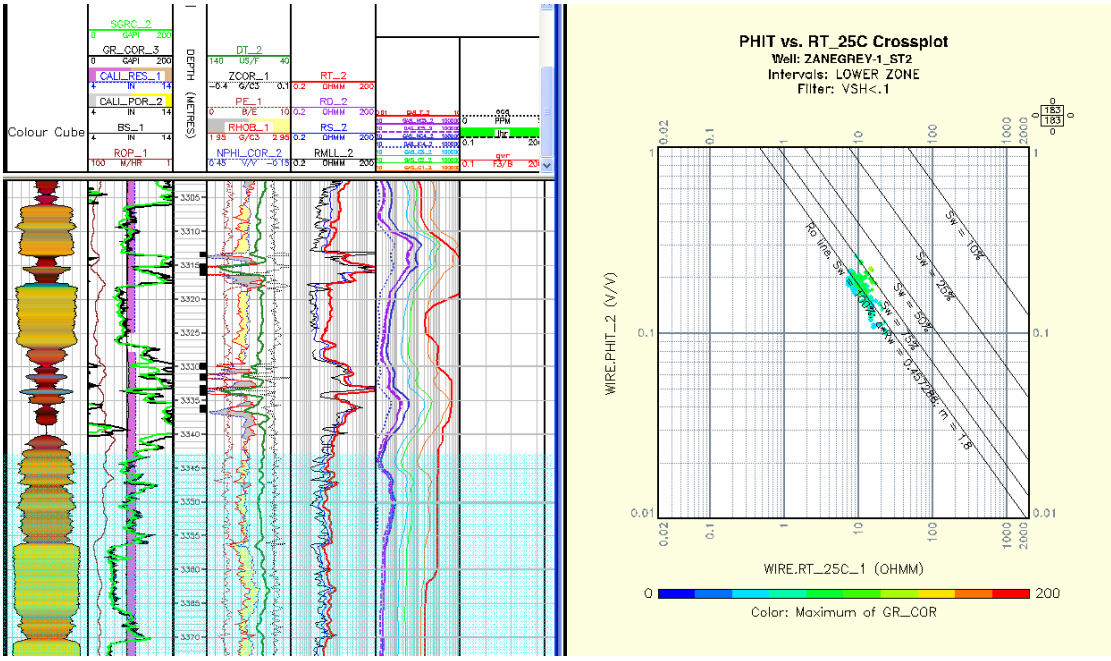


Figure 3. Pickett Plot Rwa analysis of the lower water sands below the target interval in ZG-1ST2 (area in blue).

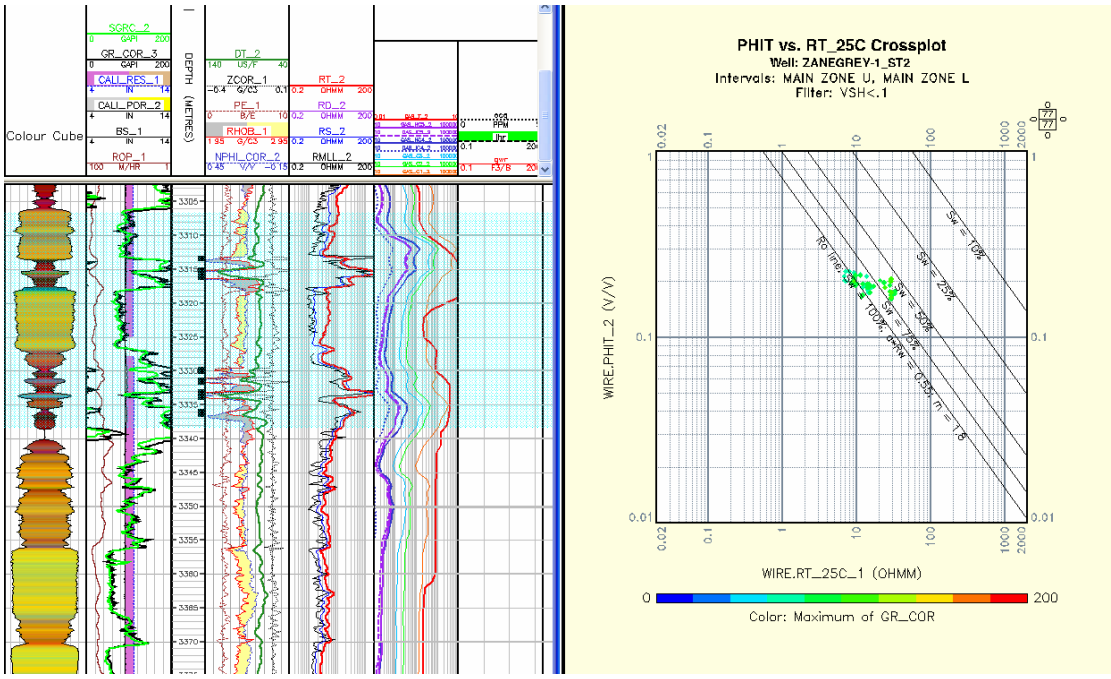


Figure 4. Pickett Plot Rwa analysis of the target sands in ZG-1ST2 (area in blue).

Permeability Evaluation

An intrinsic permeability log was derived using the Coates free fluid index (FFI) for permeability prediction. The basic equation takes on the following form;

$$K_{FFI} = 100\left[\phi_e^2 \frac{(\phi_t - BV_{irr})}{BV_{irr}}\right]^2$$

Where:

ϕ_e = *log analysis effective porosity*
ϕ_t = *log analysis total porosity*
BV_{irr} = *bulk volume irreducible water*
C = *constant multiplier*
X = *exponent*

Cutoffs

The following cutoffs were used in this well. Reservoir was defined as having VSH <40% and PHIe >10%, while HIP also included a Swt <65% cutoff.

RESULTS

Wireline Interpretation

Figure 5 is a summary plot of the log analysis over the Nannygai Sandstone interval. The log analysis indicates that the majority of the sequence is water saturated, however there is a thin hydrocarbon column at the top of the main target sand over the 3306 – 3308 mKB interval. There is a total of 1.295 m of net pay interpreted with an average total porosity of 17.8%, average total water saturation of 62.6%, and an average permeability of 103 mD.

No pay is interpreted to exist within any other intervals in ZG-1ST2.

At the base of the well within the Volador Formation, high gas shows were recorded, and apparent water saturations around 60 – 50 % are calculated from 3630 – 3638 mKB. These high water saturations are considered to be the result of lithological effects which may be causing inaccurate porosity to be predicted (Figure 6).

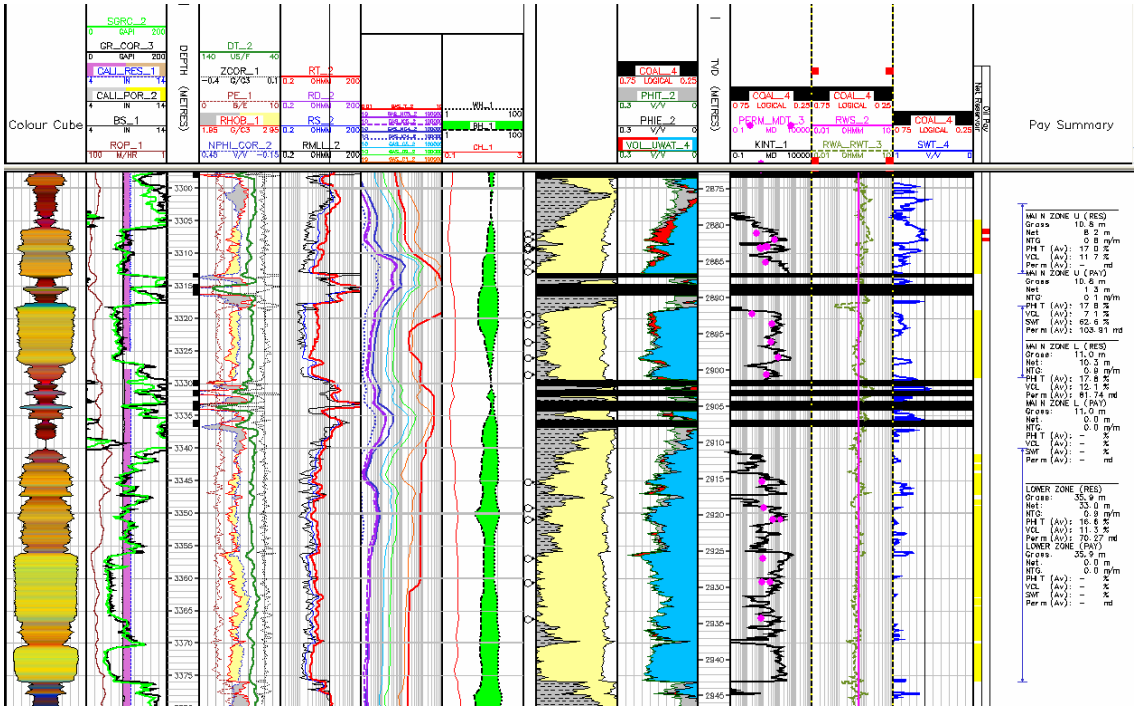


Figure 5. Summary of the wireline log analysis across the target interval, the Nannygai Sandstone.

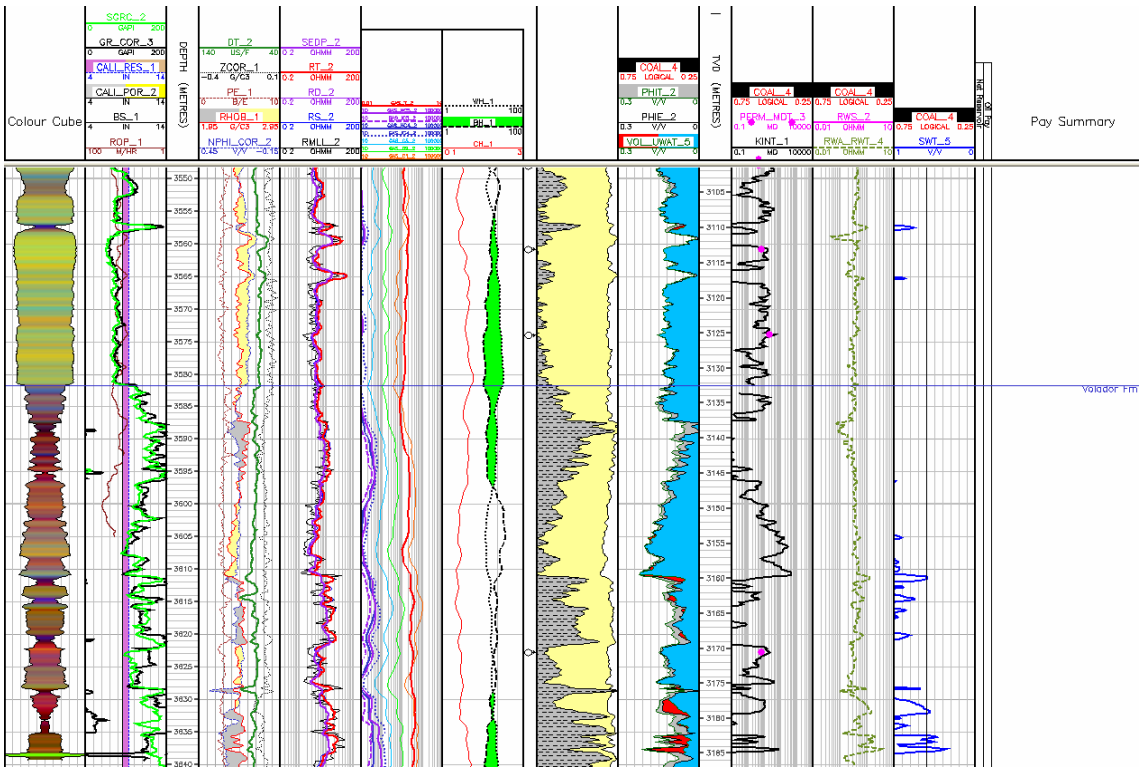


Figure 6. Wireline log analysis over the Volador Formation. The apparent hydrocarbon saturations interpreted at the base of the interval are possibly due to lithological effects and are considered highly uncertain due to unusual logging responses.

Alternative True Resistivity

As an alternative, the SEDP induction from the LWD string was used as true resistivity. The SEDP appears to give slightly improved contrast between the water and hydrocarbon bearing intervals in this zone (Figure 7), which may be a function of the improved accuracy of induction tools in low resistivity environments. Using the SEDP results in apparent water resistivity estimates of 0.25 and 0.3 ohmm respectively through the main and lower water sands of the Nannygai Sandstone, which correspond to approximately 30kppm and 20kppm respectively. It is interesting that these numbers are close to those predicted from WFT analysis (Chen, 2005).

When the SEDP is used, and increased amount of pay in predicted as a result of the improved resistivity contrast, a total of 2.5m of net pay with average porosity of 17%, average water saturation of 52.7% and average permeability of 68.7mD was predicted (Figure 8).

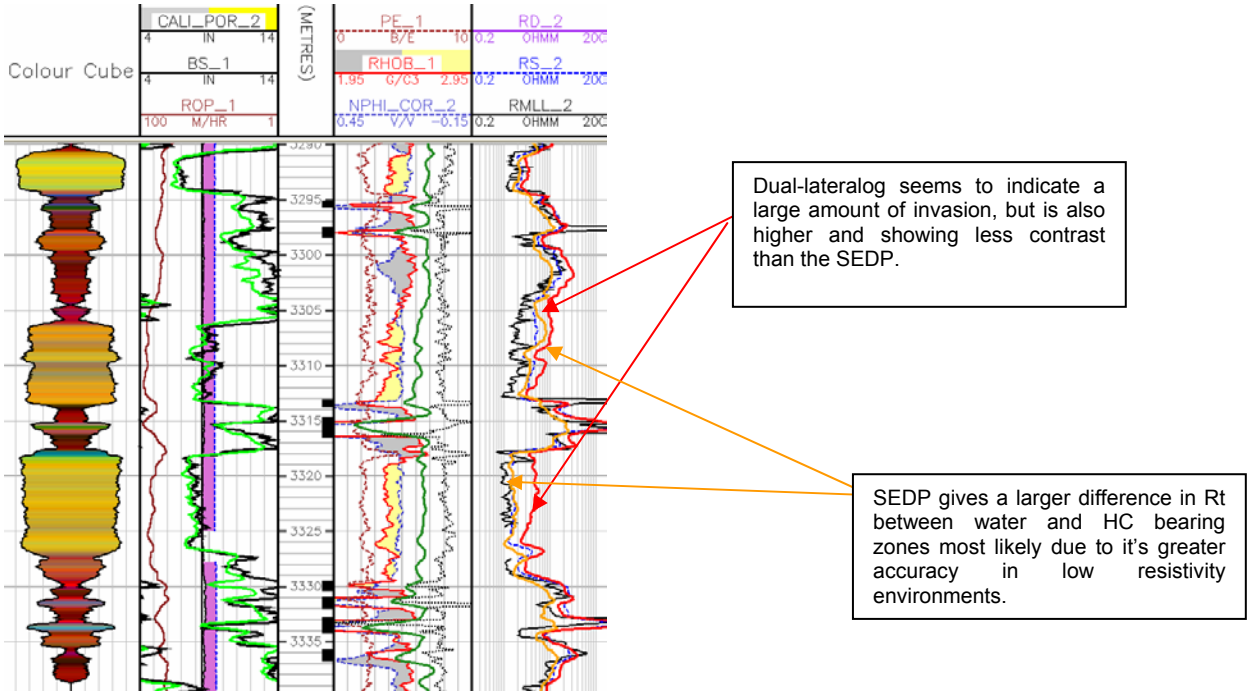


Figure 7. Comparison of SEDP and RD logs through the Nannygai Sandstone, and their response to apparent water-saturated and HC bearing sandstones.

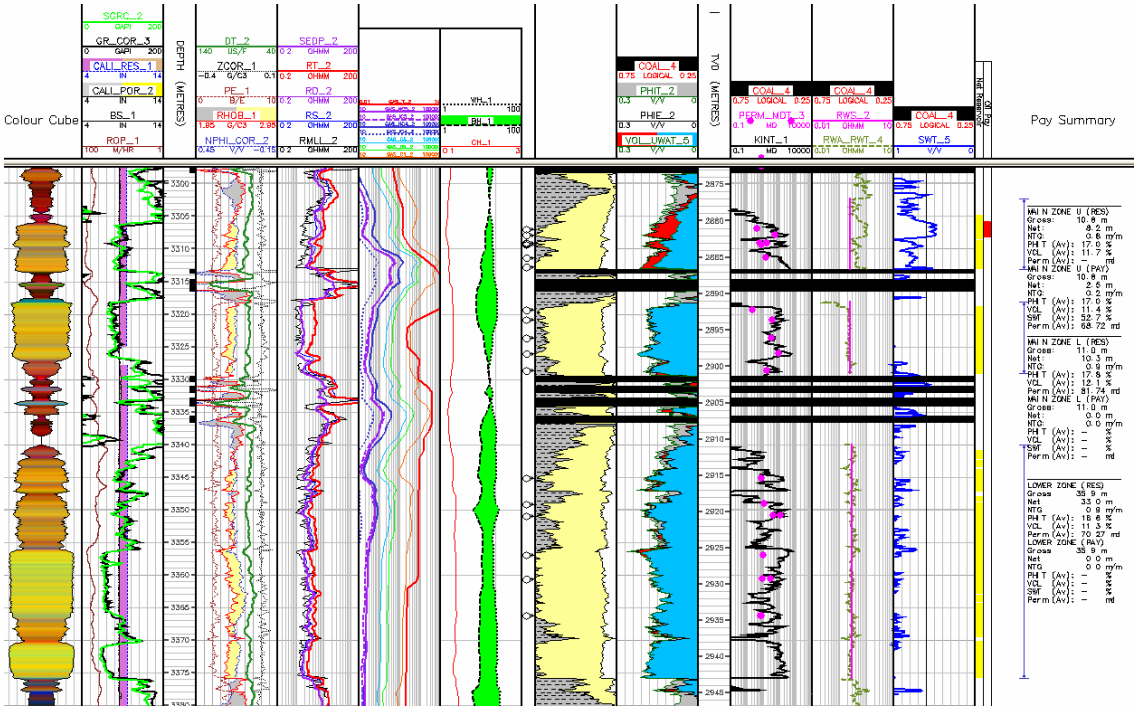


Figure 8. Results of Sw interpretation using the SEDP LWD induction resistivity instead of the dual lateralog resistivity. This seems to result in better contrast between the water and hydrocarbon bearing horizons.

RCI Interpretation

An interpretation of the RCI data was undertaken by Baker Atlas (2005), while an independent investigation of the RCI data was undertaken by Chen (2005). These interpretations represent two independent explanations of the data.

Fluid Sampling

Three sample attempts were made from the Nannygai Sandstone interval at depths of 2881.5 mTVD (#16), 2885.4 mTVD (#19) and 2883.4 mTVD (#21). The "sampleView" analysis at sample point #16 indicated the presence of gas (with minor oil) and two 840mL samples were successfully recovered. The "SampleView" analysis for points #19 & #21 were interpreted to clearly indicate water (formation or filtrate) as being present (Baker, 2005), albeit with some minor gas slugging (particularly associated with the early time of sample #19) However, no sample was recovered to confirm that interpretation. Baker (2005) interpreted this early gas slugging to be associated with cleaning up from the gas sampling associated with #16. Sampling was performed under logging while fishing conditions on the way down, however sample #19 was acquired prior to the higher sample #21.

Hydrocarbon was sampled from #16, and in sample chamber 1 - 124 mL of stabilised condensate was recovered with 115.68 litres of gas at standard conditions. 140mL of aqueous fluid was recovered also. Tests for thiocyanate showed that this water was predominantly mud filtrate, possibly with some condensed water. During draining, Drager tube measurements were carried out. The gas was found to contain 1.0%vol. CO_2. H_2S was detected at 200ppm by volume. The dead condensate collected was measured at 52.7ºAPI.

Prior to transfer, sample chamber 2 was preconditioned by pressurising to 1450psig (minimum) above reservoir pressure (3995.4psia), whilst heated to 60ºC and agitated for two hours. Once stable, 550ml of sample was transferred to a Petrotech dual-phase shipping bottle at 5400psig minimum pressure. Line flushing indicated that the sample is likely to contain some mud filtrate with the gas.

PVT analysis of the hydrocarbons has indicated that it is a condensate rich gas (GOR ~14440 scf/bbl or CGR ~69 bbl/MMscf), for which the saturation pressure is close to the reservoir pressure. This data should not preclude the presence of a down dip oil leg.

No samples were recovered from sample points #19 or #21 to identify water properties.

Baker Atlas Interpretation

Figure 9 is a summary of the gradient interpretation from the Baker (2005) report. The key interpretation points are as follows:

- After the final build-up pressures were screened using FRA and PTA techniques, seventeen pressure points with FRA compliance are identified between depths of 2821.8 and 2926.3mTVD, and 8 points of slightly higher permeability (but not FRA compliant) were plotted for fluid gradient determination.
- A water gradient of 1.46 psi/m (0.445 psi/ft) was estimated based on all of these points.
- A wet gas gradient of 0.45 psi/m (0.1385 psi/ft) was estimated based on pre-test pressures at #18, #17 and #21.
- A free water level is interpreted to be present at the intersection of the wet-gas and water gradients at a depth of 2884.1 mTVD.

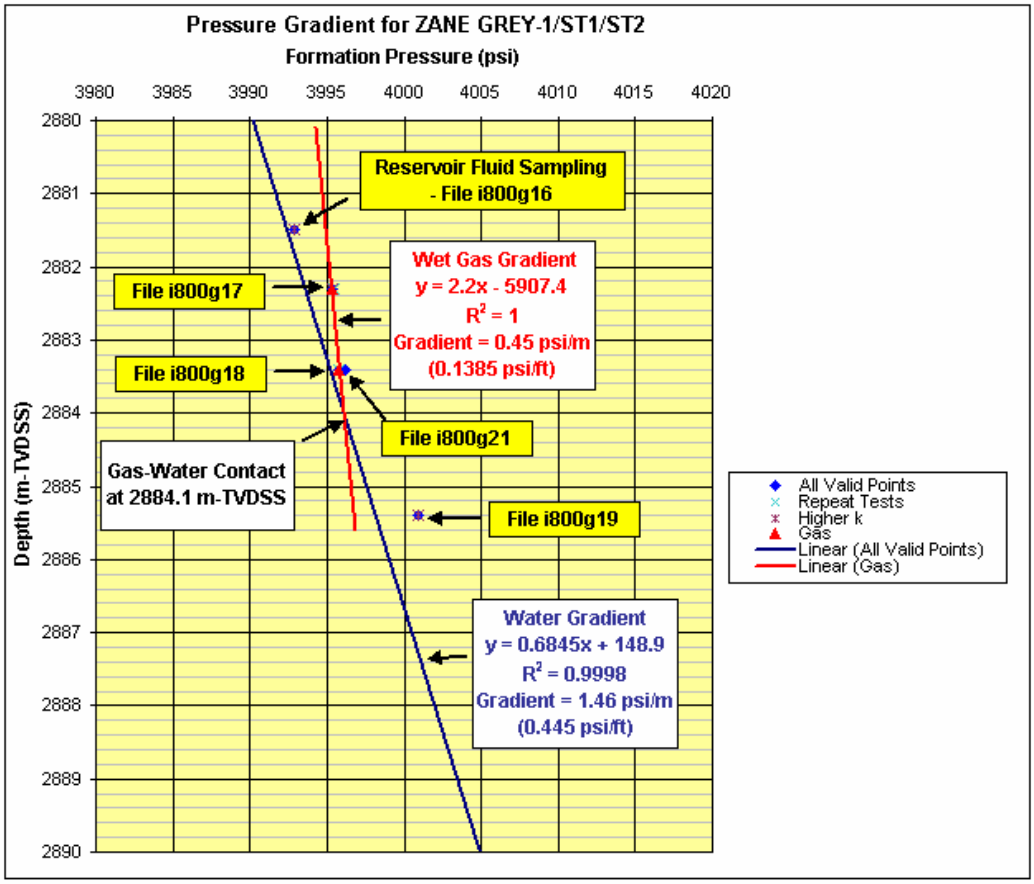


Figure 9. Summary of one of the fluid gradient interpretations for ZG-1ST2 (Baker, 2005). Note that the vertical axis is TVD (RT) not subsea as displayed.

Chen Interpretation

Figure 10 is a plot of the RCI pressure data from the target zone and water sands below vs TVD. Two pressure gradients are shown, the baseline pressure gradient, and a lower water pressure gradient. The baseline pressure gradient is most relevant to the target interval. Pickett plot analysis of the equivalent intervals indicates apparent water resistivity values of .55 (0.3 using SEDP) and .46 (0.25 using SEDP) ohmm @ 25degC in the baseline and lower zones respectively and supports a change in water sailinity.

Figure 11 is an expanded view of the target interval. This plot shows the baseline water gradient (blue line) and the attempted sampling and pre-test points. As can be seen from this plot, the majority of the pressures actually lie on, or below the baseline water gradient, with the highest mobility point (point # 17) sitting directly on the water gradient. No hydrocarbon gradient can be observed, and when errors in measurements are taken into account the majority of the points can be considered to fit with the water gradient.

As no hydrocarbon pressure gradient could be obtained from the RCI pre-test data, an in-situ fluid density or likely saturation condition can not be estimated from the available data.

The main conclusions from Chen (2005) were as follows:

1. The water gradient is 1.39 psi/m, equivalent to a water salinity of 30,000 ppm. This is the most solid result, although yet to be confirmed by a water sample analysis. This water gradient is derived from the pressure data across the interval referred to as the “baseline water” because of its highest and best quality.

2. The pressure data at the upper target zone is no better or worse than most of the pressures acquired in this RCI job.

3. This upper zone is not considered to contain a significant amount of hydrocarbon (be it wet gas, condensate or light oil). The best scenario would be some small amount of overriding hydrocarbon mixture afloat at the top of this zone.

4. The recovered sample did confirm a certain amount of hydrocarbon, while the SampleView data are conflicted: the resistivity and the capacitance data both strongly indicated water during this test; the optical density data has some indication of hydrocarbons, but most likely it is a mixture of hydrocarbon and water.

5. A cross check of the pressure data, from all the individual pressure tests, the P-D plotting, and the excess pressure plotting, indicated that most likely this zone primarily contains water, with a little hydrocarbon.

6. It is impossible to establish any pressure gradient across this zone, as the errors that could have been introduced to both the pressure and the depth measurements are within the limit of the tool specifications.

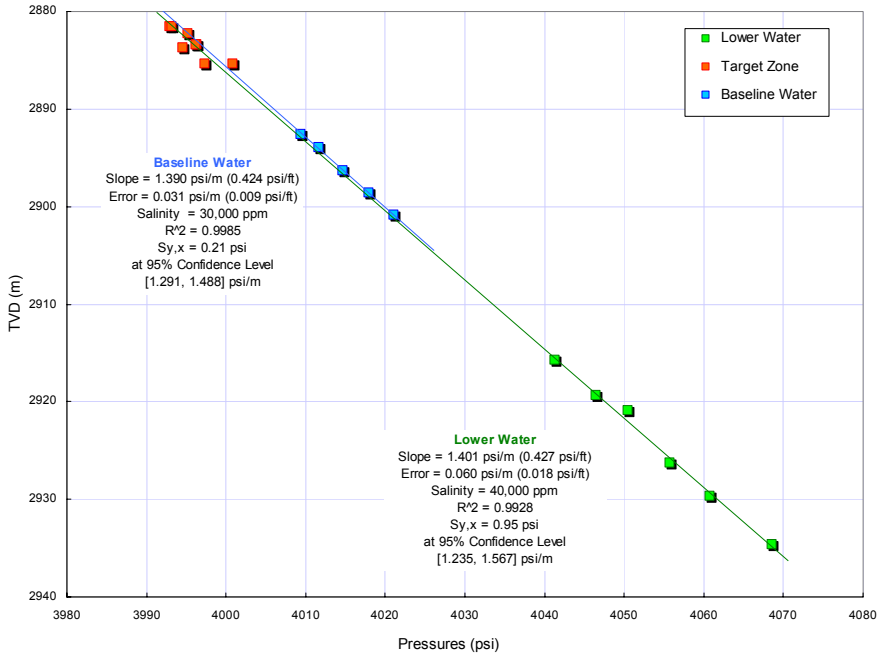


Figure 10. Water pressure gradients through the main target sands and the lower water sand beneath in ZG-1ST2 (Chen, 2005).

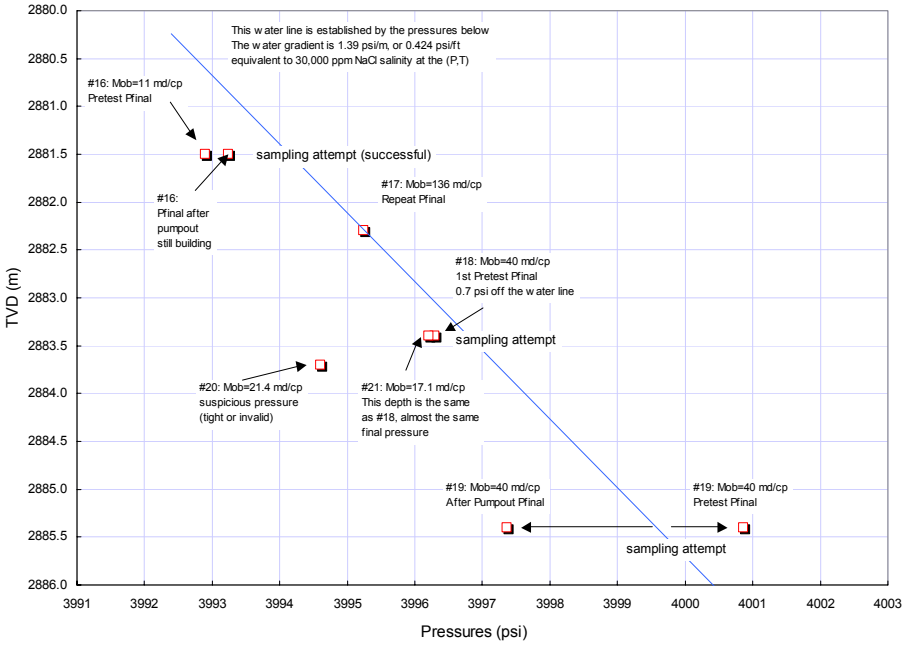


Figure 11. Target interval pressure gradient interpretation in ZG-1ST2 (Chen, 2005).

Saros Review

Saros has reviewed both of the interpretations, and available supporting data and accept that both interpretations are possible. General observations about the two interpretations are as follows:

- Baker (2005) have incorporated pressures from locations #18, #17, and #21 in the calculation of both the water gradient and wet-gas gradient. It is inconsistent to use the same data to calculate both gradients.

- Baker (2005) has used all of the valid pre-test pressures through the well to produce an average water gradient. This does not take into account any variations in water salinity, or over-pressure that may be present between reservoir intervals.

- One of the two sample locations that showed clear water on the "SampleView" analysis (#21) is actually at the same depth as pre-test #18 which has been interpreted to be on a valid wet-gas fluid gradient. However no water sample was obtained to confirm the interpretation of water.

- The gas sample location (#16) was not included in the definition of the wet-gas fluid gradient because it does not reconcile with that gradient. In fact, this pressure actually sits on the water gradient defined by baker. Baker claim that this is due to the poor mobility at that location which has resulted in insufficient time for build-up.

- Chen has indicated that the "SampleView" analysis from Baker for #16 was ambiguous, however Baker indicate that the results show the sample to be clearly gas. The recovery proved to be a gas-condensate mixture and support Baker's interpretation of the "sampleView" analysis.

Figure 12 shows a comparison of the water gradient as interpreted by Baker (2005), the water gradient interpreted by Chen (2005) and the pressure data through the interval of interest. As can be seen, the Baker gradient does not reconcile with the pressures observed in the adjacent water-wet sands, whilst the Chen gradient was interpreted from the pressures in these sands.

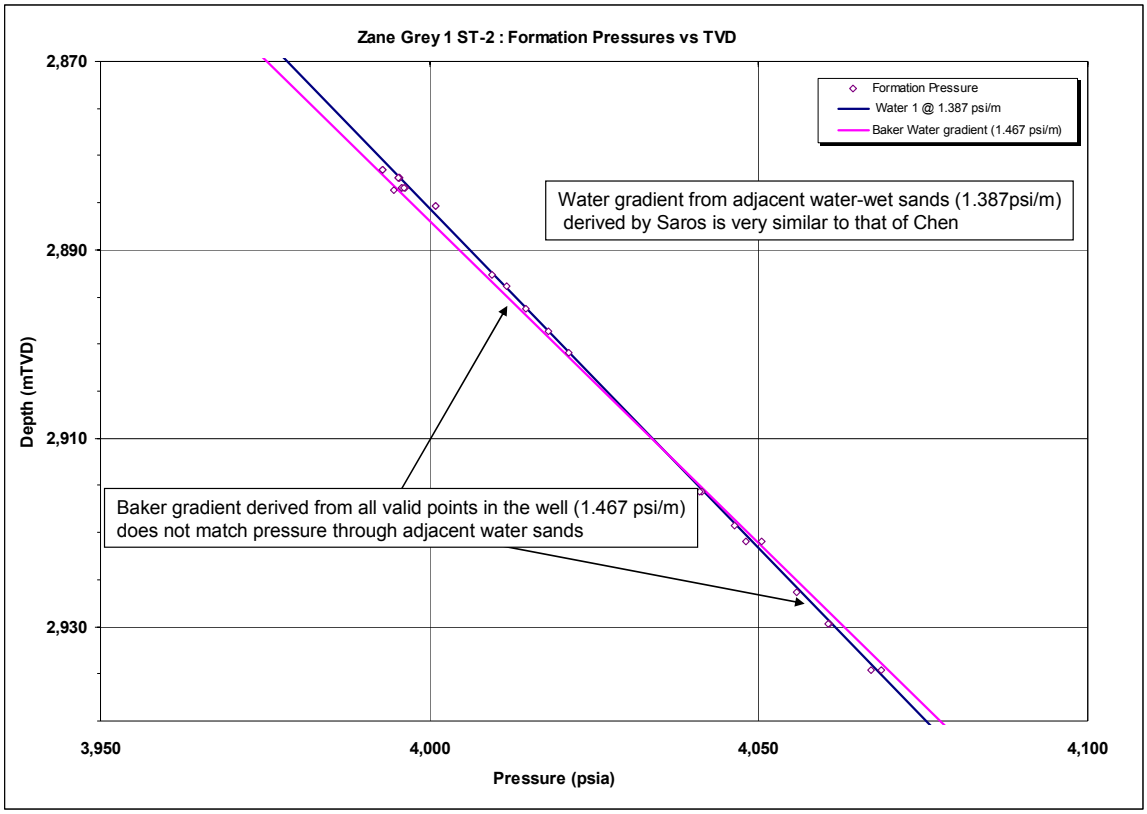


Figure 12. Comparison of interpreted water gradients for ZG-1ST2.

DISCUSSION

Wireline log interpretation of ZG-1ST2 over the target interval indicated the potential presence of a thin hydrocarbon column (1.3 – 2.5 m) within the upper portion of the target interval from 3305.7 – 3308 mKB (2880 – 2882 mTVD). Average porosity in this interval is 17%, and average water saturation is interpreted to be between 53 and 63% (depending on the resistivity device used). Elevated gas chromatograph readings were recorded across this interval, while no fluorescence was observed.

Based on the results from the initial wireline log analysis, RCI pressure data was acquired through adjacent water sands and through the target interval, and light hydrocarbons were successfully recovered using RCI sampling within the upper portion of the target interval at a measured depth of 3307 mKB.

There is no data to determine if the in-situ fluids are fully saturated or not, however PVT compositional simulation indicates that the saturation point of the fluid is very close to the existing reservoir pressure. This data is supportive, but not in itself proof of a down dip oil leg.

The absence of a definable hydrocarbon pressure gradient from RCI pressure data, in combination with the thin pay zone identified from log analysis supports the theory that ZG-1ST2 has intersected the very base of a rich gas-condensate accumulation, with a gas-water contact very close to 3307 mKB (or 2882 mTVD). Depth uncertainty should be considered, however from the RCI data, the LKG (sample #16) is at 2881.5 mTVD, whilst the most likely HKW (from attempted sample #21 – but no recovery made) is 2883.4 mTVD. Wireline log interpretation indicates possible net pay down to 2882 mTVD.

Based on the available data, a gas-condensate hydrocarbon accumulation would seem to exist up-dip from the ZG-1ST2 intersection, and a well which intersected the reservoir higher up the same structure should produce hydrocarbons. There is no direct evidence to support hydrocarbons below the lowest net pay interpretation (2882 mTVD), and this LKG should be used as a base case to map out reserves.

Nannygai Play

Live ‘oil shows’ have been interpreted in an equivalent reservoir unit in the off-set Nannygai-1 well (Philips,1994). This interpretation was based on the analysis of oils shows and wireline logs. One possible interpretation is that the live oil shows observed in Nannygai-1 are the downdip oil leg of the wet-gas accumulation in ZG-ST2.

While it is possible that the live oil shows interpreted in Nannygai-1 do represent a downdip oil leg to this reservoir, it is considered unlikely given the available data. Given that the reservoir in Nannygai-1 is some 30 m downdip from the ZG-1ST2 intersection, the target sand would have to be under-pressured in order to show the pressures observed in ZG-1ST2. Also a 30m hydrocarbon column (if present) should have provided enough buoyancy to give higher oil saturations than those observed in ZG-1ST2. This interpretation also seems to contradict the in-direct evidence of water from the failed RCI sampling attempts.

REFERENCES

Baker Atlas (2005) - RCI Formation Pressure Test Validation and Analysis. *Internal unpublished report for Bass Strait Oil Company Ltd.*

Chen, A. (2005) – ZaneGrey RCI Data Analysis. *Internal unpublished report to Bass Strait Oil Company Ltd.*

Phillips, J. (1994) – G91AK Kingfish 3D Seismic Survey Area – Summary Package. *Unpublished Esso report.*

PAY SUMMARY RESULTS

The following table summarises the reservoir and hydrocarbon in place estimations made as a result of this analysis (using lateralog resistivity).

Pay Summary Specification: ql_zanegrey
Primary reference for reporting and sample control: DEPTH
Cutoff details:-

PHIE	**>= .1 V/V**
SWT	**<= .65 V/V**
VSH	**<= .4 V/V**

Lumping details:-

Standalone Minimum Thickness:	**0.25 METRES**
Include Minimum Thickness:	**0.25 METRES**
Maximum Separation:	**0.25 METRES**

Well	Interval	DEPTH_TOP	DEPTH_BASE	GROSS	NET	NET_TO_GROSS	PHITH	BVWH	HVOLH	KINTH	PHIT_AV	SWT_AV	SWE_AM	PHIE_AM	KINT_AM	VSH_AM
		METRES	METRES	METRES	METRES	M/M	(V/V)M	(V/V)M	(V/V)M	MDM	V/V	V/V	V/V	V/V	MD	V/V
ZANEGREY-1_ST2	MAIN ZONE U	3302.300	3313.100	10.800	1.295	0.120	0.230	0.144	0.086	134.582	0.178	0.626	0.614	0.172	103.908	0.071
ZANEGREY-1_ST2	MAIN ZONE L	3318.100	3329.100	11.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
ZANEGREY-1_ST2	LOWER ZONE	3340.000	3375.900	35.900	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
ZANEGREY-1_ST2	-	3302.300	3375.900	57.700	1.295	0.022	0.230	0.144	0.086	134.582	0.178	0.626	0.614	0.172	103.908	0.071

Pay Summary Specification: ql_zanegrey
Primary reference for reporting and sample control: DEPTH
Cutoff details:-

PHIE	**>= .1 V/V**
VSH	**<= .4 V/V**

Lumping details:-

Standalone Minimum Thickness:	**0.25 METRES**
Include Minimum Thickness:	**0.25 METRES**
Maximum Separation:	**0.25 METRES**

Well	Interval	DEPTH_TOP	DEPTH_BASE	GROSS	NET	NET_TO_GROSS	PHITH	KINTH	PHIT_AV	PHIE_AM	KINT_AM	VSH_AM
		METRES	METRES	METRES	METRES	M/M	(V/V)M	MDM	V/V	V/V	MD	V/V
ZANEGREY-1_ST2	MAIN ZONE U	3302.300	3313.100	10.800	8.170	0.756	1.388	-	0.170	0.160	87.050	0.117
ZANEGREY-1_ST2	MAIN ZONE L	3318.100	3329.100	11.000	10.342	0.940	1.845	845.357	0.178	0.168	81.743	0.121
ZANEGREY-1_ST2	LOWER ZONE	3340.000	3375.900	35.900	32.978	0.919	5.466	2317.300	0.166	0.156	70.268	0.113
ZANEGREY-1_ST2	-	3302.300	3375.900	57.700	51.489	0.892	8.700	3865.164	0.169	0.159	75.213	0.115

The following table summarises the hydrocarbon in place estimations made as a result of this analysis (using LWD induction resistivity).

Cutoff details:-

PHIE	**>= .1 V/V**
SWT	**<= .65 V/V**
VSH	**<= .4 V/V**

Lumping details:-

Standalone Minimum Thickness:	**0.25 METRES**
Include Minimum Thickness:	**0.25 METRES**
Maximum Separation:	**0.25 METRES**

Well	Interval	DEPTH_TOP	DEPTH_BASE	GROSS	NET	NET_TO_GROSS	PHITH	BVWH	HVOLH	KINTH	PHIT_AV	SWT_AV	SWE_AM	PHIE_AM	KINT_AM	VSH_AM
		METRES	METRES	METRES	METRES	M/M	(V/V)M	(V/V)M	(V/V)M	MDM	V/V	V/V	V/V	V/V	MD	V/V
ZANEGREY-1_ST2	MAIN ZONE U	3302.300	3313.100	10.800	2.491	0.231	0.424	0.223	0.200	171.167	0.170	0.527	0.499	0.160	68.720	0.114
ZANEGREY-1_ST2	MAIN ZONE L	3318.100	3329.100	11.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
ZANEGREY-1_ST2	LOWER ZONE	3340.000	3375.900	35.900	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
ZANEGREY-1_ST2	-	3302.300	3375.900	57.700	2.491	0.043	0.424	0.223	0.200	171.167	0.170	0.527	0.499	0.160	68.720	0.114

APPENDIX 1 INTERPRETATION PARAMETERS REPORT

Analysis Parameters for ZANEGREY-1_ST2

Summary of Analysis Parameters for the GURNARD FM interval

RHO shale:	2.60	(g/cc)
NPHI shale:	0.318	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	2.0	
N:	2.0	
Rw:	0.20	(ohm.m) @ 25.0 (degC)

Summary of Analysis Parameters for the KINGFISH FM interval

RHO shale:	2.52	(g/cc)
NPHI shale:	0.296	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	1.8	
N:	2.0	
Rw:	0.20	(ohm.m) @ 25.0 (degC)

Summary of Analysis Parameters for the KINGFISH FM COALS interval

---

RHO shale:	2.52	(g/cc)
NPHI shale:	0.296	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	1.8	
N:	2.0	
Rw:	0.55	(ohm.m) @ 25.0 (degC)

Summary of Analysis Parameters for the KATE SH interval

RHO shale:	2.58	(g/cc)
NPHI shale:	0.253	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	1.8	
N:	2.0	
Rw:	0.55	(ohm.m) @ 25.0 (degC)

Summary of Analysis Parameters for the ROUNDHEAD MB interval

GR matrix:	-	(GAPI)
GR shale:	-	(GAPI)
DT matrix:	-	(us/ft)
DT shale:	-	(us/ft)
RHO shale:	2.58	(g/cc)
NPHI shale:	0.253	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	1.8	
N:	2.0	
Rw:	0.55	(ohm.m) @ 25.0 (degC)

Summary of Analysis Parameters for the VOLADOR FM interval

GR matrix:	-	(GAPI)
GR shale:	-	(GAPI)
DT matrix:	-	(us/ft)
DT shale:	-	(us/ft)
RHO shale:	2.58	(g/cc)
NPHI shale:	0.253	(v/v)
RT shale:	-	(ohm.m)
A:	1.0	
M:	2.0	
N:	2.0	
Rw:	0.45	(ohm.m) @ 25.0 (degC)

ENCLOSURE 1: COMPOSITE SUMMARY DEPTH PLOT (1:500)

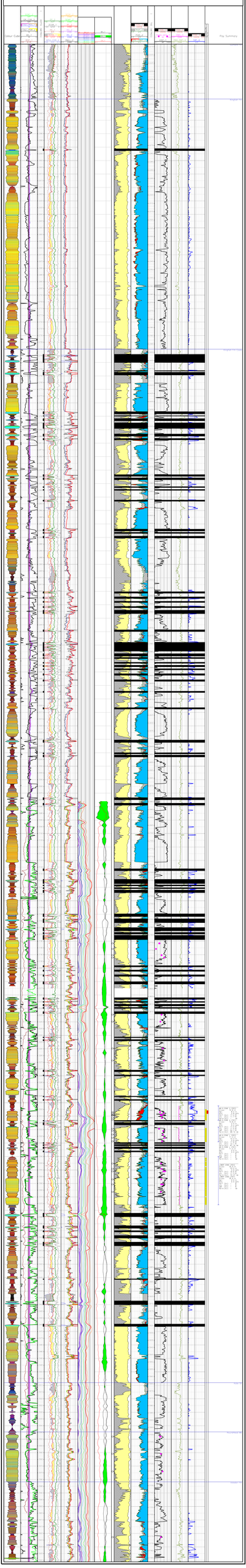
Petrophysics

Well: ZANEGREY-1ST2

COMPANY: BASS STRAIT OIL COMPANY LTD
LOCATION: Gippsland Basin
LATITUDE: 38 34' 31.64" S
LONGITUDE: 147 59' 16.27" E
HORIZONTAL UNITS: METRES
DATE PLOTTED: 06-Jul-2005

DATUM FOR ELEVATION: MSL
WATER DEPTH: 72.5 m
MEASUREMENT REF.: R.T.
ELEVATION MEAS. REF.: 21.50
DRILLED DEPTH: 3675.00
VERTICAL UNITS: METRES
DATE LOGGED: 11-MAR-2005

VERTICAL SCALE: 1:500



APPENDIX 3

Palynology Report

By Dr Alan Partridge

INTERPRETATIVE DATA
Palynological analysis of Zane Grey-1, offshore Gippsland Basin.

by

Alan D. Partridge

Biostrata Pty Ltd
A.B.N. 39 053 800 945

Biostrata Report 2005/16A

5th August 2005

INTERPRETATIVE DATA

Palynological analysis of Zane Grey-1, offshore Gippsland Basin.

by Alan D. Partridge

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INTERPRETATIVE DATA

Palynological analysis of Zane Grey-1, offshore Gippsland Basin.

by Alan D. Partridge

Summary

Palynological analyses have been performed on fifteen cuttings samples between 2515 and 3670mMD in the deviated Zane Grey-1 well. Three samples are from the Gurnard Formation at the top of the Latrobe Group and of these the middle sample at 2525-30mMD contained a Late Eocene Middle *Nothofagidites asperus* Zone assemblage. The remaining twelve sample are from the bottom 380 metres (3290 to 3770mMD) penetrated in the well, and these contained Early Paleocene to Late Maastrichtian age assemblages assigned respectively to the Lower *Lygistepollenites balmei* and Upper *Forcipites longus* zones. This latter interval covers the uppermost Volador Formation, Kate Shale and basal Kingfish Formation. Results of the analyses are given in Tables 1 and 2 below:

Table 1. Stratigraphic and Palynological Summary of Zane Grey–1

AGE	STRATIGRAPHY	SPORE-POLLEN ZONES	DEPTHS (MDKB)
Recent to Late Oligocene	**SEASPRAY GROUP** Undifferentiated Seafloor to 2513.3mMD	Not analysed by palynology	
Middle to Late Eocene	**LATROBE GROUP** **Cobia Subgroup** Gurnard Formation 2513.3 to 2554.4mMD	Middle *Nothofagidites asperus* Zone	2525-30mMD
Early Eocene to Paleocene	**Halibut Subgroup** Kingfish Formation 2554.4 to 3508.1mMD	Lower *Lygistepollenites balmei* Zone	3290 to 3445mMD
basal Paleocene	Kate Shale 3508.1 to 3546.7mMD	Lower *Lygistepollenites balmei* Zone	3510 to 3545mMD
latest Maastrichtian	Volador Formation 3546.7 to 3675mTDMD	Upper *Forcipites longus* Zone	3590 to 3670mMD

Introduction

Fifteen cuttings samples have been analysed from the Zane Grey-1 well drilled by the Bass Strait Oil Company Ltd in permit VIC/P42 located in the central offshore Gippsland Basin. The samples cover a ~40 mMD (Measured Depth) interval at the top of the Latrobe Group, and a ~380 mMD thick interval at the bottom of the well. The ~735 mMD thick section between these two suite of samples was not analysed by palynology. All samples have been processed in the palynological laboratory facilities of Core Laboratories Australia Pty Ltd in Perth. An initial suite of palynological slides were received on 26th May 2005, but as a consequence of the low palynomorph concentration on the slides all the samples with remaining organic residue were requested to be re-oxidised, and the additional slides prepared were received on 8th June 2005. The results of the microscope analysis were provided in Provisional Report No. 1 issued on 24th June 2005.

Processing Methods and Basic Analyses

The samples were selected and submitted directly to Core Laboratories Australia Pty Ltd by Robert Fisher, so consequently the lithologies of the samples were neither inspected nor recorded by the author. In the processing procedures it was requested that all the samples be oxidised prior to the application of zinc bromide density separation used to remove any undissolved mineral matter. This modified procedure was preferred because it removes most of the finely disseminated pyrite that typically impregnate the palynomorphs recovered from the Gippsland Basin, and therefore can substantially improve both the quantity of organic residue recovered and the concentration of palynomorphs on the slides.

Basic sample data comprising the weights of sample processed, the visual organic residues yields, the concentration and preservation of the palynomorphs observed on the slides, and the number of species of spore-pollen (SP) and microplankton (MP) recorded from individual samples are all provided in Table 3. The visual yield from the samples varies from negligible to high, but unfortunately the concentration of palynomorph on the slides was typically only low to very low, while the palynomorph preservation was consistently poor. The recorded spore-pollen diversity varies from very low to moderate, whereas the recorded microplankton diversity is low to very low.

The final zones and ages assigned to the samples, zone confidence ratings, and zone identification criteria for each of the samples are summarised on Table 2. The distribution of the palynomorphs identified in the samples are displayed on the accompanying StrataBugs™ range chart. Author citations for most of the recorded spore-pollen species can be sourced from papers by Stover & Partridge (1973, 1982) and Macphail (1999), while the author citations for the microplankton species can be sourced from the indexes for dinocysts and other organic-walled microplankton prepared by Fensome *et al.* (1990) and Williams *et al.* (1998). Manuscript species names and combinations are indicated by “sp. nov.” or “comb. nov.” on the range chart, and “ms” after their binomials names in the text and tables.

Geological Discussion.

In the following section the palynological results are integrated with the electric logs displayed on the range chart to subdivide the section analysed in Zane Grey-1 into the stratigraphic units shown on Table 1. The nomenclature used primarily follows the revisions of Partridge (1999), which has been published in outline by Bernecker & Partridge (2001; Appendix).

Latrobe Group: The Zane Grey-1 well is located in the Central Deep of the offshore Gippsland Basin where the Latrobe Group is represented by a thin section of the Cobia Subgroup, which all belongs to the Gurnard Formation, overlying a thick section of the Halibut Subgroup, comprising in descending order a complete section of the Kingfish Formation, a thin Kate Shale and the uppermost part of the Volador Formation.

Gurnard Formation: Three samples were analysed from this ~40mMD thick formation, but only the middle sample at 2525-30mMD gave a datable assemblage. The dominance of *Nothofagidites* pollen (39%) in the quantitative count confirms assignment to the broad *Nothofagidites asperus* Zone of Middle Eocene to Early Oligocene age, while the presence of the index species *Triorites magnificus* indicates that the Late Eocene Middle subzone is present in the interval. It is highly likely however that the latter species may be slightly caved as the Middle *N. asperus* Zone is generally very thin within the Gurnard Formation from this central part of the basin. For example it is <10 metres thick in the Swordfish-1 and Kingfish-7 wells, where the zones are more accurately delineated because of the dense sidewall cores sampling (Partridge, 1999).

Kingfish Formation: The next five productive samples between 3290 and 3445mMD are from the bottom quarter of the ~950 mMD thick Kingfish Formation. The assemblages recovered all belong to the Lower *Lygistepollenites balmei* Zone and can be characterised by the common occurrence of the probably aquatic herb *Australopollis obscurus*. Together with the presence of rare marine and brackish microplankton this association suggests mixed swampy and paralic environments on the lower coastal plain as recently described by Bernecker & Partridge (2005). This interpretation is supported by the sonic log which displays the common presence of thin coals through the interval.

Kate Shale: Three productive sample between 3510 and 3545mMD are from the ~39mMD thick Kate Shale. These samples are all assigned to the Lower *Lygistepollenites balmei* Zone, as the thin interval of Upper *Forcipites longus* Zone known to occur at the base of the formation unfortunately could not be identified in the cuttings assemblages. Microplankton were also poorly represented in the samples, with only the shallowest sample at 3510-15mMD containing a significant abundance of poorly preserved dinocysts which are assigned, albeit with the very low confidence, to the *Trithyrodinium evittii* Acme Zone. The thickness of the unit encountered in Zane Grey-1 is compatible with the isopach of the Kate Shale mapped by Bernecker & Partridge (2005; fig.11).

Volador Formation: The bottom ~130mMD of section penetrated in Zane Grey-1 is referred to the Volador Formation and is documented by the deepest three samples which all are considered to belong to the Upper *Forcipites longus* Zone, even though the key zone criteria were not found in all samples. The assemblages show an increase in the abundance of the pollen of *Proteacidites* species, and lower abundances of gymnosperm pollen compared to the overlying Lower *L. balmei* Zone assemblages. Microplankton are very rare in the assemblages and are probably not *in situ*.

Biostratigraphy.

The samples analysed in Zane Grey–1 are classified according to the spore-pollen zonation scheme original described by Stover & Evans (1974) and Stover & Partridge (1973, 1982), and more recently updated and refined by Partridge (1999). Those samples which contain diagnostic marine dinocyst assemblages are also classified according to the parallel microplankton scheme originally proposed in outline by Partridge (1975, 1976), and subsequently substantially refined and modified by Partridge (1999). A recent published summary of both these zonation schemes can also be found in the latest edition of the *Geology of Victoria* (Partridge & Dettmann, 2003).

Middle *Nothofagidites asperus* spore-pollen Zone
Cuttings at: 2525-30 metresMD
Age: Late Eocene

Three samples were processed between 2515 and 2555mMD from the top of the Latrobe Group, but only the middle sample contained a datable assemblage, characterised by the abundant occurrence of *Nothofagidites* pollen (39% of SP count), and the oldest or first appearance of *Nothofagidites falcatus*. Both these features confirm an age no older than the Lower *N. asperus* Zone, while a single, poorly preserved, specimen of *Triorites magnificus* indicates an age no younger than the Middle *N. asperus* Zone. Supporting the latter zone assignment is the presence of a single broken specimen of the dinocyst *Schematophora speciosus*, while identification of a possible endocyst of *Deflandrea heterophlycta* would favour the older subzone. The remainder of the microplankton assemblage is dominated by the dinocysts *Spiniferites* spp. and *Operculodinium centrocarpum* (representing >65% of MP count) and is interpreted to be mainly caved from the younger Seaspray Group. Although the number of key index species recorded is limited the assemblage overall is consistent with assignment of the interval to the Gurnard Formation.

Lower *Lygistepollenites balmei* spore-pollen Zone
Interval: 3290 to 3545 metresMD
Age: Early Paleocene

Samples within the interval are assigned to the broad *L. balmei* Zone based on the consistent presence of the eponymous species *Lygistepollenites balmei* (in 8 out of 9 samples and average abundance of ~2%), and the somewhat less consistent presence of the accessory index species *Australopollis obscurus* (6 of 9 samples and average abundance of 5%), and *Gambierina rudata* and *G. edwardsii* (5 of 9 samples and average abundance of <1%). Restriction of the interval to the Lower *L. balmei* subzone is based on the youngest occurrence of *Proteacidites angulatus* at 3290-3300mMD, and the older occurrences of *Polycolpites langstonii* and *Tricolpites phillipsii* at 3540-45mMD. A further two-fold subdivision of the interval is recognised based on the youngest consistent occurrence of *Tetracolporites verrucosus* at 3440-45mMD, and the prominent occurrence of *Australopollis obscurus* over the interval 3290 to 3350mMD, where it has an average abundance of ~11%. The latter species has been shown to have an affinity with the extant aquatic herb family Callitrichaceae by Macphail & Partridge (1991), and is considered to be a important indicator species for the coaly lower coastal plain deposition facies in the Gippsland Basin during the Paleocene.

Overall the assemblages are dominated by the bisaccate gymnosperm pollen *Podocarpidites* spp. (average 26%) and *Phyllocladidites mawsonii* (average 18%), with *Proteacidites* spp. (average 13%) the most common angiosperm pollen category. Total spores average 19% with *Cyathidites* spp. and *Stereisporites antiquasporites* the most common types.

Microplankton have an average background abundance of about 2% throughout the interval, and can mostly be distributed between obvious caved species (from the Seaspray Group) and long ranging species that are not zone diagnostic. The only exceptions are the ~19% abundance of very poorly preserved marine dinocysts at 3510-15mMD, and the ~9% abundance of a monospecific assemblage of the colonial algae *Amosopollis cruciformis* at 3440-50mMD. The deeper sample at 3510-15mMD is assigned, albeit with very low confidence to the ***Trithyrodinium evittii* Acme** microplankton zone based on tentative identification of very poorly preserved specimens of the eponymous species. This sample is also interpreted to represent part of the marine deposition environments of the transgressive Kate Shale (Bernecker & Partridge, 2001, 2005). The assemblage from the shallower sample at 3440-50mMD, in contrast, has no age significance and is interpreted to represent a fresh to brackish water deposition environment, such as a coastal lagoon on the lower coastal plain.

Upper *Forcipites longus* spore-pollen Zone
Interval: 3590 to 3670 metresMD
Age: Late Maastrichtian

The three deepest cuttings samples are assigned to the broad *F. longus* Zone based on the youngest occurrences of *Proteacidites reticuloconcavus* ms and *P. clinei* ms at 3590-95mMD and the oldest occurrence of *Tetracolporites verrucosus* at 3660-70mMD. Other index species are limited but include *Nothofagidites senectus* and *Tricolpites confessus* at 3630-40m. The occurrence of common *Gambierina rudata* (8%) in the middle sample at 3630-40mMD also favours assignment of the interval to the Upper *F. longus* subzone, even though there was nothing definitive to identify this subzone in the other two samples.

The assemblages can broadly be distinguished from those through the overlying Lower *L. balmei* Zone, by an increase in the abundance of spores and angiosperm pollen and corresponding decline in the abundance of gymnosperm pollen. Most conspicuous is increased abundance of *Proteacidites*

spp. (average 18%) and the trisaccate gymnosperm pollen *Trichotomosulcites subgranulatus* (average ~6%), and the decline in abundance of *Phyllocladidites mawsonii* (average 13%).

Microplankton are rare in the samples (average abundance of <1%) and consist of a mixture of caved and long-ranging species which are neither zone nor age diagnostic. Because of their rarity and the possibility of contamination they are not considered to have any environmental significance.

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Table 2: Interpretative assemblage data for Zane Grey-1, Gippsland Basin.

Sample Type	Depth mMD	Spore-Pollen Zones (Microplankton Zones)	CR*	Comments and Key Species Present
Cuttings	2515–20m	Indeterminate		Essentially BARREN with <20 palynomorphs on two slides.
Cuttings	2525–30m	Middle *N. asperus* Zone	D3	MP ~30% but mostly caved. Zone assignment based on FADs of abundant *Nothofagidites* pollen (39%), and index pollen *Triorites magnificus*.
Cuttings	2550–55m	Indeterminate		Essentially BARREN with two slides prepare containing only two palynomorphs.
Cuttings	3290–3300m	Lower *L. balmei* Zone	D2	MP <1% probably all caved. Zone assignment based on LAD of *Proteacidites angulatus* in assemblage containing common *Australopollis obscurus* (15%).
†Cuttings	3300–10m	Lower *L. balmei* Zone	D2	MP ~2% probably all *in situ*. *Proteacidites angulatus* present, *Australopollis obscurus* common (12%).
†Cuttings	3330–40m	Lower *L. balmei* Zone	D3	MP ~5% mostly caved. *Proteacidites angulatus* present, *Australopollis obscurus* frequent (6%).
†Cuttings	3340–50m	*L. balmei* Zone	D4	MP ~2% mostly *in situ*. *Australopollis obscurus* common (~12%), *Lygistepollenites balmei* frequent (~4%).
Cuttings	3440–45m	Lower *L. balmei* Zone	D2	MP 9% comprising monotypic assemblage of *Amosopollis cruciformis*. Assemblage contains FAD of *Proteacidites angulatus* and LAD of *Tetracolporites verrucosus* in well.
†Cuttings	3505–10m	Indeterminate		Very lean assemblage with <20 identifiable specimens per slide, without any diagnostic Paleocene species recorded.
†Cuttings	3510–15m	Lower *L. balmei* Zone (*T. evittii* Acme)	D4 D5	MP ~19%, mostly indeterminate peridinium dinocysts, but including probable *Trithyrodinium evittii.*
†Cuttings	3525–30m	*L. balmei* Zone	D2	No *in situ* MP recorded in lean assemblage with <30 specimens per slide. Zone assignment based on frequent *Lygistepollenites balmei* (3%) and common *Phyllocladidites mawsonii* (~20%).
†Cuttings	3540–45m	Lower *L. balmei* Zone	D2	MP ~5% but not diagnostic. Zone assigned on FADs of *Polycolpites langstonii* and *Tricolpites phillipsii* plus incoming of abundant *Phyllocladidites mawsonii* (~50%).
†Cuttings	3590–95m	Upper *F. longus* Zone by superposition	D3	MP <2% but not diagnostic. Zone assignment based on LADs of *Proteacidites reticuloconcavus* ms and *P. clinei* ms in assemblage with abundant *Proteacidites* spp. (>30%).
†Cuttings	3630–40m	Upper *F. longus* Zone	D2	No *in situ* MP recorded in lean assemblage with <30 specimens per slide. Upper subzone assignment based on common *Gambierina rudata* (8%).
†Cuttings	3660–70m	*F. longus* Zone	D4	No MP recorded in very lean recovery with <20 specimens per slide. No older than broad zone based on FAD of *Tetracolporites verrucosus.*

†Cuttings samples given second oxidation

FAD & LAD = First and Last Appearance Datums.
MP = Abbreviation for Microplankton.

*Confidence Ratings used in STRATDAT database and applied to Table 2.

Alpha codes: Linked to sample		**Numeric codes:** Linked to fossil assemblage		
A	Core	**1**	**Excellent confidence:**	High diversity assemblage recorded with key zone species.
B	Sidewall core	**2**	**Good confidence:**	Moderately diverse assemblage with key zone species.
C	Coal cuttings	**3**	**Fair confidence:**	Low diversity assemblage recorded with key zone species.
D	Ditch cuttings	**4**	**Poor confidence:**	Moderate to high diversity assemblage without key zone species.
E	Junk basket	**5**	**Very low confidence:**	Low diversity assemblage without key zone species.

Description of Range Chart.

The distribution of the palynomorphs identified in the samples are displayed on the accompanying StrataBugs™ range chart which displays the recorded palynomorph species in the samples proportional to their depth in the well and in terms of their relative abundance (as a percentage). The palynomorphs recorded are split between different categories. The terrestrial spore and pollen are divided between spores, gymnosperm pollen and angiosperm pollen, which are plotted in separate panels. This is followed by a panel showing the total count of marine and non-marine microplankton as a percentage relative to the combined spore-pollen and microplankton count. Next the percentage abundance of individual species in the microplankton count (again relative to the combined spore-pollen and microplankton count) is displayed in panel labelled Microplankton. Then plotted are Other Palynomorphs, with abundances expressed as a percentage of sum of the total Spore-Pollen plus Other Palynomorphs counted. Because all the samples are cuttings the species are plotted within the panels according to their shallowest or youngest occurrences.

The following codes or abbreviations apply to the individual species occurrences and abundances on the range chart:

Numbers	=	Absolute abundance or number of specimens counted
+	=	Species outside of count
C	=	Caved species
R	=	Reworked species
?	=	Questionable identification of species.

Table 3: Basic sample and assemblage data for Zane Grey-1, Gippsland Basin.

Sample Type	Depth metres	Weight grams	Visual Yield	Palynomorph Concentration	Preservation	No. SP Species	No. MP Species
Cuttings	2515-20	19.4	Very low	Very low	Poor	6+	(1+)
Cuttings	2525-30	16.7	Low	Moderate	Poor	33+ (1+)	2+ (8+)
Cuttings	2550-55	18.6	Negligible	Very low	Poor	2+	
Cuttings	3290-3300	20.0	High	Low	Very poor	20+	(1+)
†Cuttings	3300-10	19.2	High	Low	Very poor	24+	2+
†Cuttings	3330-40	21.2	Moderate	Very low	Very poor	17+	2+ (3+)
†Cuttings	3340-50	21.3	Low	Low	Poor	27+	2+ (1+)
Cuttings	3440-45	19.5	Moderate	Low	Poor	22+	1+ (2+)
†Cuttings	3505-10	19.9	Low	Very low	Poor	13+	(4+)
†Cuttings	3510-15	20.4	Moderate	Low	Poor	25+	5+
†Cuttings	3525-30	18.6	Moderate	Low	Very poor	24+	(1+)
†Cuttings	3540-45	19.7	Low	Low	Poor	18+	2+ (1+)
†Cuttings	3590-95	18.9	Low	Very low	Very poor	24+	(3+)
†Cuttings	3630-40	20.2	Low	Very low	Very poor	25+	(1+)
†Cuttings	3660-70	20.0	Moderate	Very low	Poor	17+	
	Average:	19.6			Averages:	19.9	2.8

† Cuttings samples given second oxidation and extra slides prepared.

MP = Microplankton

SP = Spore-Pollen

Numbers in brackets in two right-hand columns refer to species which are caved or contaminants.

APPENDIX

Palynological slides prepared and analysed from Zane Grey-1

No.	Sample Type	Depth Metres MD	Museum Victoria Catalogue Number	Core Lab Prep. No.	Description
1	Cuttings	2515-20	P218600	1276	Oxidised slide 1: 1/2 cover slip
2	Cuttings	2515-20	P218601	1276	Oxidised slide 2: 1/2 cover slip
3	Cuttings	2525-30	P218602	1277	Oxidised slide 1: 1/2 cover slip
4	Cuttings	2525-30	P218603	1277	Oxidised slide 2: 1/2 cover slip
5	Cuttings	2550-55	P218604	1278	Oxidised slide 1: 1/2 cover slip
6	Cuttings	2550-55	P218605	1278	Oxidised slide 2: 1/2 cover slip
7	Cuttings	3290-3300	P218606	1287	Oxidised slide 1:
8	Cuttings	3290-3300	P218607	1287	Oxidised slide 2:
9	Cuttings	3290-3300	P218608	1287	Oxidised slide 3:
10	Cuttings	3290-3300	P218609	1287	Oxidised slide 4: Second oxidation
11	Cuttings	3290-3300	P218610	1287	Oxidised slide 5: Second oxidation
12	Cuttings	3300-10	P218611	1288	Oxidised slide 1:
13	Cuttings	3300-10	P218612	1288	Oxidised slide 2:
14	Cuttings	3300-10	P218613	1288	Oxidised slide 3:
15	Cuttings	3300-10	P218614	1288	Oxidised slide 4: Second oxidation
16	Cuttings	3300-10	P218615	1288	Oxidised slide 5: Second oxidation
17	Cuttings	3330-40	P218616	1289	Oxidised slide 1:
18	Cuttings	3330-40	P218617	1289	Oxidised slide 2:
19	Cuttings	3330-40	P218618	1289	Oxidised slide 3:
20	Cuttings	3330-40	P218619	1289	Oxidised slide 4: Second oxidation
21	Cuttings	3330-40	P218620	1289	Oxidised slide 5: Second oxidation
22	Cuttings	3340-50	P218621	1290	Oxidised slide 1:
23	Cuttings	3340-50	P218622	1290	Oxidised slide 2:
24	Cuttings	3340-50	P218623	1290	Oxidised slide 3:
25	Cuttings	3340-50	P218624	1290	Oxidised slide 4: Second oxidation
26	Cuttings	3340-50	P218625	1290	Oxidised slide 5: Second oxidation
27	Cuttings	3440-45	P218626	1279	Oxidised slide 1:
28	Cuttings	3440-45	P218627	1279	Oxidised slide 2:
29	Cuttings	3440-45	P218628	1279	Oxidised slide 3:
30	Cuttings	3505-3510	P218629	1280	Oxidised slide 1:
31	Cuttings	3505-3510	P218630	1280	Oxidised slide 2:
32	Cuttings	3505-3510	P218631	1280	Oxidised slide 3:
33	Cuttings	3505-3510	P218632	1280	Oxidised slide 4: Second oxidation
34	Cuttings	3505-3510	P218633	1280	Oxidised slide 5: Second oxidation
35	Cuttings	3510-15	P218634	1281	Oxidised slide 1:
36	Cuttings	3510-15	P218635	1281	Oxidised slide 2:
37	Cuttings	3510-15	P218636	1281	Oxidised slide 3:
38	Cuttings	3510-15	P218637	1281	Oxidised slide 4: Second oxidation
39	Cuttings	3510-15	P218638	1281	Oxidised slide 5: Second oxidation
40	Cuttings	3525-30	P218639	1282	Oxidised slide 1:
41	Cuttings	3525-30	P218640	1282	Oxidised slide 2:
42	Cuttings	3525-30	P218641	1282	Oxidised slide 3:
43	Cuttings	3525-30	P218642	1282	Oxidised slide 4: Second oxidation
44	Cuttings	3540-3545	P218643	1283	Oxidised slide 1:
45	Cuttings	3540-3545	P218644	1283	Oxidised slide 2:
46	Cuttings	3540-3545	P218645	1283	Oxidised slide 3:
47	Cuttings	3540-3545	P218646	1283	Oxidised slide 4: Second oxidation
48	Cuttings	3590-95	P218647	1284	Oxidised slide 1:
49	Cuttings	3590-95	P218648	1284	Oxidised slide 2:
50	Cuttings	3590-95	P218649	1284	Oxidised slide 3:
51	Cuttings	3590-95	P218650	1284	Oxidised slide 4: Second oxidation
52	Cuttings	3590-95	P218651	1284	Oxidised slide 5: Second oxidation
53	Cuttings	3630-40	P218652	1285	Oxidised slide 1:
54	Cuttings	3630-40	P218653	1285	Oxidised slide 2:
55	Cuttings	3630-40	P218654	1285	Oxidised slide 3:
56	Cuttings	3630-40	P218655	1285	Oxidised slide 4: Second oxidation
57	Cuttings	3630-40	P218656	1285	Oxidised slide 5: Second oxidation
58	Cuttings	3660-70	P218657	1286	Oxidised slide 1:
59	Cuttings	3660-70	P218658	1286	Oxidised slide 2:
60	Cuttings	3660-70	P218659	1286	Oxidised slide 3:
61	Cuttings	3660-70	P218660	1286	Oxidised slide 4: Second oxidation
62	Cuttings	3660-70	P218661	1286	Oxidised slide 5: Second oxidation

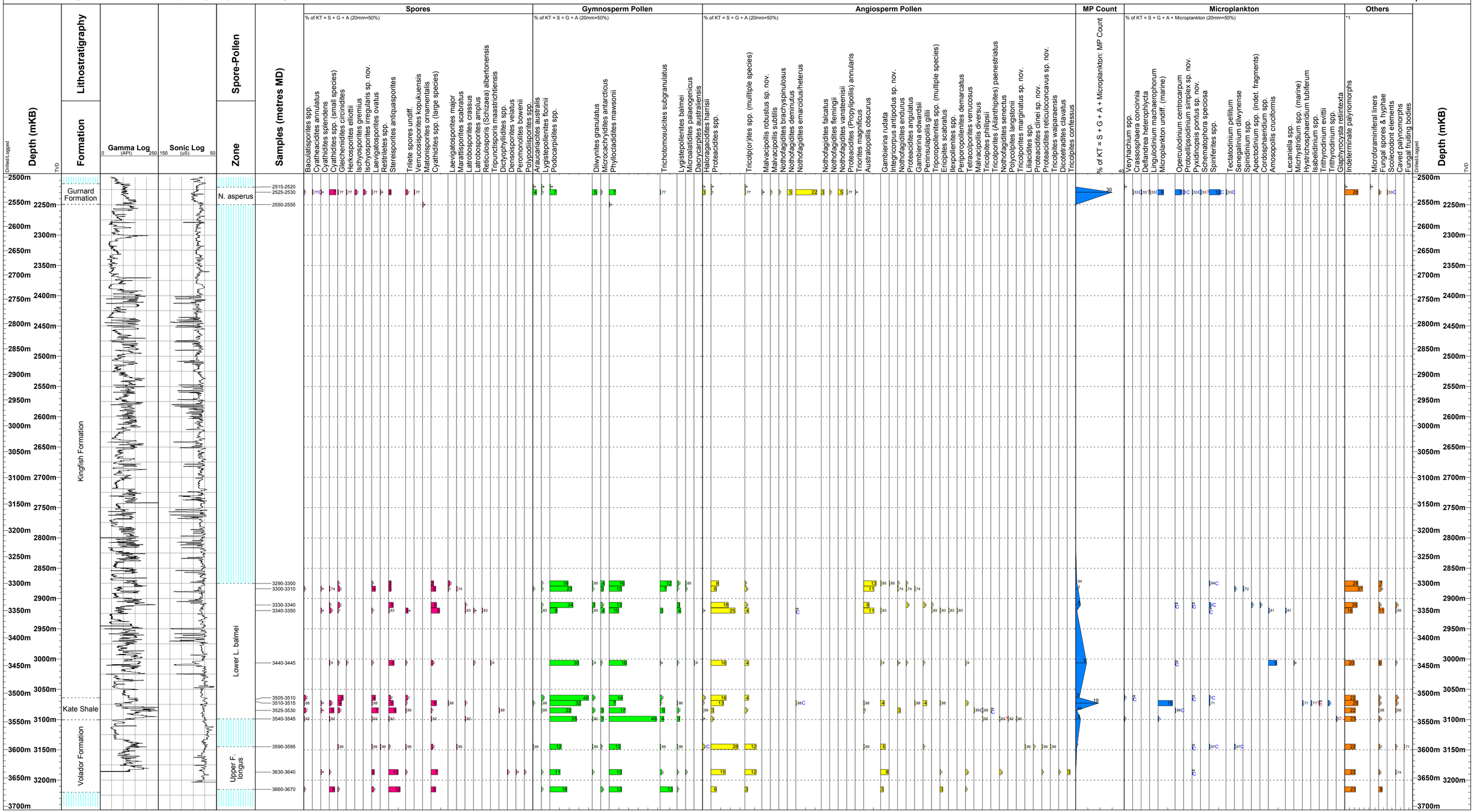
Well Name : Zane Grey-1

Operator : Bass Strait Oil Pty Ltd — Spudded : 29 January 2005
Well Code : ZANEGREY-1 — Completed : 18 March 2005
Lat/Long : 38°34' 31.64"S 147°59' 16.27"E
Interval : 2500m - 3700m — Palynomorph Range Chart displayed in TVD
Scale : 1:4000 — Sample interval 2515 to 3670mMD
Chart date: 05 August 2005 — Microscope analysis by Alan D. Partridge

Zane Grey-1

Biostrata Pty Ltd
AUSTRALIA

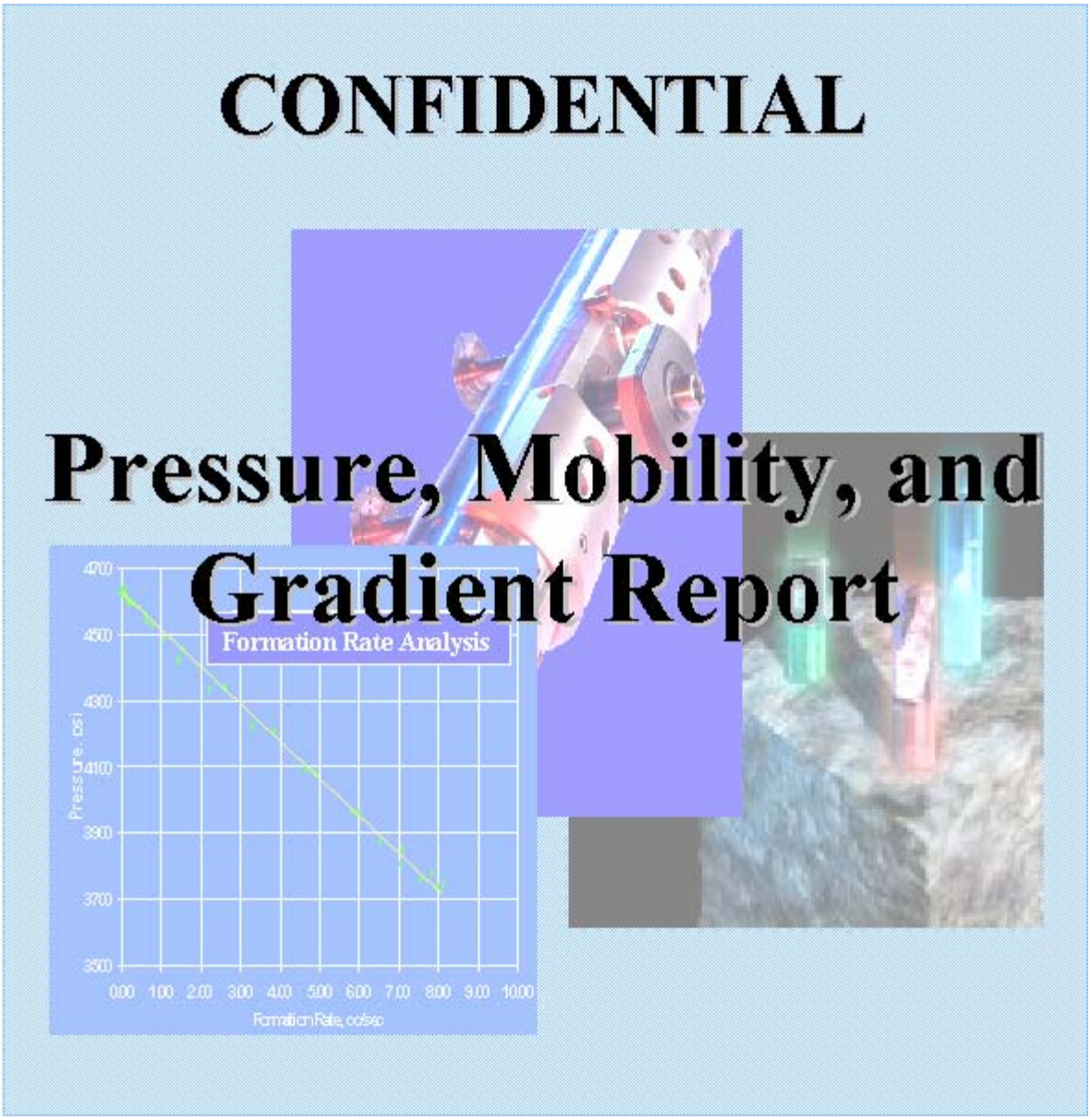
Biostrata Report 2005/16A



APPENDIX 4

RCI ANALYSIS: Pressure, Mobility and Gradient Report for Well ZaneGrey-1/ST1/ST2

By BakerAtlas GeoScience



RCI Formation Pressure Test Validation and Analysis
for Well ZANE GREY-1/ST1/ST2
BASS STRAIT OIL COMPANY LIMITED.

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1. Introduction

This report presents the results from the RCI Formation Pressure Test Validation and Analysis. This report is a combined result of Flow Rate Analysis (FRA) and Pressure Transient Analysis (PTA) for the exploration well ZANE GREY-1/ST1/ST2. The pressure transient data was obtained from this well using the Reservoir Characterization Instrument (RCI) on 14th March 2005. A total of 55 pressure tests were performed in this well between 3179.6m and 3622.8m MD. A total of 34 tests were actually used for interpretation.

This study was conducted in order to QC the final build-up pressure obtained from the RCI tool. A total of 55 tests, including the sample points, were examined closely for this particular well. The RCI pressure points reported from the field did not provide any clear fluid gradients and hence the need for this study which aims to validate final build-up pressure and then use these valid pressure points to plot fluid gradients. This study applies the Flow Rate Analysis (FRA) and Pressure Transient Analysis (PTA) techniques as powerful tools to examine the quality of final build-up pressure, mobility, and compressibility and to validate formation pressure at each test depth. This study also aims to evaluate the reason for scattering of final build-up pressure.

This report was prepared with Wireline Formation Test Analyser (WFTA) software. This software is based on the Flow Rate Analysis (FRA) method that simultaneously computes extrapolated pressure, mobility, and compressibility. Combining drawdown and buildup pressure with simultaneous calculation tests the data for self-consistency, which in turn confirms that a pressure response is driven by the formation.The degree of confidence is indicated by the correlation coefficient. Formation pressure is measured by a quartz pressure gauge located in the packer section of a Reservoir Characterization Instrument (RCI). A second quartz gauge measures fluid pressure in the drawdown section and will alternate between suction and discharge when the drawdown section is used to pump. Pressure measurements are corrected for temperature as measured by a separate quartz sensor in each gauge. Quartz gauges are calibrated to a pressure standard that is traceable to the U.S. National Institute of Standards and Technology (NIST) in the USA and thereby are traceable to international standards. Dielectric response of fluid in the instrument is measured in the packer section while volume displacement and fluid temperature are measured in the drawdown section. All measurements are recorded at each depth throughout testing.

The results are shown in Section 6 (Summary of Formation Rate Analysis and Pressure Transient Analysis). For each test depth, the FRA plot was prepared with Wireline Formation Test Analyzer (WFTA^{SM}) software. The plot of pressure versus formation rate was analysed. If the FRA plot indicates a good straight line then this test can be verified as FRA compliant. This means that the tool communicates with the formation and the measured final build-up pressure represents formation pressure. In other words, the flow in porous media follows Darcy's Law. There are only 23 pressure tests that are FRA compliant. Those pressure tests are i800g09_2, i800g10_2, i800g11_1, i800g11_2, i800g11_3, ig80012_1, i800g12_2, i800g13_1, i800g13_2, i800g14_1, i800g16_2, i800g17_3, i800g17_4, i800g18_2, i800g18_3, i800g19_2, i800g21_1, i800g25_1, i800g26_1, i800g28_1, i800g30_1, i800g31_2 and i800g32_1. For the ZANE GREY-1/ST1/ST2 well, it was found that the remaining 32 tests were classified as low permeability to tight formation. After the FRA technique was used to verify the final build-up pressure, then the Pressure Transient Analysis (PTA) was used to examine the pressure response and pressure derivative in detail. The use of the PTA technique helps to obtain more accurate estimates of spherical permeability and also obtains more reservoir parameters, i.e. formation pressure, tool compressibility, skin factor, tool storage and radius of investigation.

Pressure Transient Analysis (PTA) uses an extension to advanced well testing techniques in order to match the pressure data from wireline formation testers. The PTA software, Interpret 2003, was used to analyse the pressure transient tests. The Flow Rate Analysis (FRA) technique was added in this software in order to initially estimate reservoir parameters. The detailed explanation of both PTA and FRA theories are stated in Sections 7 and 8.

This report consists of 9 sections. Section 2 shows an Executive Summary of the results. Section 3 shows Fluid Gradients obtained from the RCI field plot (i.e. the field measurement). Section 4 provides Recommendations for Future Tests. Section 5 indicates input parameters used in PTA Analysis. Section 6 shows all Formation Rate Analysis and Pressure Transient Analysis Results. Sections 7 and 8 explain the principle and theory for both PTA and FRA analysis techniques. Section 9 shows Examples of FRA Plots indicating Types of Problems in RCI Pressure Tests.

2. Executive Summary

Table 1 shows the validation from FRA analysis obtained from WFTA software. The theory and equations used in the FRA technique are shown in Section 8. If a straight-line is obtained from the plot of Formation Rate vs. Pressure, the particular test will be identified as "FRA Compliant". In this particular well, most tests were identified as "NOT FRA Compliant" because non-straight lines are observed in those FRA plots. The reason for this is that most pressure points were tested in low permeability or tight zones. The FRA plots show the distinct "hook shape" indicating the low permeability to tight reservoir. For tests that are NOT FRA Compliant the piston rate is higher than the formation rate. Even though the slowest rate was used to conduct these tests, the piston rate still cannot match with the formation rate due to the very slow movement of fluid from the formation.

Figure 2 shows an example of the FRA plot in the case of supercharging effect. The FRA shows a distinct straight line with a steep slope at zero formation rate. In the ZANE GREY-1/ST1/ST2 well, pressure tests i800g17_1, i800g17_2, i800g17_3, i800g18_1, i800g18_2, and i800g36_1 indicate a supercharging effect as shown by the FRA plot shown in Figure 1 (This compares against FRA Analysis Results shown in Section 6 for these RCI pressure tests).

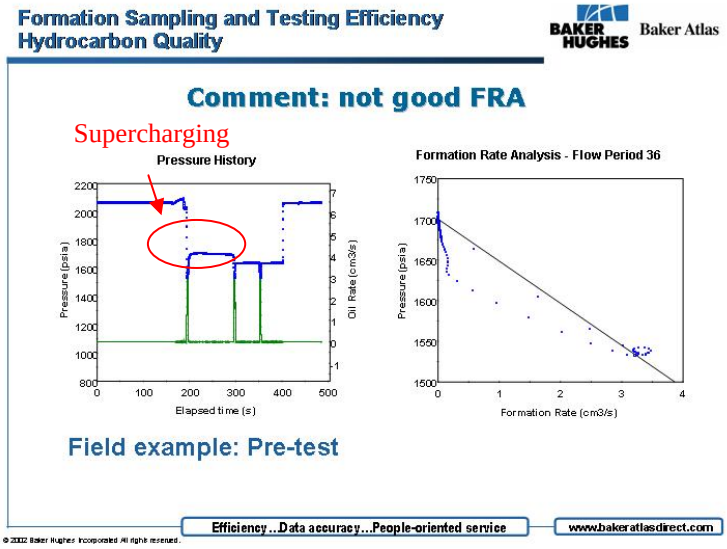


Figure 1 Shows the pressure history plot in the left hand side. The final build-up pressure of the pre-test is significantly higher than the repeated test when supercharging effects occur in the wellbore.

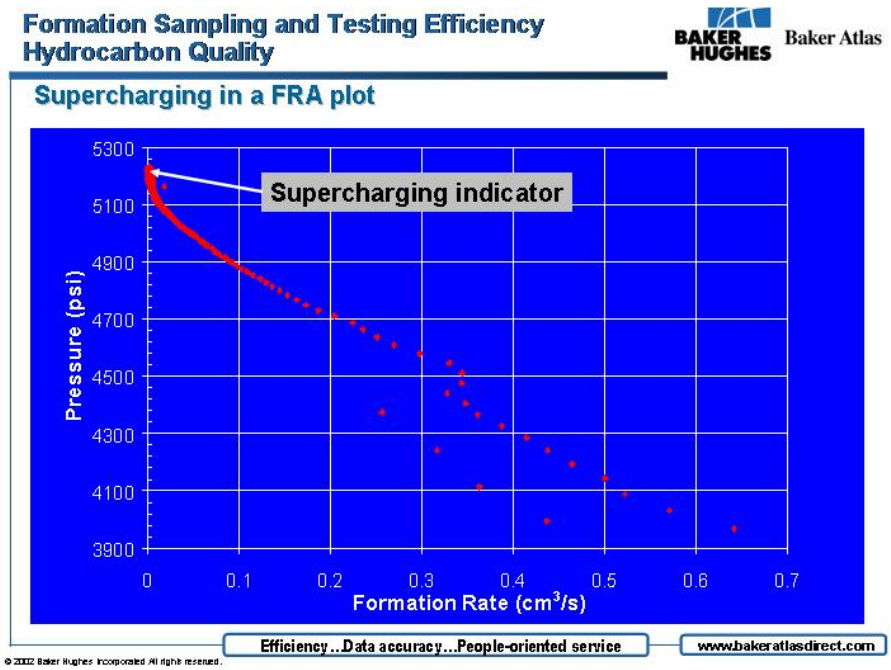


Figure 2 Shows the FRA plot of the test with supercharging effect. The supercharging can be identified by the change in slope at zero formation rate. The slope gets steeper at the left hand side of this plot.

In the pre-test, pressure drops from hydrostatic to the flowing pressure. For the repeated test, pressure drops from the last build-up pressure to second flowing pressure, as shown in Figure 3. Even though the field engineer tried to decrease the piston rate in the repeated test, as shown by the green points, the flowing pressure in the repeated test is still lower than in the case of pre-test, as shown in the blue points, and therefore, the repeated test takes longer to reach the formation pressure. In all pressure tests, the final build-up pressure of the pretest was found to be higher than the repeated test. The final build-up pressure of the repeated test has not stabilized or reached the formation pressure.

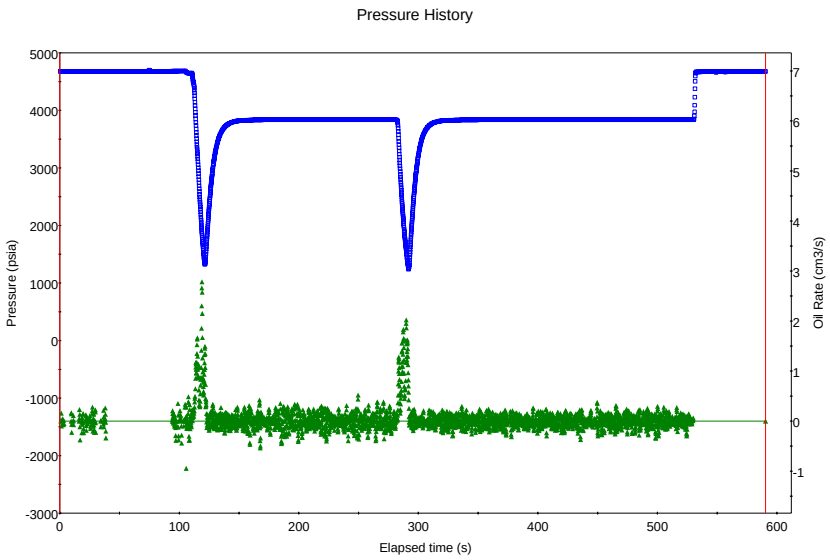


Figure 3 The pressure history of file no i800g06 at 3185.8 m-TVD. The flowing bottomhole pressure of the repeated is lower than the pre-test, and therefore pressure takes longer to reach the formation pressure.

Formation Rate Analysis (FRA) was used to validate pressure points, and the results show that only 23 pressure points were validated as FRA compliant. Those pressure tests are i800g09_2, i800g10_2, i800g11_1, i800g11_2, i800g11_3, ig80012_1, i800g12_2, i800g13_1, i800g13_2, i800g14_1, i800g16_2, i800g17_3, i800g17_4, i800g18_2, i800g18_3, i800g19_2, i800g21_1, i800g25_1, i800g26_1, i800g28_1, i800g30_1, i800g31_2 and i800g32_1. This means that the flow communicates with the formation and the flow in porous media follows Darcy's Law.

After the FRA method was used to validate pressure points, the final build-up pressure was examined in detail. The Pressure Transient Analysis (PTA) software, Interpret 2003, was used for this purpose. Another main objective of using the pressure transient analysis technique is to estimate the spherical permeability using the same principle as advanced well test analysis techniques. A spherical flow regime is identified when a negative half slope is identified from pressure derivatives. Such tests are highlighted in yellow (when the flow is fully developed) and the estimated spherical permeability represents the true formation spherical permeability. Three tests indicating this spherical flow are i800g05_2, i800g26_1, and i800g28_1.

However, when the spherical flow does not fully develop, the estimated spherical permeability is just that i.e., an estimation. In this particular well, since the test zones are low permeability to tight formations, the spherical flow cannot be seen in pressure derivatives. The diagnostic negative half slope was placed at the location close to the late time pressure derivative data. As a result, the estimated spherical flow means a minimum spherical permeability. Most tests in this well fall into this category (see The Pressure Transient Analysis (PTA) Results as shown in Table 2).

Please note that for this analysis, since the mud viscosity was not known, a viscosity of 1 cp was assumed for the PTA Analysis, as shown in Section 4. If the actual mud viscosity is known, it can be input in the analysis for more accurate estimation of spherical permeability.

In addition, another objective of using the PTA technique is to obtain more reservoir parameters, i.e. system compressibility, probe skin, tool storage and radius of investigation. The Summary of the PTA Analysis Results is shown in Table 2.

Using the pressure transient analysis technique; pressure response and pressure derivative plots were examined in detail. The results show that even though only three pressure tests indicate spherical flow regime, there are another eight pressure tests indicating slightly higher permeability (not tight formation). These pressure tests are: i800g09_2, i800g10_2, i800g11_3, i800g13_2, i800g16_2, i800g17_4, i800g19_2, and i800g25_1. These pressure points were included when the fluid gradient was evaluated (the detailed discussion of pressure gradient determination is shown in Section 3). Table 1 shows the FRA validation in terms of fluid gradient and the mobility calculation.

Table 1 Summary of Results obtained from FRA Validation Analysis

FL NO	MEAS. DEPTH (m)	TVD DEPTH (m)	RCI Log Summary									FRA Validation		
			PUMPED VOLUME (cm3)	SNDFCE PRESS. (psi)	FLOWING PRESS. (psi)	FINAL BLDUP (psi)	HYDRO BEFORE (psi)	HYDRO AFTER (psi)	FRA MOB. (mD/cp)	CHAMBER	REMARKS	FRA Compliance	Validation for Fluid gradient plot	Validation for mobility calculation
04_1	3179.6	2768.8	0.0	0.0	0.0	0.0	4665.7	4665.1	175.5	D	TIGHT, 111.2C	Not FRA Compliant	No	No
05_1	3181.6	2770.7	10.0	3829.7	3443.6	3829.7	4669.9	4669.3	13.0	D	GOOD, 113.4C	Not FRA Compliant	No	No
05_2	3181.6	2770.7	10.0	3829.7	3435.7	3829.7	4669.9	4669.3	15.8	D	REPEAT	Not FRA Compliant	Yes (Spherical Flow)	Yes (Spherical Flow)
06_1	3185.8	2774.3	10.4	3837.2	1307.9	3837.1	4676.0	4675.8	2.2	D	GOOD, 114.2C	Not FRA Compliant	No	No
06_2	3185.8	2774.3	9.8	3836.6	1231.6	3836.6	4676.0	4675.8	1.7	D	REPEAT	Not FRA Compliant	No	No
07_1	3185.7	2774.3	10.6	3836.8	1332.7	3836.8	4677.5	4676.7	1.8	D	SAMPLE CANCELLED	Not FRA Compliant	No	No
09_1	3190.4	2778.3	10.2	3840.4	3751.0	3840.4	4678.6	4672.9	73.9	D	GOOD, 117.9C	Not FRA Compliant	No	No
09_2	3190.4	2778.3	9.6	3840.3	3745.9	3840.3	4678.6	4672.9	59.1	D	REPEAT	FRA Compliant	Yes	Yes
10_1	3192.2	2779.9	9.2	3843.0	3829.7	3843.0	4674.4	4674.8	413.2	D	GOOD, 118.3C	Not FRA Compliant	No	No
10_2	3192.2	2779.9	10.2	3843.1	3812.9	3843.1	4674.4	4674.8	388.2	D	REPEAT	FRA Compliant	Yes	Yes
11_1	3234.6	2817.2	11.0	3899.1	3590.2	3899.1	4747.3	4741.4	65.3	D	GOOD, 120.4C	FRA Compliant	Yes	No
11_2	3234.6	2817.2	10.6	3896.9	3604.1	3896.9	4747.3	4741.4	59.6	D	REPEAT	FRA Compliant	Yes	No
11_3	3234.6	2817.2	10.5	3897.0	3619.2	3897.0	4747.3	4741.4	58.2	D	REPEAT 2	FRA Compliant	Yes	Yes
12_1	3239.8	2821.8	11.2	3903.3	3355.4	3903.3	4750.8	4747.9	33.1	D	GOOD, 121.0C	FRA Compliant	Yes	No
12_2	3239.8	2821.8	11.0	3903.3	3319.5	3903.3	4750.8	4747.9	29.9	D	REPEAT	FRA Compliant	Yes	No
13_1	3259.7	2839.4	10.6	3930.4	3802.1	3930.4	4795.6	4780.2	143.2	D	GOOD, 121.5C	FRA Compliant	Yes	No
13_2	3259.7	2839.4	10.3	3929.7	3807.7	3929.7	4795.6	4780.2	133.3	D	REPEAT	FRA Compliant	Yes	Yes
14_1	3268.7	2847.4	10.9	3940.7	3893.2	3940.7	4798.8	4793.3	369.1	D	GOOD, 122.0C	FRA Compliant	Yes	No
16_1	3307.0	2881.5	11.1	3992.9	3295.3	3992.9	4827.9	4848.5	200.0	D	SAMPLE, 125.8C	Not FRA Compliant	No	No
16_2	3307.0	2881.5	10.9	3992.9	3267.0	3992.9	4827.9	4848.5	49.4	D	REPEAT	FRA Compliant	Yes	Yes
17_1	3307.9	2882.3	10.2	3995.5	3938.1	3995.4	4847.9	4847.9	250.3	D	GOOD, 125.7C	Not FRA Compliant	No	No
17_2	3307.9	2882.3	10.2	3995.5	3938.1	3995.4	4847.9	4847.9	250.3	D	REPEAT	Not FRA Compliant	No	No
17_3	3307.9	2882.3	10.3	3995.3	3937.8	3995.3	4847.9	4847.9	258.1	D	REPEAT 2	FRA Compliant	Yes	No
17_4	3307.9	2882.3	10.3	3995.3	3937.8	3995.3	4847.9	4847.9	258.1	D	REPEAT 3	FRA Compliant	Yes	Yes
18_1	3309.1	2883.4	20.1	3996.3	3832.2	3996.3	4846.1	4855.4	71.3	D	GOOD, 125.5C	Not FRA Compliant	No	No
18_2	3309.1	2883.4	10.1	3995.8	3793.9	3995.8	4864.1	4855.4	67.4	D	REPEAT	FRA Compliant	Yes	No
18_3	3309.1	2883.4	10.1	3995.8	3793.9	3995.8	4864.1	4855.4	67.4	D	REPEAT 2	FRA Compliant	Yes	No
19_1	3311.4	2885.4	20.1	4000.9	3798.5	4000.9	4856.9	4857.2	51.5	D	NO SAMPLE, 127.3C	Not FRA Compliant	No	No
19_2	3311.4	2885.4	20.1	4000.9	3798.5	4000.9	4856.9	4857.2	51.5	D	NO SAMPLE, 127.3C	FRA Compliant	Yes	Yes
20_1	3309.4	2883.7	19.7	3994.6	3580.1	3994.6	4857.3	4855.1	21.0	D	GOOD, 129.1C	Not FRA Compliant	No	No

Table 1 Summary of Results obtained from FRA Validation Analysis

FL NO	MEAS. DEPTH (m)	TVD DEPTH (m)	RCI Log Summary									FRA Validation		
			PUMPED VOLUME (cm3)	SNDFCE PRESS. (psi)	FLOWING PRESS. (psi)	FINAL BLDUP (psi)	HYDRO BEFORE (psi)	HYDRO AFTER (psi)	FRA MOB. (mD/cp)	CHAMBER	REMARKS	FRA Compliance	Validation for Fluid gradient plot	Validation for mobility calculation
21_1	3309.2	2883.4	19.9	3996.2	3589.8	3996.2	4857.4	4856.4	23.0	D	NO SAMPLE, 129.1C	FRA Compliant	Yes	No
22_1	3312.8	2886.7	0.0	0.0	0.0	0.0	4866.3	4861.4	62.3	D	TIGHT, 129.2C	Not FRA Compliant	No	No
22_2	3312.8	2886.7	0.0	0.0	0.0	0.0	4866.3	4861.4	62.3	D	TIGHT, 129.2C	Not FRA Compliant	No	No
24_1	3319.4	2892.6	19.7	4009.4	3498.7	4009.4	4874.6	4871.3	13.7	D	GOOD, 127.3C	Not FRA Compliant	No	No
25_1	3321.0	2893.9	20.0	4011.7	3881.6	4011.7	4882.5	4874.0	225.6	D	GOOD, 127.1C	FRA Compliant	Yes	Yes
26_1	3323.7	2896.3	20.6	4014.7	3798.2	4014.7	4880.6	4875.8	148.3	D	GOOD, 126.9C	FRA Compliant	Yes	Yes
27_1	3326.1	2898.6	20.5	4018.0	3943.7	4018.0	4883.6	4879.7	489.1	D	GOOD, 126.8C	Not FRA Compliant	No	No
28_1	3328.7	2900.9	22.5	4021.1	3657.7	4021.1	4888.8	4882.7	77.6	D	GOOD, 126.6C	FRA Compliant	Yes	Yes
29_1	3345.2	2915.7	19.8	4041.3	3447.7	4041.3	4910.6	4904.8	7.4	D	GOOD, 126.2C	Not FRA Compliant	No	No
29_2	3345.2	2915.7	11.2	4041.0	3418.8	4041.0	4910.6	4904.8	4.1	D	REPEAT	Not FRA Compliant	No	No
30_1	3349.2	2919.3	20.0	4046.4	3617.6	4046.4	4913.7	4911.3	30.7	D	GOOD, 126.1C	FRA Compliant	Yes	No
31_1	3351.0	2920.9	19.9	4050.5	3924.2	4050.5	4921.6	4914.4	181.5	D	GOOD, 126.0C	Not FRA Compliant	No	No
31_2	3351.0	2920.9	5.8	4048.1	3941.7	4048.1	4921.6	4914.4	257.3	D	REPEAT	FRA Compliant	Yes	No
32_1	3357.0	2926.3	19.5	4055.8	3562.3	4055.8	4930.6	4925.3	21.2	D	GOOD, 126.2C	FRA Compliant	Yes	No
33_1	3360.7	2929.7	20.2	4060.8	3515.5	4060.8	4936.9	4929.5	14.5	D	GOOD, 126.2C	Not FRA Compliant	No	No
33_2	3360.7	2929.7	6.3	4060.5	3703.6	4060.5	4936.9	4929.5	11.7	D	REPEAT	Not FRA Compliant	No	No
34_1	3366.3	2934.6	20.5	4068.6	3436.8	4068.6	4937.8	4935.2	14.2	D	GOOD, 126.3C	Not FRA Compliant	No	No
34_2	3366.3	2934.6	4.8	4067.1	3711.8	4067.1	4937.8	4935.2	10.0	D	REPEAT	Not FRA Compliant	No	No
36_1	3548.1	3101.5	20.2	4314.8	3284.7	4314.8	5236.5	5234.3	7.6	D	GOOD, 131.6C	Not FRA Compliant	No	No
36_2	3548.1	3101.5	5.3	4314.6	3858.0	4314.6	5236.5	5234.3	5.9	D	REPEAT	Not FRA Compliant	No	No
36_3	3548.1	3101.5	5.3	4314.6	3858.0	4314.6	5236.5	5234.3	5.9	D	REPEAT 2	Not FRA Compliant	No	No
36_4	3548.1	3101.5	5.3	4314.6	3858.0	4314.6	5236.5	5234.3	5.9	D	REPEAT 3	Not FRA Compliant	No	No
37_1	3560.9	3113.4	21.1	4342.5	3652.9	4342.4	5238.2	5247.5	16.7	D	GOOD, 132.6C	Not FRA Compliant	No	No
38_1	3574.0	3125.6	20.7	4345.0	4082.1	4345.0	5288.1	5282.8	82.1	D	GOOD, 132.8C	Not FRA Compliant	No	No
39_1	3622.8	3170.9	20.6	4436.4	3729.6	4436.3	5342.2	5343.6	15.2	D	GOOD, 134.2C	Not FRA Compliant	No	No

Table 2 Summary of Results obtained from PTA Analysis

FL NO	MEAS. DEPTH (m)	TVD DEPTH (m)	PTA Analysis								
			Analysis model	Porosity % ϕ	Formation Pressure psi pav(i)	Spherical Permeability mD k(xyz)	Tool Compressibility 1/psi c(sys)	Probe Skin S(p)	Tools Storage bbl/psi C	Radius of investigation ft ri	Comments
04_1	3179.6	2768.8	Spherical Flow	23.3							
05_1	3181.6	2770.7		25.1							
05_2	3181.6	2770.7	Spherical Flow	25.1	3829.698	30.2	8.64E-06	0.07	1.90E-08	6	Can see Spherical Flow
06_1	3185.8	2774.3		24.1							
06_2	3185.8	2774.3	Spherical Flow	24.1	3836.65	4.915	5.28E-06	11.54	1.16E-08	4	Unable to Identify Spherical Flow
07_1	3185.7	2774.3	Spherical Flow	23.7	3838.786	0.9537	5.29E-06	1.73	1.16E-08	2	Unable to Identify Spherical Flow
09_1	3190.4	2778.3		23.0							
09_2	3190.4	2778.3	Spherical Flow	23.0	3840.334	63.1	1.12E-05	0.37	2.46E-08	11	Can see Spherical Flow - Higher Permeability
10_1	3192.2	2779.9		23.6							
10_2	3192.2	2779.9	Spherical Flow	23.6	3843.077	388.2	4.90E-05	0.44	1.08E-07	27	Can see Spherical Flow - Higher Permeability
11_1	3234.6	2817.2		84.0							
11_2	3234.6	2817.2		84.0							
11_3	3234.6	2817.2	Spherical Flow	84.0	3896.996	58.82	8.12E-06	1.22	1.79E-08	17	Can see Spherical Flow - Higher Permeability
12_1	3239.8	2821.8		14.9							
12_2	3239.8	2821.8	Spherical Flow	14.9	3903.281	33.5	7.17E-06	1.38	1.58E-08	6	Cannot see Spherical Flow
13_1	3259.7	2839.4		11.4							
13_2	3259.7	2839.4	Spherical Flow	11.5	3929.692	148.3	1.94E-05	2.57	4.27E-08	22	Can see Spherical Flow - Higher Permeability
14_1	3268.7	2847.4	Spherical Flow	10.8	3940.728	388.9	1.11E-04	1.6	2.44E-07	46	Cannot see Spherical Flow
16_1	3307.0	2881.5		14.5							
16_2	3307.0	2881.5	Spherical Flow	14.5	3992.908	6.694	1.43E-06	0.05	3.15E-09	7	Can see Spherical Flow - Higher Permeability
17_1	3307.9	2882.3		20.1							Supercharged
17_2	3307.9	2882.3		20.1							Supercharged
17_3	3307.9	2882.3	Spherical Flow	20.1							Supercharged
17_4	3307.9	2882.3	Spherical Flow	20.1	3995.318	52.98	4.21E-05	-0.19	9.26E-08	9	Can see Spherical Flow - Higher Permeability
18_1	3309.1	2883.4		17.9							Supercharged
18_2	3309.1	2883.4	Spherical Flow	17.9							Supercharged
18_3	3309.1	2883.4	Spherical Flow	17.9	3995.766	47.62	7.27E-05	1.94	1.60E-07	7	Cannot see spherical flow
19_1	3311.4	2885.4	Spherical Flow	18.1							
19_2	3311.4	2885.4	Spherical Flow	18.1	4000.897	51.13	1.38E-04	1.56	3.04E-07	8	Can see Spherical Flow - Higher Permeability
20_1	3309.4	2883.7	Spherical Flow	20.0	3995.531	0.06332	3.55E-07	-0.98	7.81E-10	1	Cannot see Spherical Flow

Table 2 Summary of Results obtained from PTA Analysis

FL NO	MEAS. DEPTH (m)	TVD DEPTH (m)	PTA Analysis								
			Analysis model	Porosity % ϕ	Formation Pressure psi pav(i)	Spherical Permeability mD k(xyz)	Tool Compressibility 1/psi c(sys)	Probe Skin S(p)	Tools Storage bbl/psi C	Radius of investigation ft ri	Comments
21_1	3309.2	2883.4	Spherical Flow	18.6	3996.216	22.58	6.17E-05	1.25	1.36E-07	20	Unable to Identify Spherical Flow
22_1	3312.8	2886.7	Spherical Flow	19.7							
22_2	3312.8	2886.7	Spherical Flow	19.7							
24_1	3319.4	2892.6	Spherical Flow	11.3	4009.441	39.33	9.83E-05	7.44	2.16E-07	21	Unable to Identify Spherical Flow
25_1	3321.0	2893.9	Spherical Flow	19.4	4011.715	47.31	1.86E-06	2.3	4.09E-09	8	Can see Spherical Flow - Higher Permeability
26_1	3323.7	2896.3	Spherical Flow	18.4	4014.731	26.8	1.84E-05	-0.22	4.06E-08	5	Can see Spherical Flow
27_1	3326.1	2898.6	Spherical Flow	19.8	4017.98	411.7	8.69E-05	1.56	1.91E-07	18	Cannot see spherical flow
28_1	3328.7	2900.9	Spherical Flow	13.2	4021.078	12.62	3.27E-06	0.07	7.20E-09	5	Can see Spherical Flow
29_1	3345.2	2915.7		22.5							
29_2	3345.2	2915.7	Spherical Flow	22.5	4041.01	8.96	5.14E-05	7.37	1.13E-07	10	Unable to Identify Spherical Flow
30_1	3349.2	2919.3	Spherical Flow	21.7	4046.45	47.65	5.62E-05	1.99	1.24E-07	6	Unable to Identify Spherical Flow
31_1	3351.0	2920.9		21.2							
31_2	3351.0	2920.9	Spherical Flow	21.2	4048.064	295.7	4.08E-05	2.13	8.99E-08	18	Unable to Identify Spherical Flow
32_1	3357.0	2926.3	Spherical Flow	22.4	4055.901	2.272	4.32E-05	-0.77	9.51E-08	1	Unable to Identify Spherical Flow
33_1	3360.7	2929.7		21.4							
33_2	3360.7	2929.7	Spherical Flow	21.4	4060.647	3.041	4.71E-05	0.33	1.04E-07	4	Unable to Identify Spherical Flow
34_1	3366.3	2934.6		18.5							
34_2	3366.3	2934.6	Spherical Flow	18.5	4067.725	6.45E-01	3.92E-05	-0.35	8.63E-08	3	Unable to Identify Spherical Flow
36_1	3548.1	3101.5		16.9							Supercharged
36_2	3548.1	3101.5	Spherical Flow	16.9							
36_3	3548.1	3101.5	Spherical Flow	16.9							
36_4	3548.1	3101.5	Spherical Flow	16.9	4315.867	0.2995	3.15E-05	-0.66	6.94E-08	2	Unable to Identify Spherical Flow
37_1	3560.9	3113.4	Spherical Flow	15.7	4342.466	3.733	5.77E-05	-0.37	1.27E-07	3	Unable to Identify Spherical Flow
38_1	3574.0	3125.6	Spherical Flow	17.8	4346.308	34.43	1.63E-05	0.98	3.60E-08	10	Cannot see Spherical Flow
39_1	3622.8	3170.9	Spherical Flow	16.9	4437.604	0.4659	7.57E-05	-0.76	1.67E-07	2	Unable to Identify Spherical Flow

3. Formation Pressure vs. Depth

The fluid gradient for well ZANE GREY-1/ST1/ST2 was obtained from RCI field measurement. The results for the entire interval (2770.7m to 2934.6m-TVD) before pressure points are validated, are shown in Figure 4. These results show that the pressure points are not very scattered and a reasonable fluid gradient can be obtained.

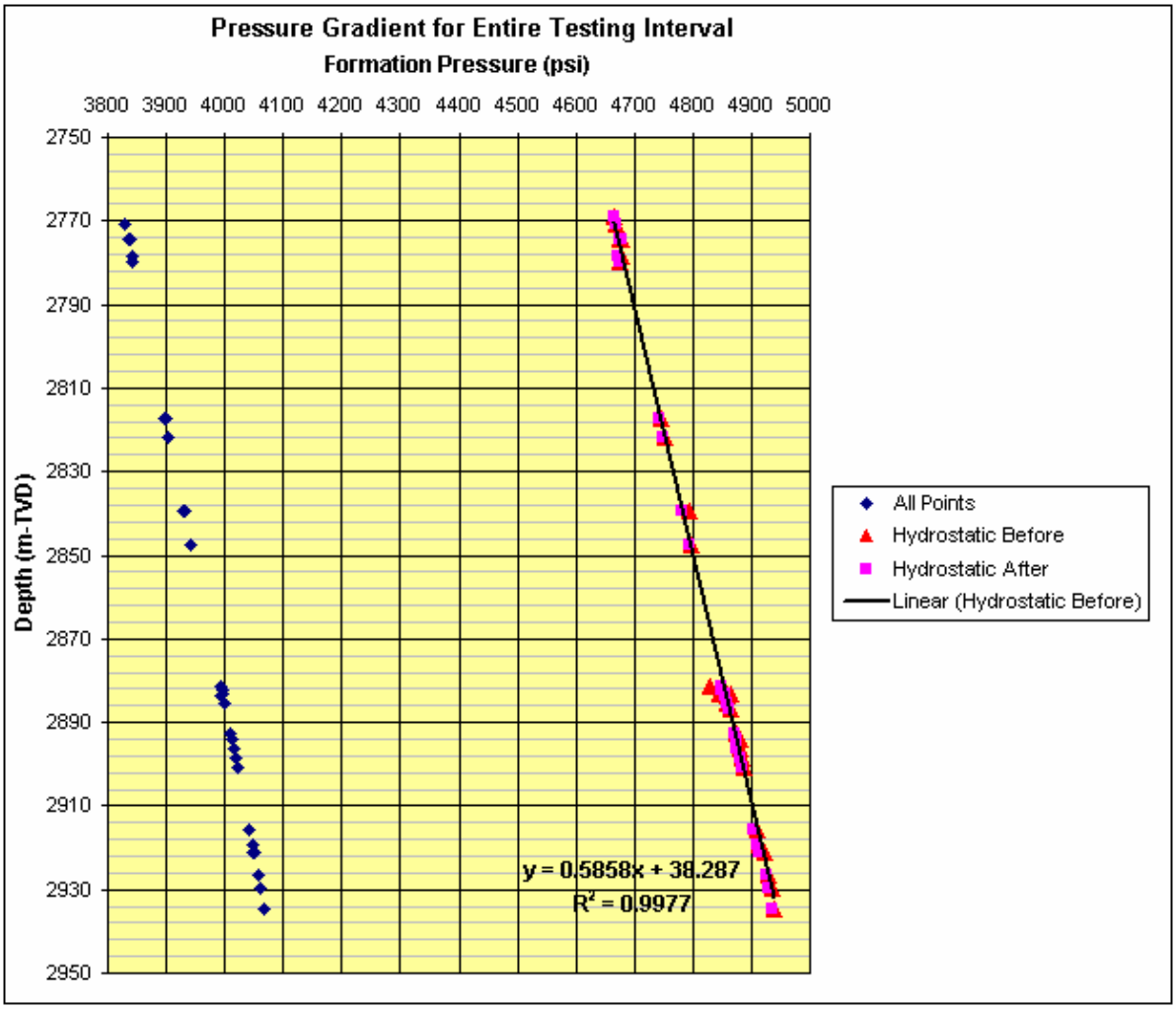


Figure 4 Pressure gradient obtained from RCI for the entire test interval before pressure points are validated

It is clear from Section 2 that the final build-up pressure of the pre-test is slightly higher than the final build-up pressure of the repeated test (as shown in Figure 5). The reservoir has low permeability and therefore tests with greater pressure drops take longer for pressure to stabilize. In most tests, the final build-up pressure of the pre-tests, were selected to plot the fluid gradient except pressure tests: i800g04_1, i800g20_1, i800g22_1 and i800g22_2, because the pre-test and/or repeated test of these files indicated an upward trend of stabilizing of the final build-up pressure compared to the pre-test. Figure 5 shows that the trend of fluid gradient is not much different when the pre-test or repeated test is used to plot fluid gradient (i.e. pressure data not very scattered).

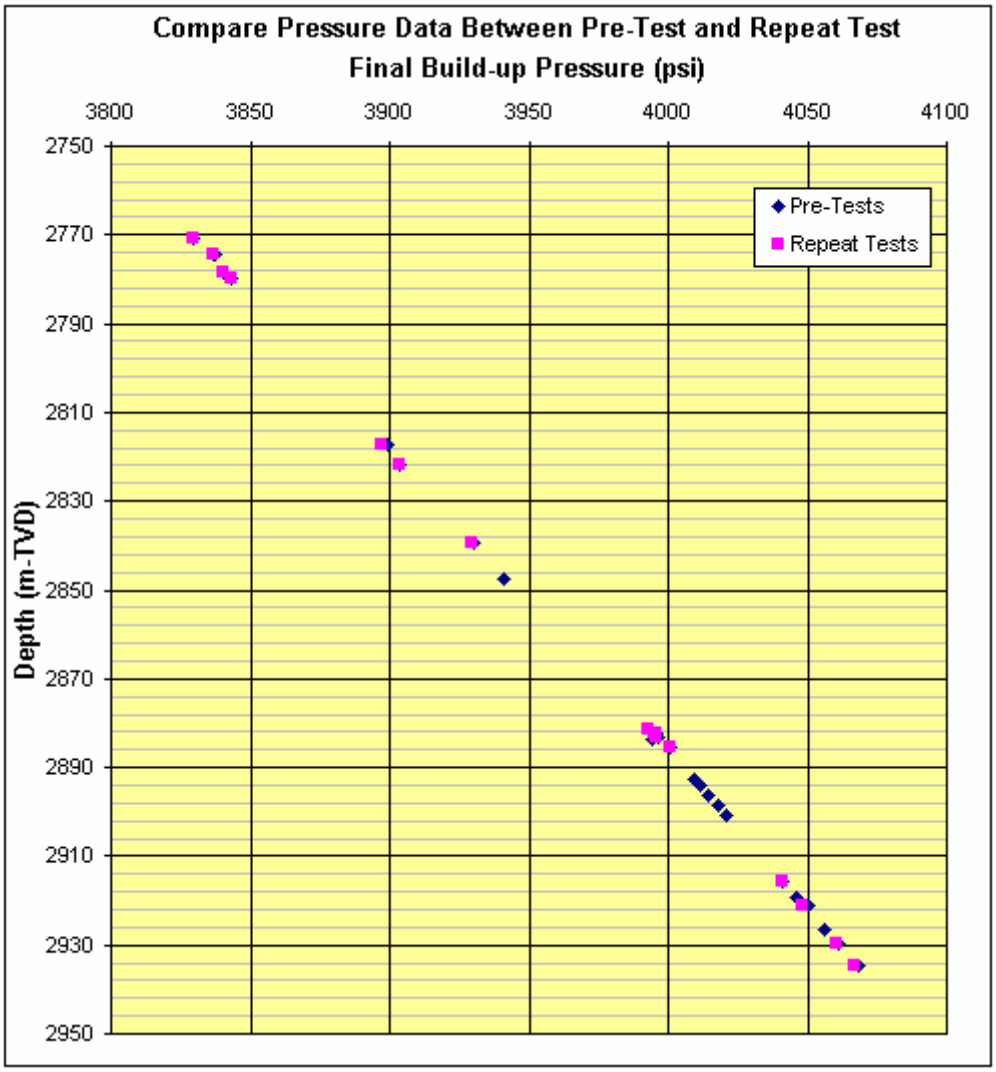


Figure 5 Shows a comparison between final build-up pressure of pre-test and the repeated test at the same depth.

Figure 6 shows hydrostatic pressure before and after pressure tests. The hydrostatic pressure shows an agreement between recorded pressures in most tested points (within 1 psi). At some points, the pressure difference is between 2-3 psi. Only one pressure point has a larger difference of 4.5 psi. This is within the acceptable range concerning all uncertainties. There are a few operation comments regarding the hydrostatic pressure:

- Normally, the hydrostatic pressure before and after are within 1-2 psi of each other. However, this is not always possible. Part of the reason for this is that the fluid inside the tool (between transducer and packer) changes as the test progresses. At the beginning, mud fills the fluid lines within the RCI tool. At the end of the test, a mix between filtrate, mud, and formation fluids fill the same fluid lines. Since the density of those fluids cannot be estimated, we cannot compensate for any differences due to this effect.
- Secondly, most tests were found to be tight to very low permeability. As the drawdowns were performed under these conditions, there is a chance that some formation solids (and/or mud cake) came into the probe section. When/if this happens, a restriction might form in the probe that may affect the reading of the "hydrostatic after" pressure. This is not to be confused with the tool being plugged.
- And third and last, due to operational circumstances, it is not advisable to remain stationary at a formation pressure testing point for too long, especially after the pre-test and/or sample attempt has been completed. Baker Atlas prefers to wait until both before and after pressures are stable, but it is not recommended to wait too much just for the hydrostatic pressure to stabilize at the end of a pressure test.

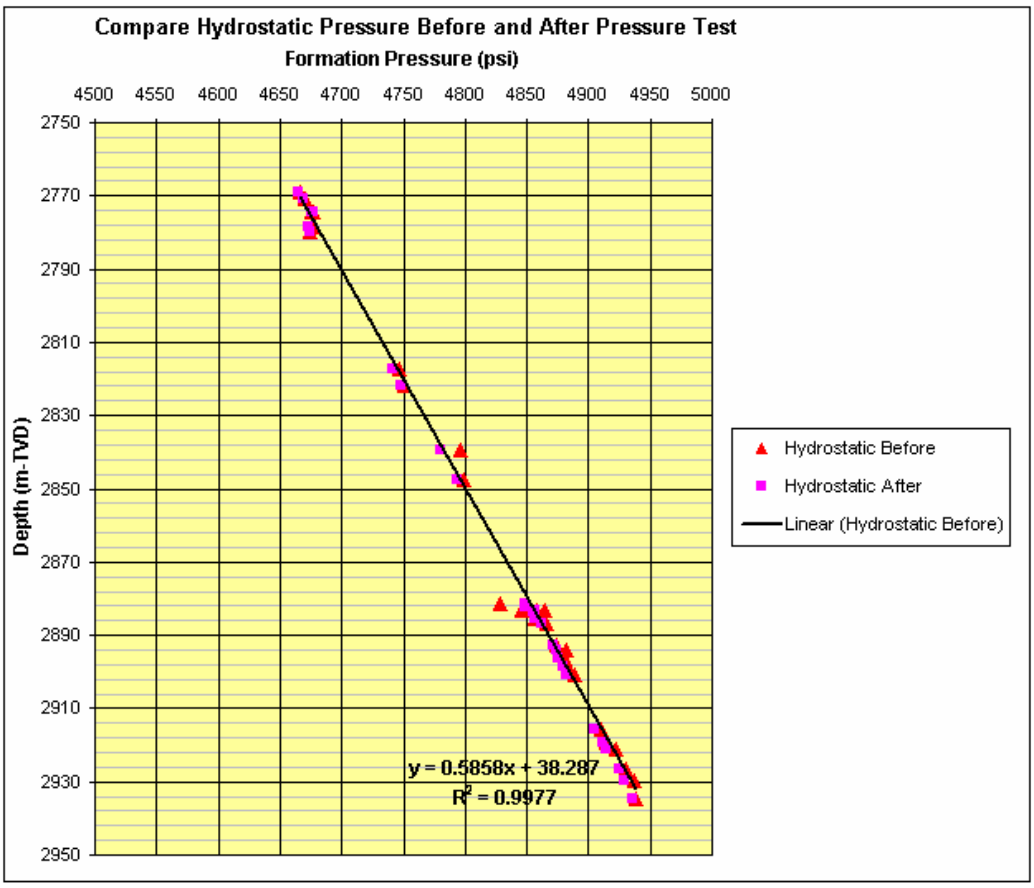


Figure 6 Shows hydrostatic pressure before and after pressure tests

After the final build-up pressures were screened using FRA and PTA techniques, 23 pressure points were identified as FRA Compliant for fluid gradient determination. Pressure tests with average permeability are at

depths of 2821.8m-TVD (i800g12), 2847.4m-TVD (i800g14), 2883.4m-TVD (i800g18), 2883.4m-TVD (i800g21), 2896.3m-TVD (i800g26), 2900.9m-TVD (i800g28), 2919.3m-TVD (i800g30), 2920.9m-TVD (i800g31), and 29926.3m-TVD (i800g32). Other tests which indicate higher permeability (pressure derivatives indicate trend for spherical flow) are at depths of 2778.3m-TVD (i800g09_2), 2779.9m-TVD (i800g10_2), 2817.2m-TVD (i800g11_3), 2839.4m-TVD (i800g13_1, and 13_2), 2881.5m-TVD (i800g16_2), 2882.3m-TVD (i800g17_4), 2885.4m-TVD (i800g19_2), and 2893.9m-TVD (i800g25_1). These valid pressure test points are shown as pink points in Figure 2. These pressure test points are plotted for fluid gradient, except for pressure tests i800g04_1, i800g20_1, i800g22_1 as these tests represent abnormal final buildup pressure and/or tight zones, with no seal for RCI testing, also the final build-up pressures of these tests do not stabilize due to low permeability zones. Fluid gradient for the valid testing interval is shown in Figure 7.

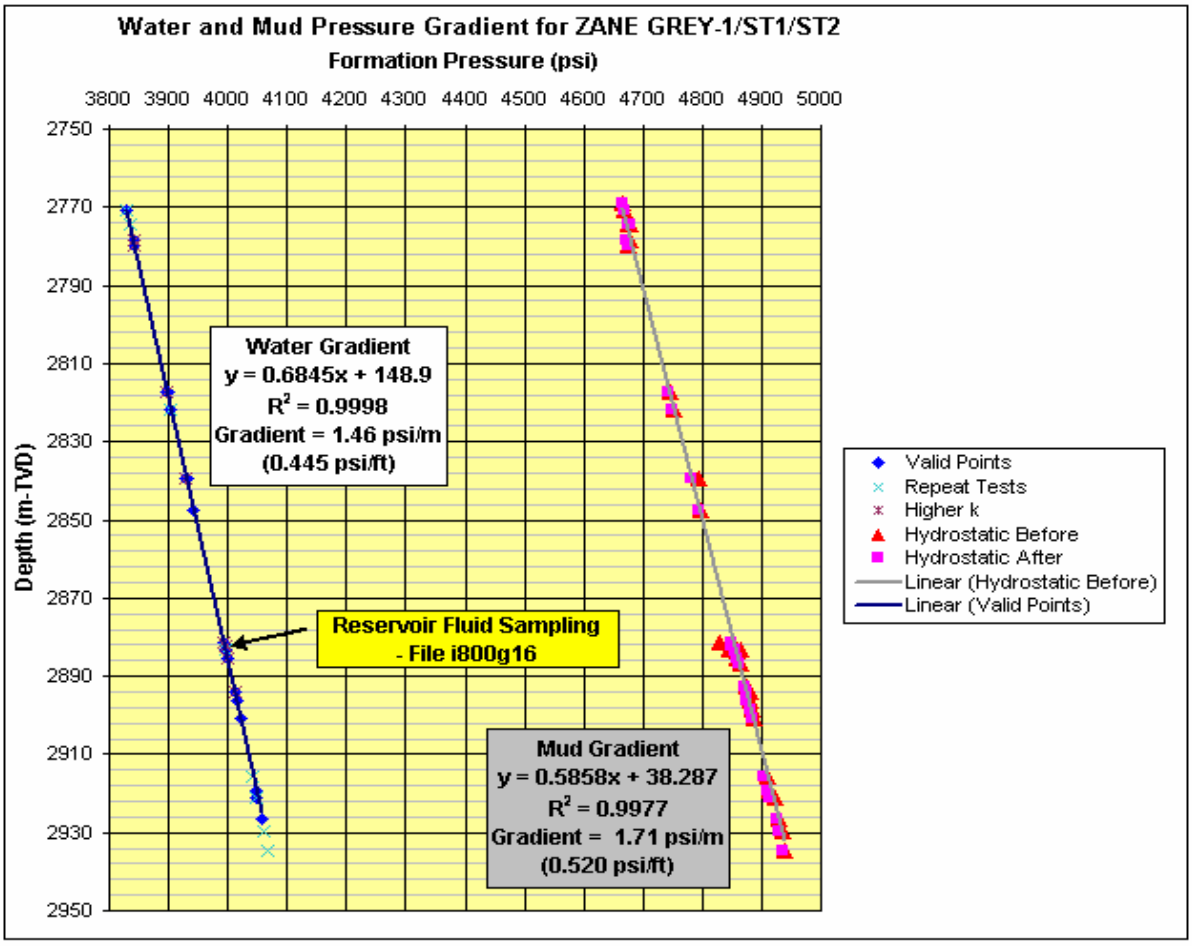


Figure 7 Pressure gradient obtained from valid pressure points. A pressure gradient of 1.46 psi/m (0.445 psi/ft) is possible, indicating the presence of water.

Together, **55** tests are analyzed between depths **2768.8m** and **3170.9m-TVD**. Among the analysed tests, **34** tests are actually used for interpretation.

Pressure Gradient/Fluid Type:

The test points between 2770.7m and 2934.6m-TVD show a pressure gradient of 1.46 psi/m (0.445 psi/ft) which indicates the presence of water (10.07 kPa/m, or, 1.0260 g/cm3).

Pressure:

Final Build-up pressures or Formation pressures (P) ranges from 3829.7 to 4067.1 psi.

Changing Fluid Phase:

Fluid samples were taken at the depth of 3307.0 m-MD, 2881.5 m-TVD, (file no. i800g16). A pressure history of this pressure test is shown in Figure 8.

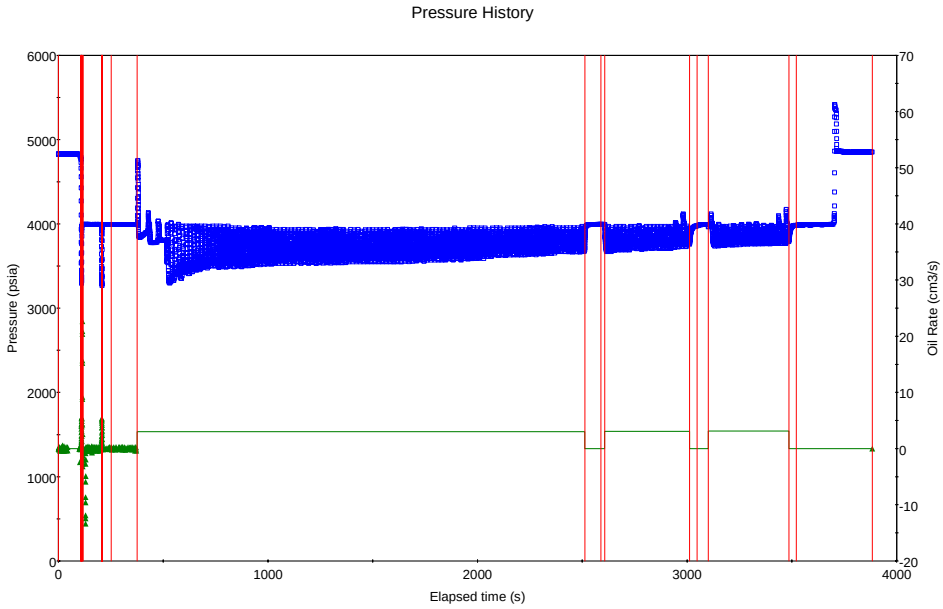


Figure 8 Pressure history plot of test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. From this figure, two pressure tests were performed before fluid samples were taken.

A total of five build-up tests can be analysed for this depth, as shown in Figure 9.

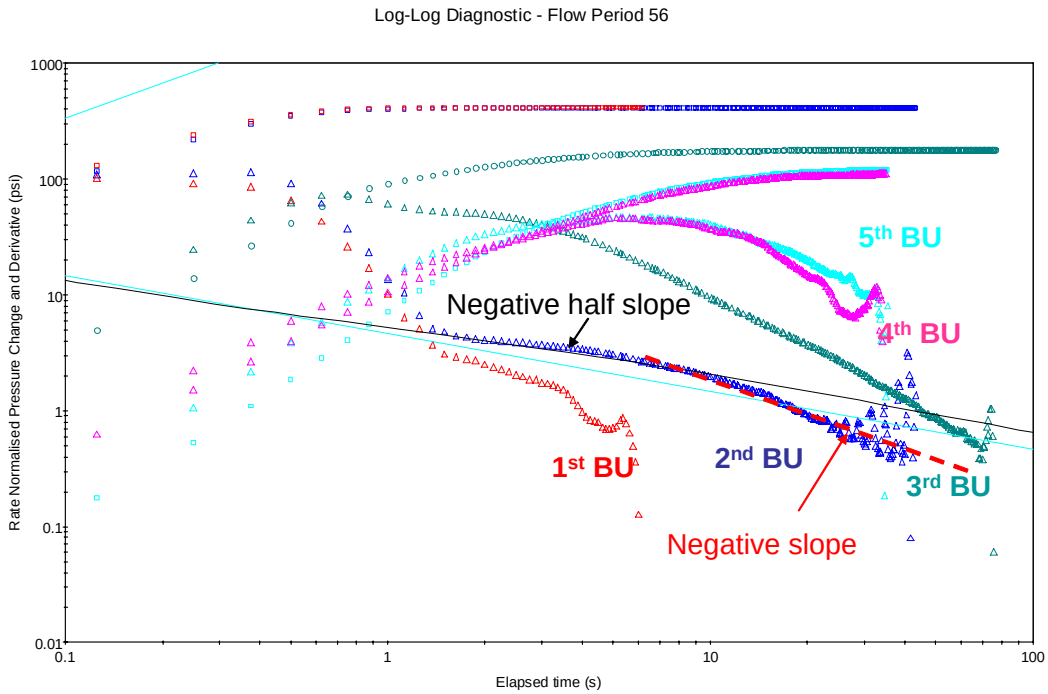


Figure 9 Log-Log plots of five build-up test plots at the same scale.

From Figure 9, the log-log plot of the five build-up tests taken from test i800g16, clearly show that a negative half slope results indicating spherical flow. This can be seen in the first and second build-up periods. The second build-up period indicates that a negative slope can be seen after time of 10 s (after the negative half slope was diminished). This indicates a changing fluid phase within the flow line (SPE88560, Daungkaew *et.* al, 2004). Since the mud system for this well is water based mud, the fluid phase with lower viscosity should be reservoir gas. The third build-up period indicates the changing fluid in the flow line with pressure derivatives has a negative slope trend. This period was taken after 6450 cc was pumped out. The fourth and fifth build-up periods do not reveal clear trends, since the build-up periods have noise at late time.

The changing fluid phase in the flow line, i.e. from WBM to reservoir gas (from the second build-up), is confirmed by the fact that traces of gas were found in sample Tanks 1 and 2 when they were opened at surface. Figures 10, 11, and 12, represent SampleView Analysis of spectral and temporal plots of sample Tanks 1 and 2 at beginning of sampling and when closing the tool after completion of sampling. Spectral plots are an analysis of absorbance, versus, wavelength (nm), and Temporal plots are an analysis of absorbance, versus, time (min). Guidelines for interpretation of SampleView plots are as follows:

Guidelines for SampleView Interpretation are as follows:

GAS

- No absorbance of spectrum except M1, and M2 and Channel 16,
- Small hydrocarbon peak in channel 16,
- Channel 16-15 < 0.3 OD for 100% Gas,
- Multiphase flow will have a % contribution from all phases ie. Concentrate on Channel 16-15 even although there may be absorbance in other channels,
- Refractive Index 1.00 to 1.25,
- Very low fluorescence reading.

OIL

- Increasing asphaltene content = lower API gravity,
- Hydrocarbon peak in channel 16,
- Channel 16-15 approximately 0.5 OD for 100% Oil,
- Channel 16-15 approximately 0.05 OD for 0% Oil,
- Multiphase flow will have a % contribution from all phases ie. 50% Oil will have channel 16-15 approximately 0.25 OD,
- For gas bearing crudes M1>M2 therefore can use GOR,
- High API (light oil) will have high fluorescence in lower wavelengths,
- Refractive Index 1.43 to 1.55.

WATER

- Very low or no absorbance in channels 1 to 12,
- Water peaks in channel 14 and 17,
- Channel 14-13 approximately 1.8 OD for 100% Water,
- Channel 14-13 approximately 0.1 OD for 0% Water,
- Multiphase flow will have a % contribution from all phases ie. 50% Water will have channel 14-13 approximately 0.9 OD,
- Where oil, or, gas and water are present the water peaks will appear to dominate the spectrum. Concentrate on channel subtraction,
- Refractive Index 1.33-1.34,
- M1 should equal M2 ie. No Methane Present.

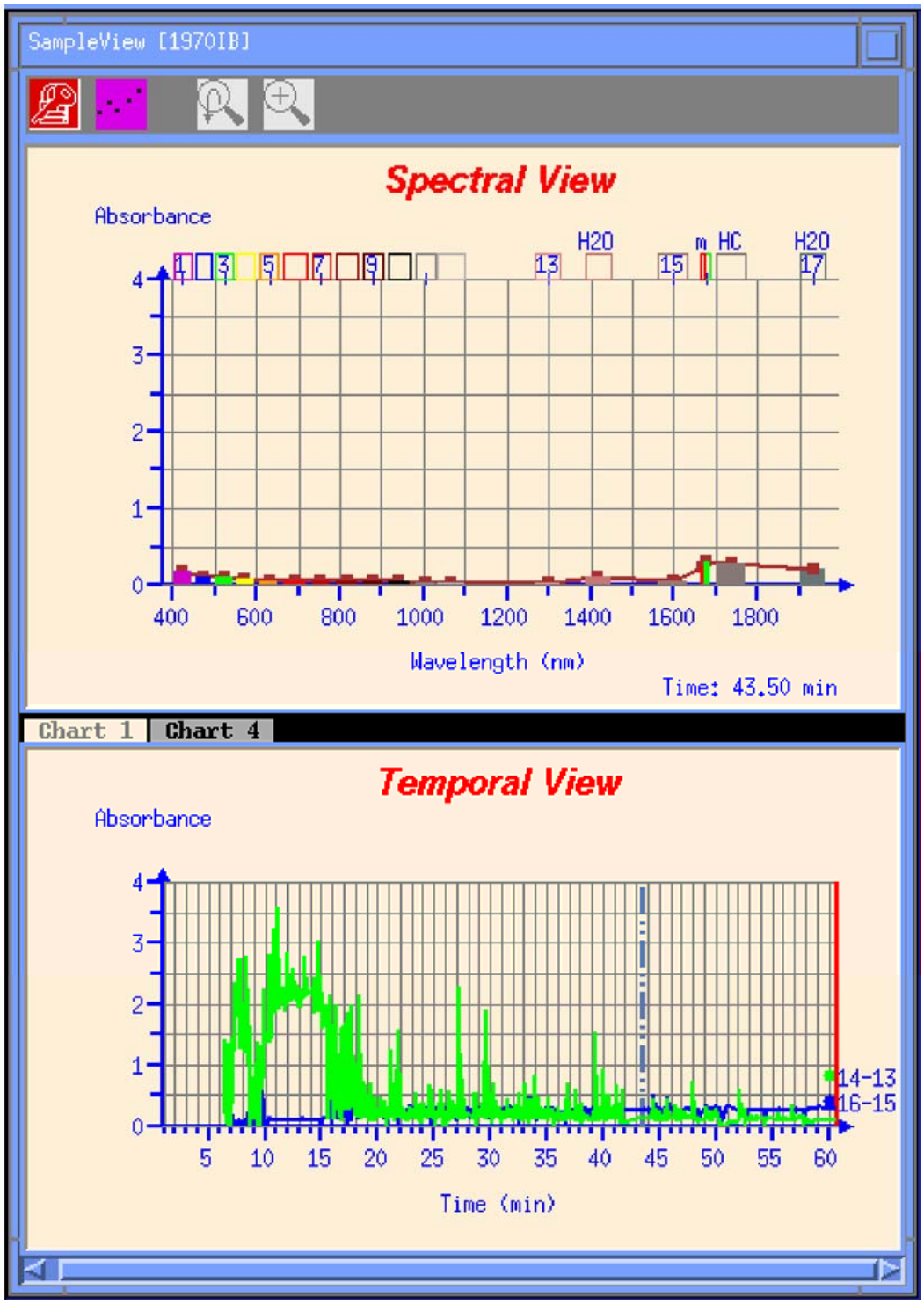


Figure 10 Reservoir Characterization Spectral and Temporal Plots, of Test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. This figure indicates a changing fluid phase, ie from WBM to reservoir gas. An initial high absorbance in channel subtraction of 14-13, above or approximately 1.8 optical density, from 10-15 minutes for the presence of water based mud and possibly reservoir water, and, channel subtraction 16-15, below 0.3 optical density, at 43.50 minutes during sampling for Tank 1, for the presence of reservoir gas.

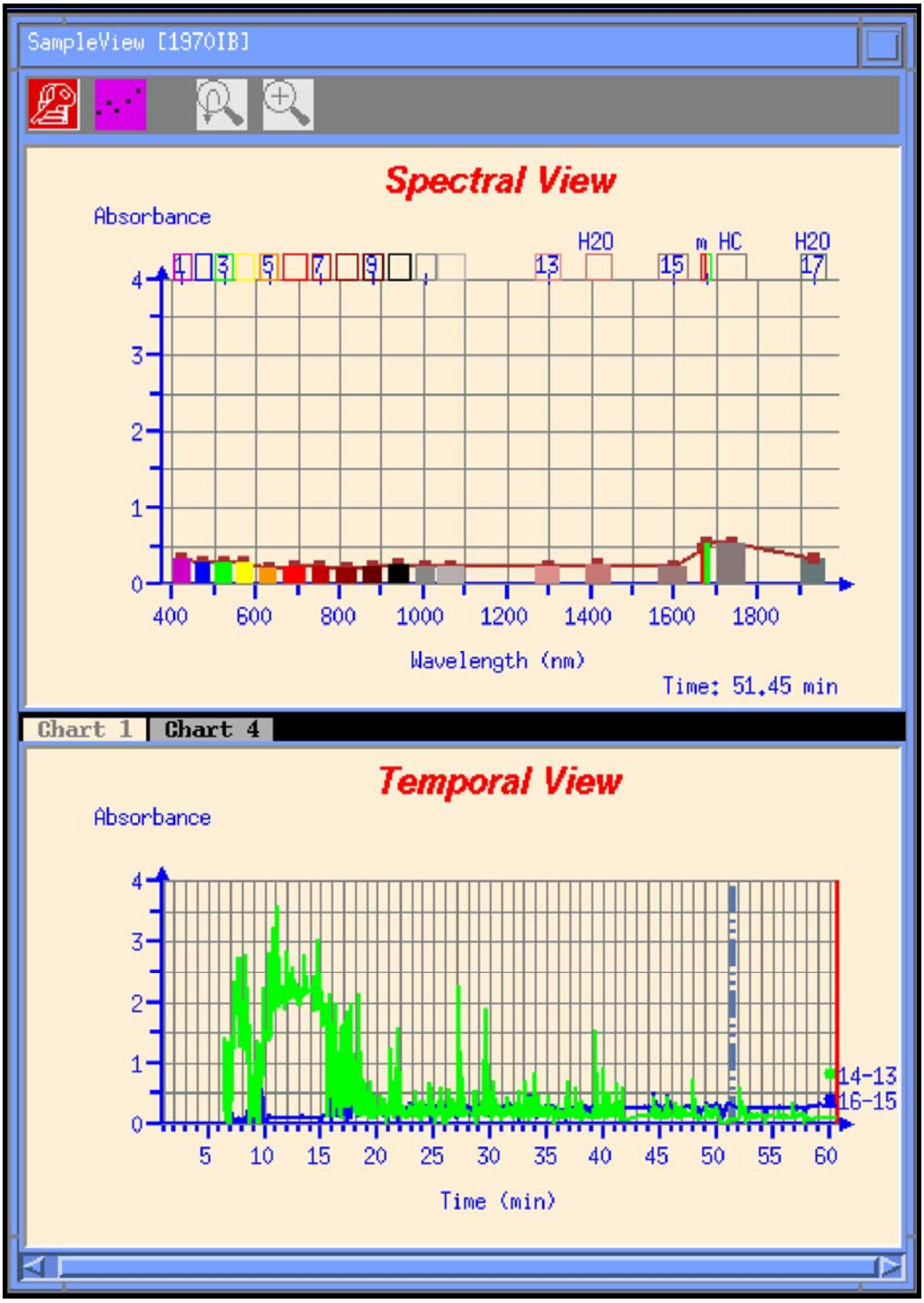


Figure 11 Reservoir Characterization Spectral and Temporal Plots, of Test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. This figure indicates a changing fluid phase, ie from WBM to reservoir gas. An initial high absorbance in channel subtraction of 14-13, above or approximately 1.8 optical density, from 10-15 minutes for the presence of water based mud and possibly reservoir water, and, channel subtraction 16-15, below 0.3 optical density, at 51.45 minutes during sampling for Tank 2, for the presence of reservoir gas.

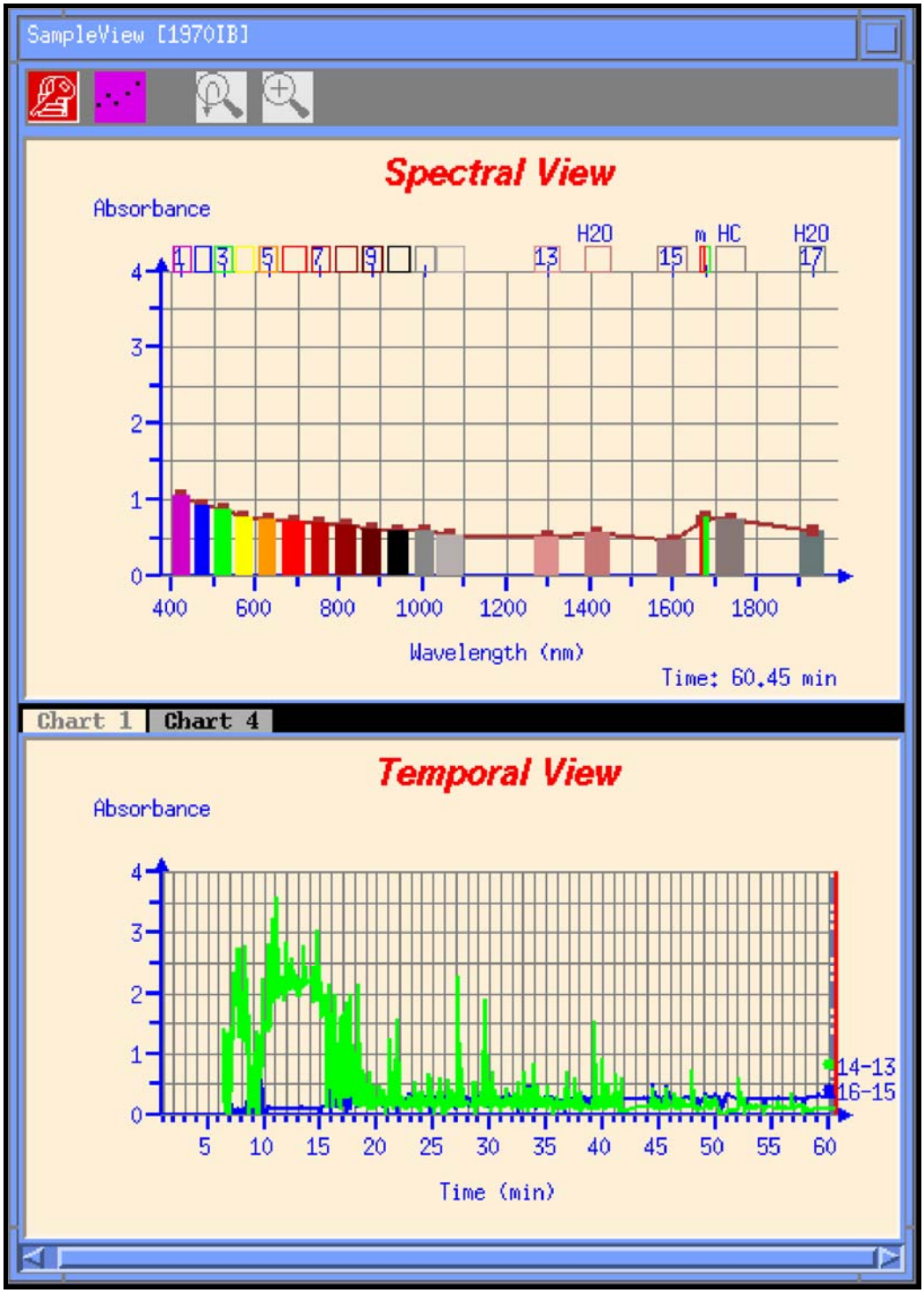


Figure 12 Reservoir Characterization Spectral and Temporal Plots, of Test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. This figure indicates a changing fluid phase, ie from WBM to reservoir gas. An initial high absorbance in channel subtraction of 14-13, above or approximately 1.8 optical density, from 10-15 minutes for the presence of water based mud and possibly reservoir water, and, channel subtraction 16-15, below 0.3 optical density, at 60.45 minutes after closing the tool at the completion of sampling, for the presence of reservoir gas. There is also initial high absorbance in lower wavelengths, suggesting possibly light oil present. Pressure gradients do not confirm this.

However, it is not clear from the composite logs what reservoir fluid is being sampled from test i800g16 at the sample depth of 3307.0 m-MD, 2881.5m-TVD (See Figure 13).

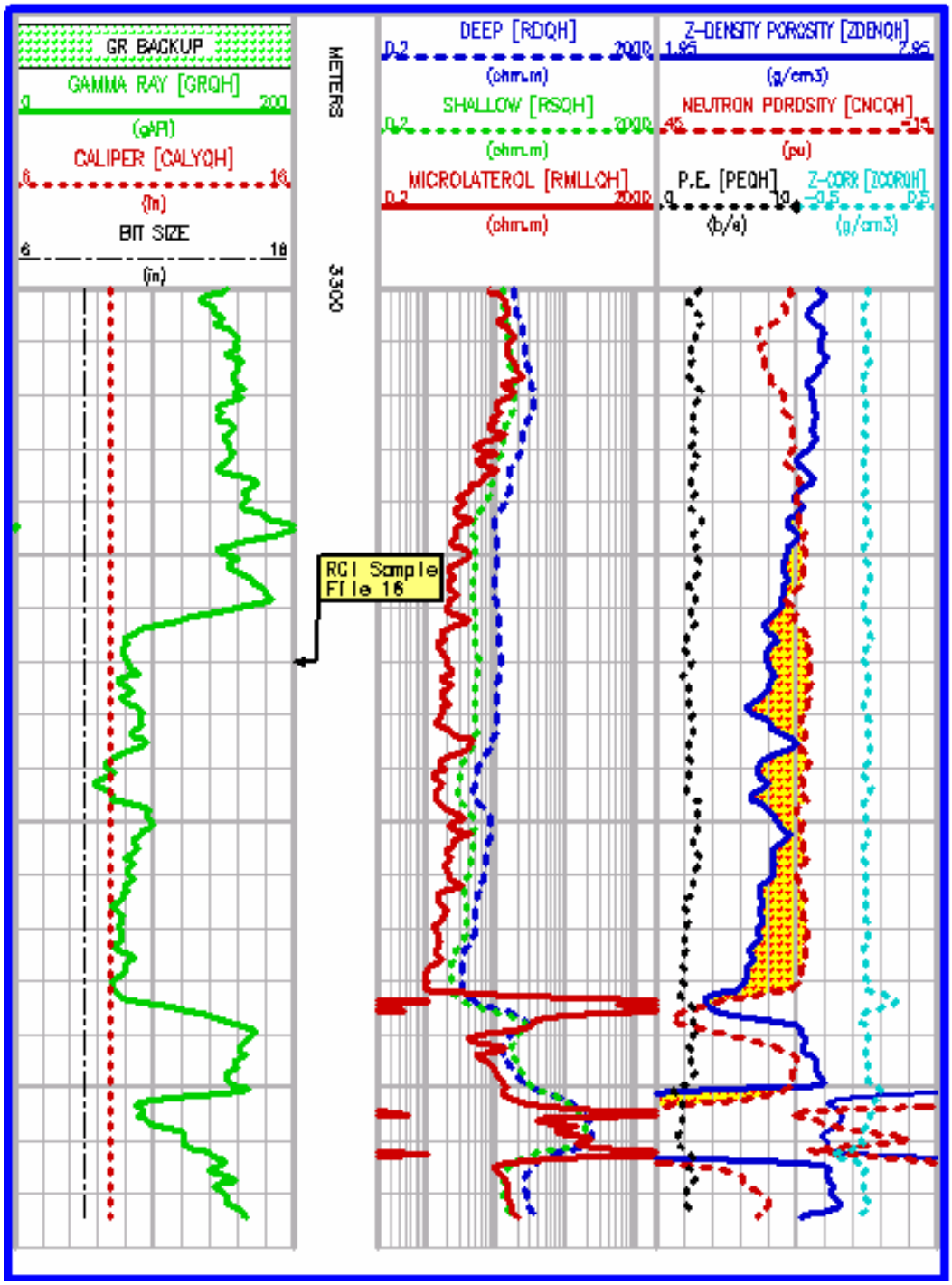


Figure 13 Composite logs plot of test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. From this figure it is not clear what reservoir fluid is at the sample depth of 3307.0 m-MD, 2881.5m-TVD. The composite logs have been depth matched to remove discrepancies (ie. depth offsets) from different runs within ZANE GREY-1/ST1/ST2.

Also, a gas gradient can be drawn for this data set from points around test i800g16. Tests i800g16, i800g17, i800g19, and i800g21 tests were considered. From tests i800g17 and i800g18 a pressure gradient of 0.45 psi/m (0.1385 psi/ft) is possible, indicating the presence of wet gas. The intersection of this wet gas gradient with the water gradient trend suggests a gas-water contact at 2884.1m-TVD (See Figure 14).

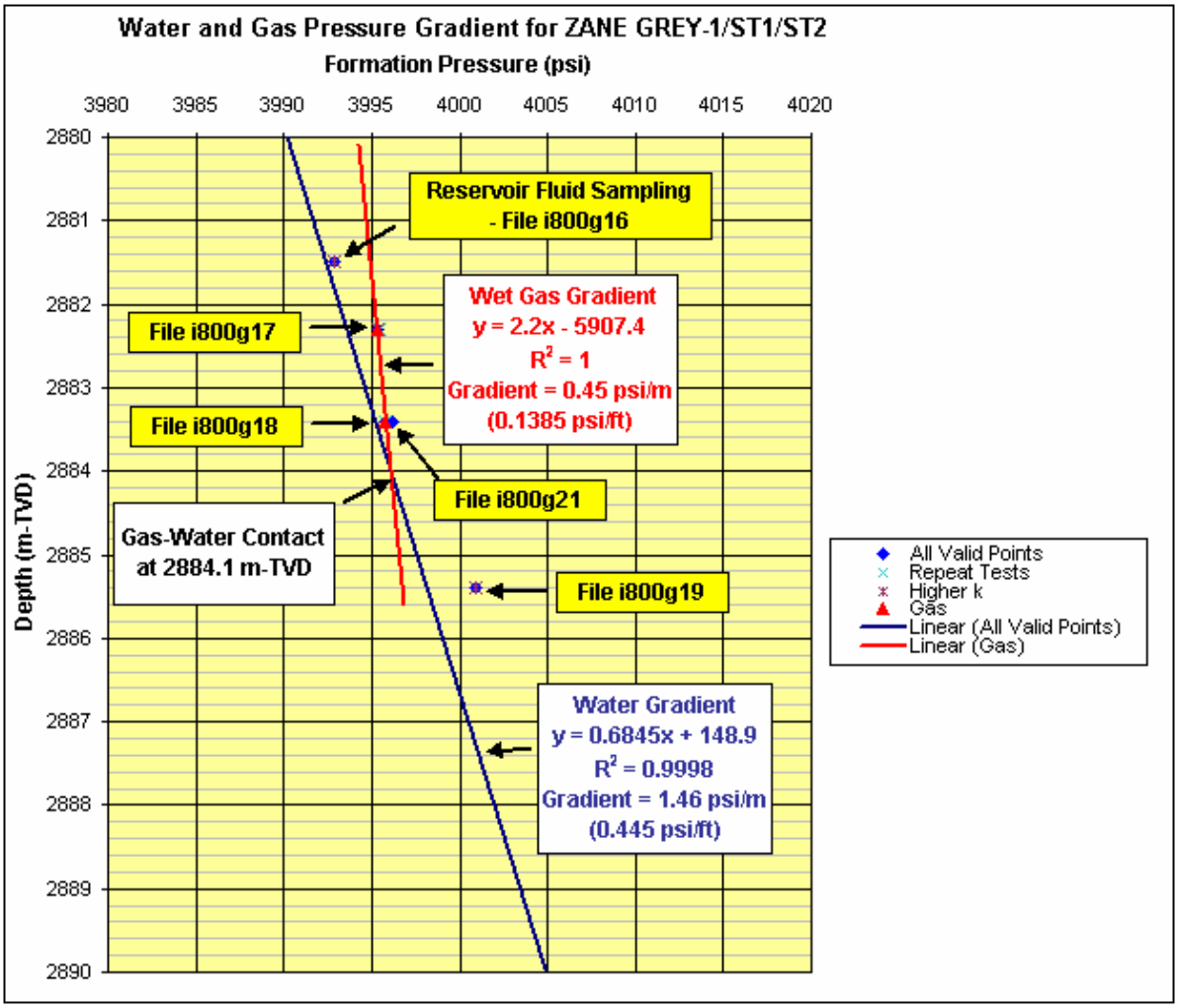


Figure 14 The zoomed in pressure gradient obtained from valid pressure points of test i800g16 at depth 3307.0 m-MD, 2881.5 m-TVD. From this figure a gas gradient can be drawn for this data. Tests i800g16, i800g17, i800g19, and i800g21 tests were considered. From tests i800g17 and i800g18 a pressure gradient of 0.45 psi/m (0.1385 psi/ft) is possible, indicating the presence of wet gas. The intersection of this wet gas gradient with the water gradient trend suggests a gas-water contact at 2884.1m-TVD

Pressure Gradient/Fluid Type:

The test points between 2781.5 m-MD and 2883.4 m-MD show a pressure gradient of 0.45 psi/m (0.1385 psi/ft) which indicates the presence of Wet Gas (3.13 kPa/m, or, 0.3195 g/cm3).

Pressure:

Final Build-up pressures or Formation pressures (P) range from 3892.9 to 4000.9 psi.

The Baker Atlas standard procedure for the FRA compliant method, is the minimum required for the fluid gradient plot. In other words, typically tests with FRA compliance can be used to plot fluid gradient. However, in the case of files i800g04, i800g20, and i800g22, the final build-up pressures do not stabilize due to low permeability zones, as shown in Figure 15, 17, and 19. Figures 16, 18 and 20 also show clearly that the pressure derivative test deviates from spherical flow. This confirms the abnormal final build-up pressure and/or tight zones, with no seal for RCI testing. Therefore the final build-up pressures of these pressure points do not provide an accurate water gradient or FRA mobility.

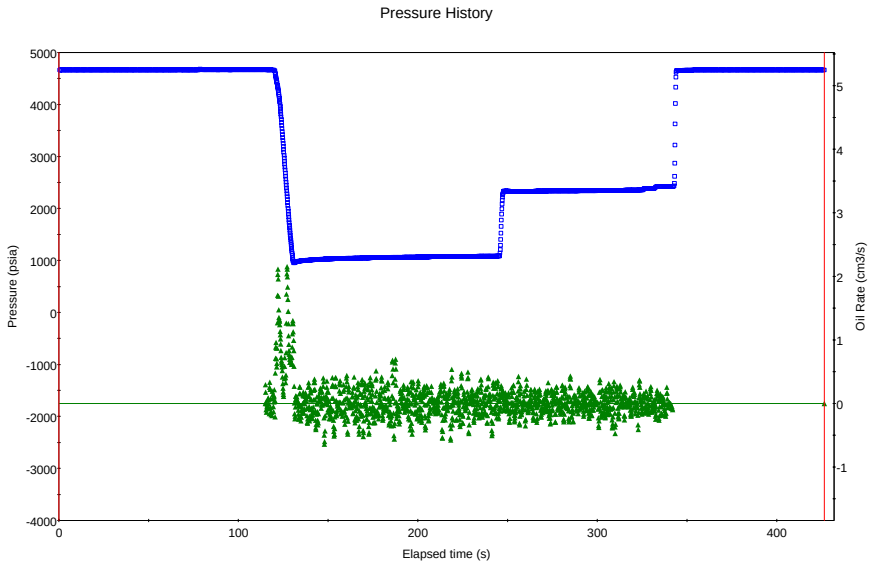


Figure 15 Shows pressure history of file no i800g04 at 3179.6 m-MD, 2768.8 m-TVD. It is clear that final build-up of the test does not stabilize.

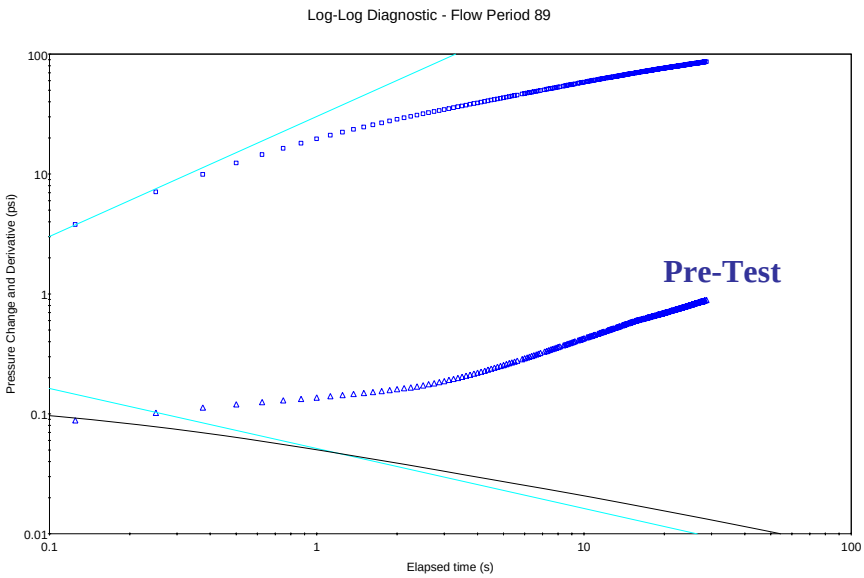


Figure 16 Shows the log-log plot of test in file i800a04 at 3179.6 m-MD, 2768.8 m-TVD. The pressure derivative of the test deviates from spherical flow. This implies that the final build-up pressure does not stabilize at the formation pressure.

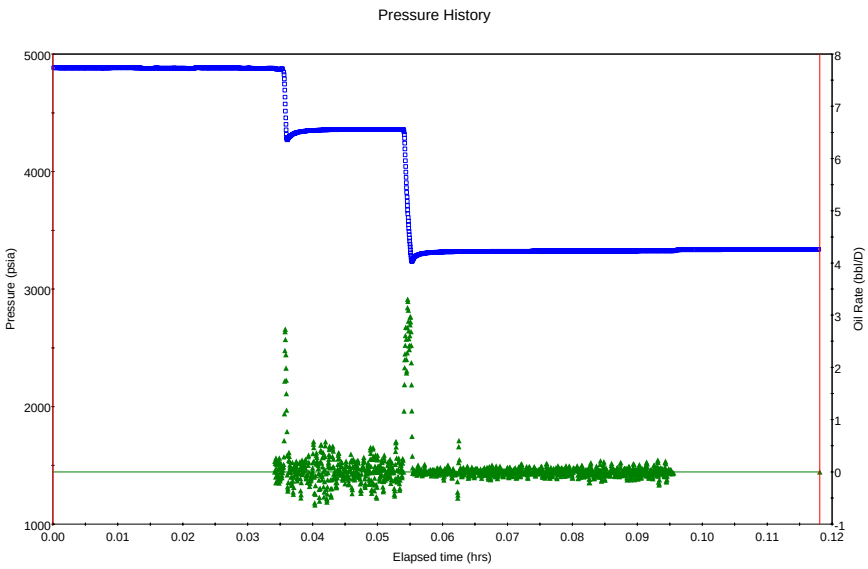


Figure 17 The zoomed in plot of pressure history of file no i800g20 at 3309.4 m-MD, 2883.7 m-TVD. It shows clearly that the final build-up pressure of the test does not stabilize.

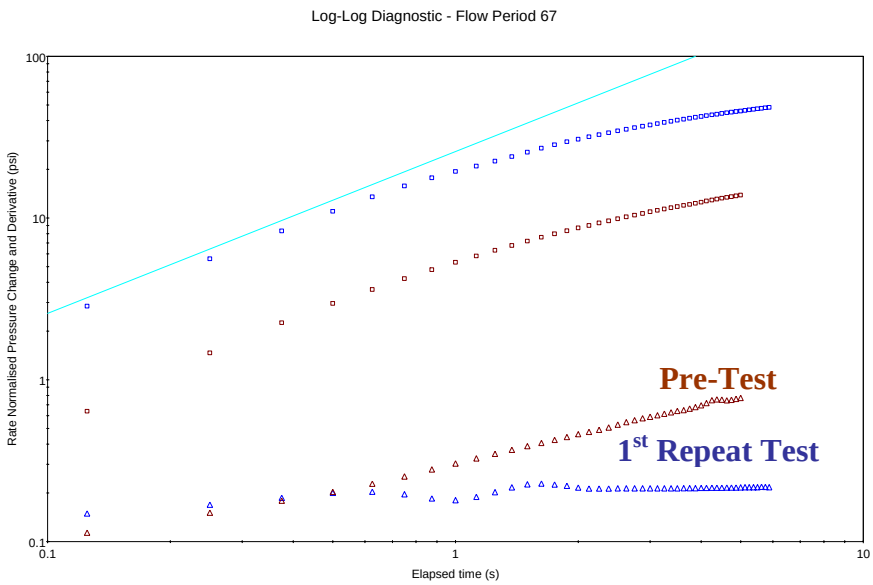


Figure 18 The log-log plot of test in file no i800a20 at 3309.4 m-MD, 2883.7 m-TVD. Pressure derivatives deviate from spherical flow showing the abnormal pressure build-up. This confirms that the final build-up pressures of the pre-test and repeated test do not stabilize at the formation pressure.

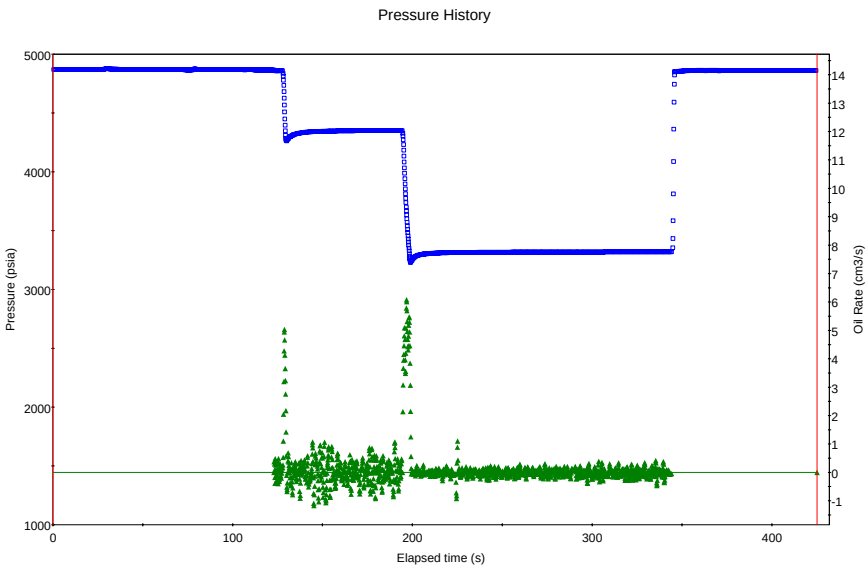


Figure 19 The zoomed in plot of the pressure history of file no i800g22 at 3312.8 m-MD, 2886.7 m-TVD. It shows clearly that the final build-up pressure of the test does not stabilize.

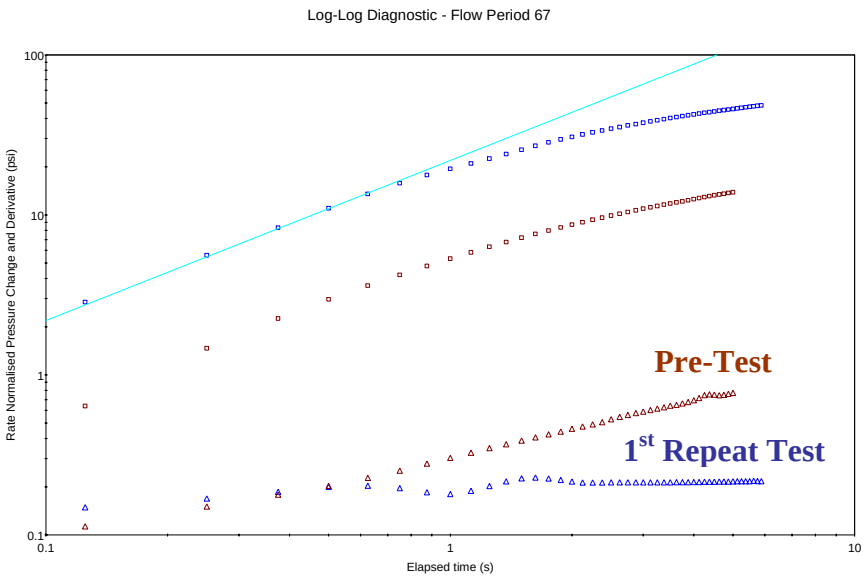


Figure 20 The log-log plot of test in file no i800a22 at 3312.8 m-MD, 2886.7 m-TVD. Pressure derivatives deviate from spherical flow showing the abnormal pressure build-up. This confirms that the final build-up pressures of pre-test and repeated test do not stabilize at the formation pressure.

4. Recommendations for Future Tests

- When the reservoir is identified as a low permeability zone, the lowest piston rate should be applied in order to match the piston rate with the formation rate.
- Multiple drawdowns are recommended when the measured pressures show inconsistent trend. The repeated test will help to confirm the valid formation pressure.
- Use of real-time FRA is recommended to optimize and validate pressure tests
- Post job FRA and PTA is recommended to evaluate and validate all pressure tests
- The SampleView should be examined closely during the RCI job to detect any changing fluid phase during pumping and sampling

5. Input Data for PTA Analysis

In order to match the pressure transient test, some well, reservoir and probe parameters are listed below:

Input Parameters	Units	Values
Matrix Porosity		0.11-0.84
Probe Diameter	inch	0.72
Tool Internal Volume	cm3	350
Geometric Factor		4.26
Fluid Viscosity	cp	1
Total Compressibility	1/psi	1E-5

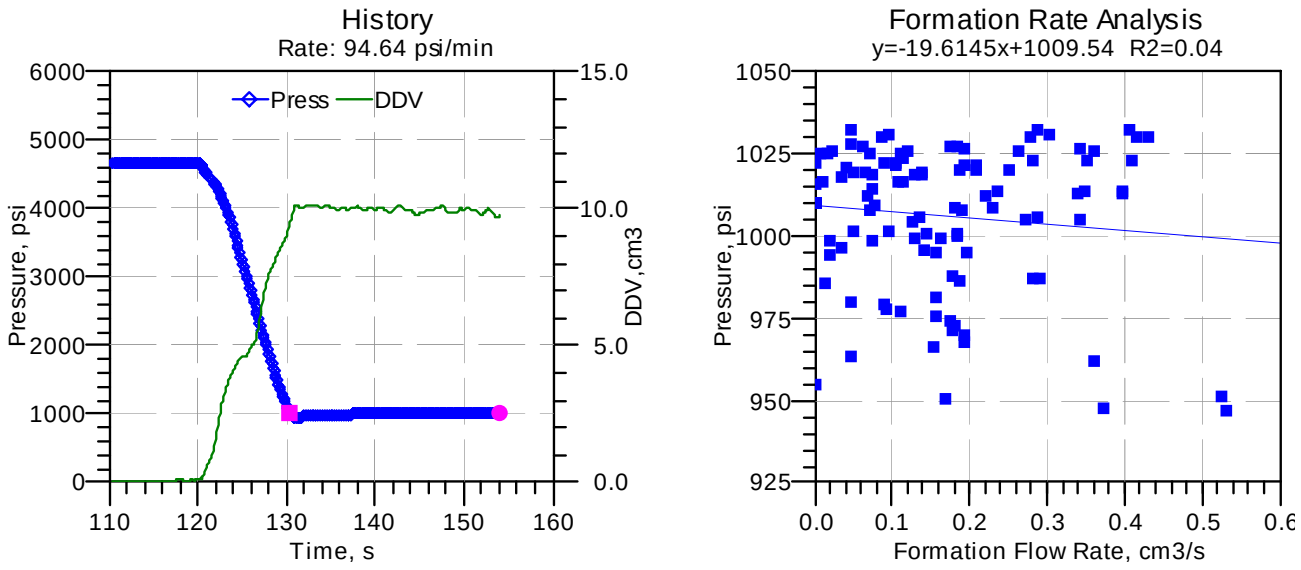
6. Summary of Formation Rate Analysis and Pressure Transient Analysis Results

Formation Rate Analysis and Pressure Transient Analysis Results for pressure points in the Zane Grey-1/ST1/ST2 well are as follows:

Figure 21 File no. i800g04_1: Depth 3179.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



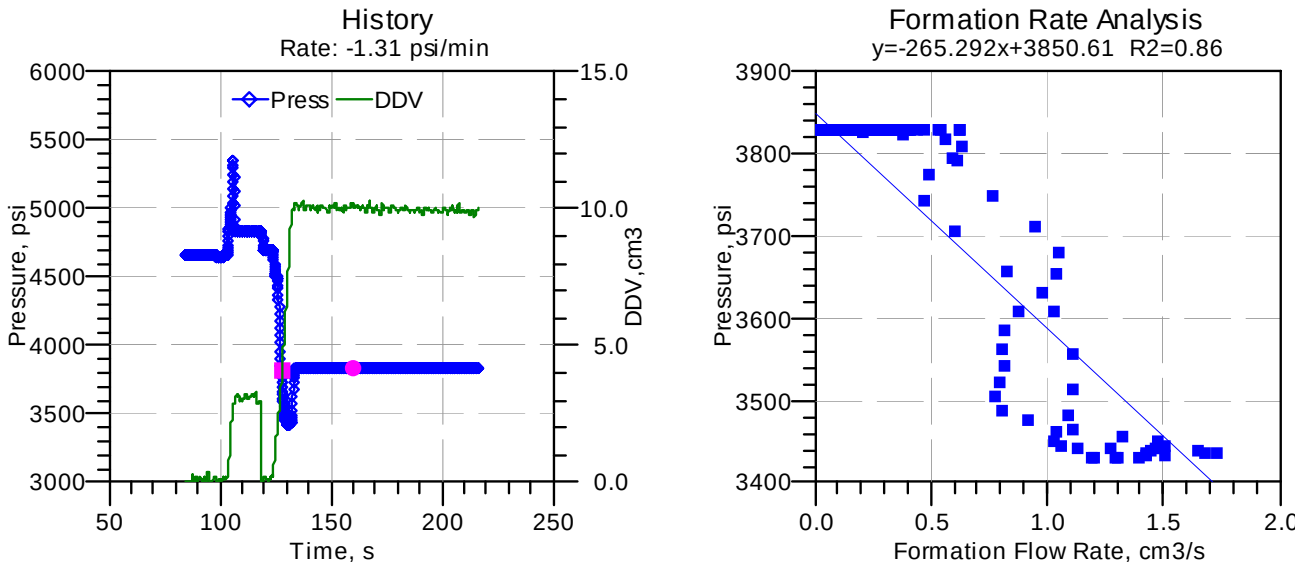
Pressure Test Results-Tight

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
04_1	3179.6	2768.8	1.5e-5	1009.5	175.5	21.3	1032.7

Figure 22 File no. i800g05_1: Depth 3181.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



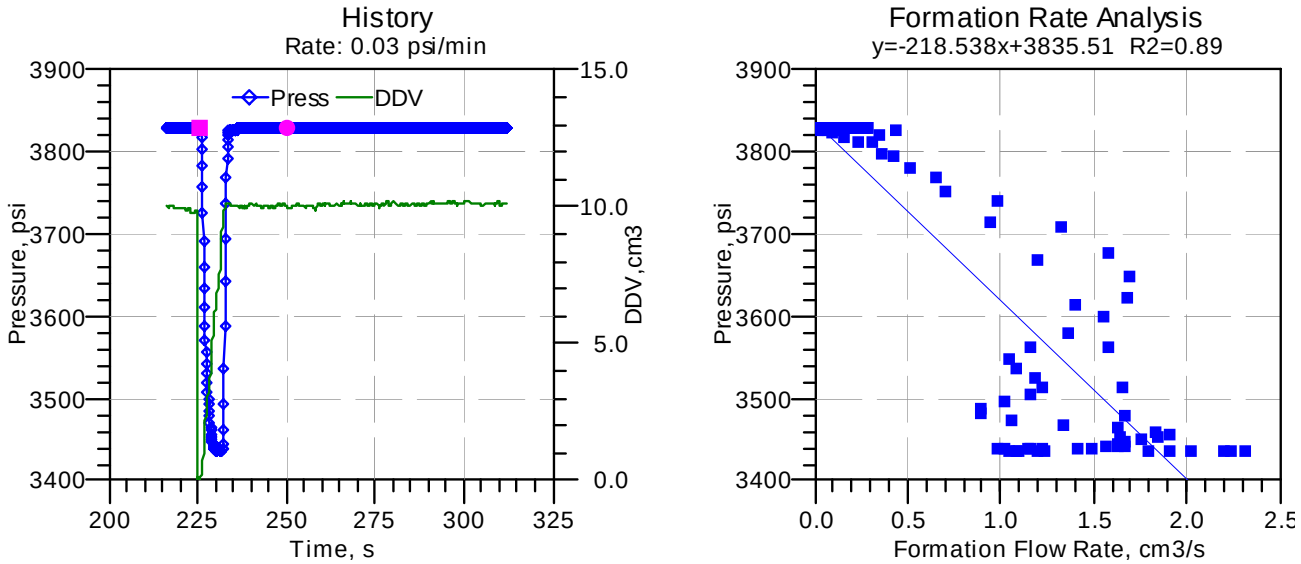
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
05_1	3181.6	2770.7	5.8e-6	3850.6	13.0	14.9	3829.7

Figure 23 File no. i800g05_2: Depth 3181.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

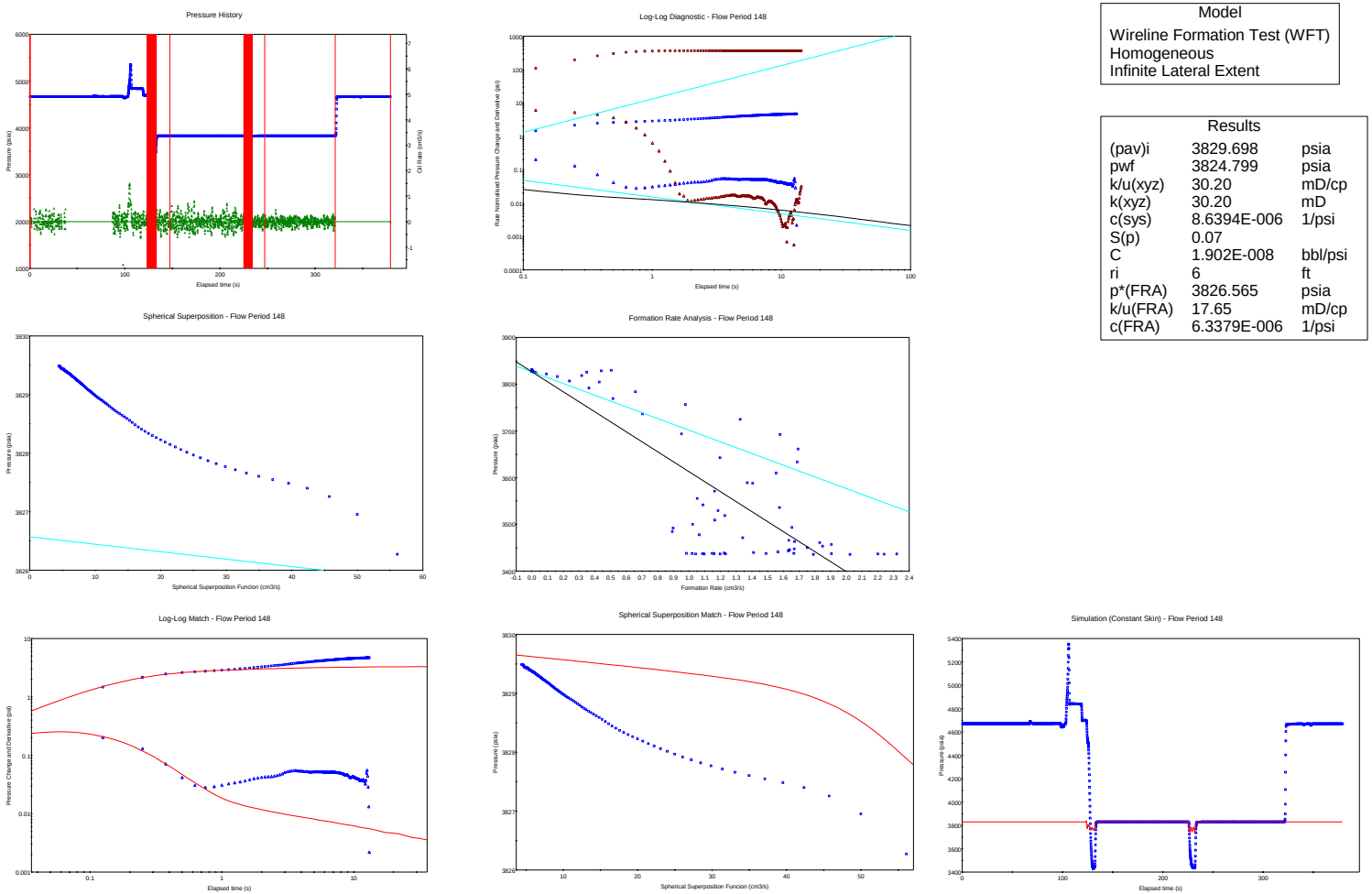
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
05_2	3181.6	2770.7	6.3e-6	3835.5	15.8	20.3	3829.7

Figure 24 File no. i800g05: Depth 3181.6 m-MD



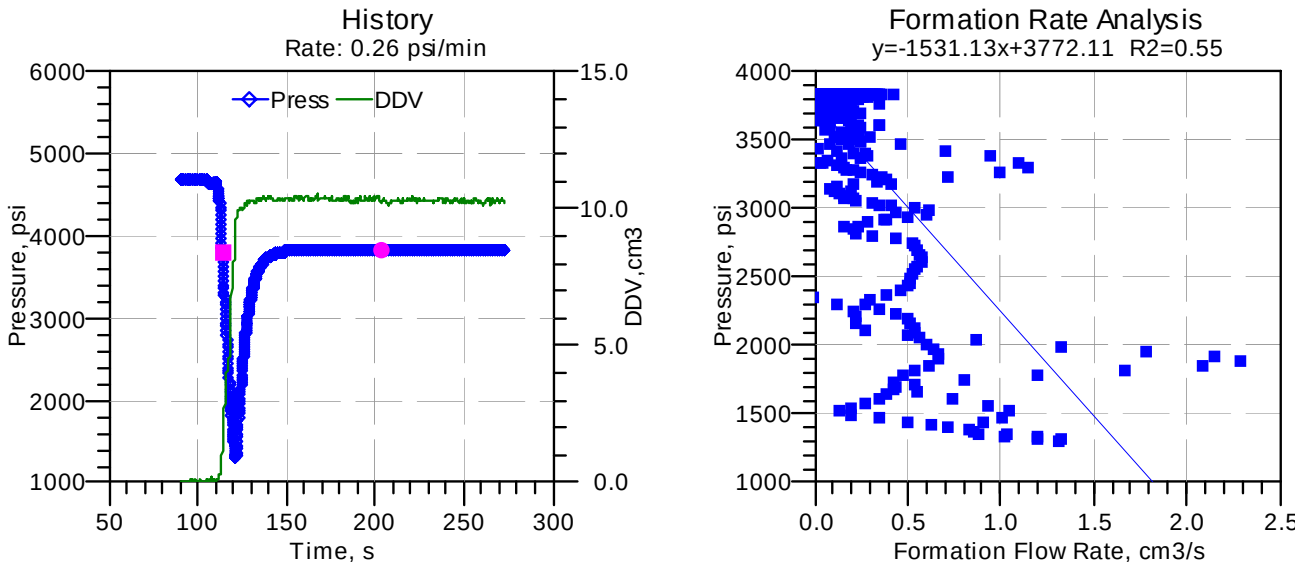
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3829.698	psia
pwf	3824.799	psia
k/u(xyz)	30.20	mD/cp
k(xyz)	30.20	mD
c(sys)	8.6394E-006	1/psi
S(p)	0.07	
C	1.902E-008	bbl/psi
ri	6	ft
p*(FRA)	3826.565	psia
k/u(FRA)	17.65	mD/cp
c(FRA)	6.3379E-006	1/psi

Figure 25 File no. i800g06_1: Depth 3185.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



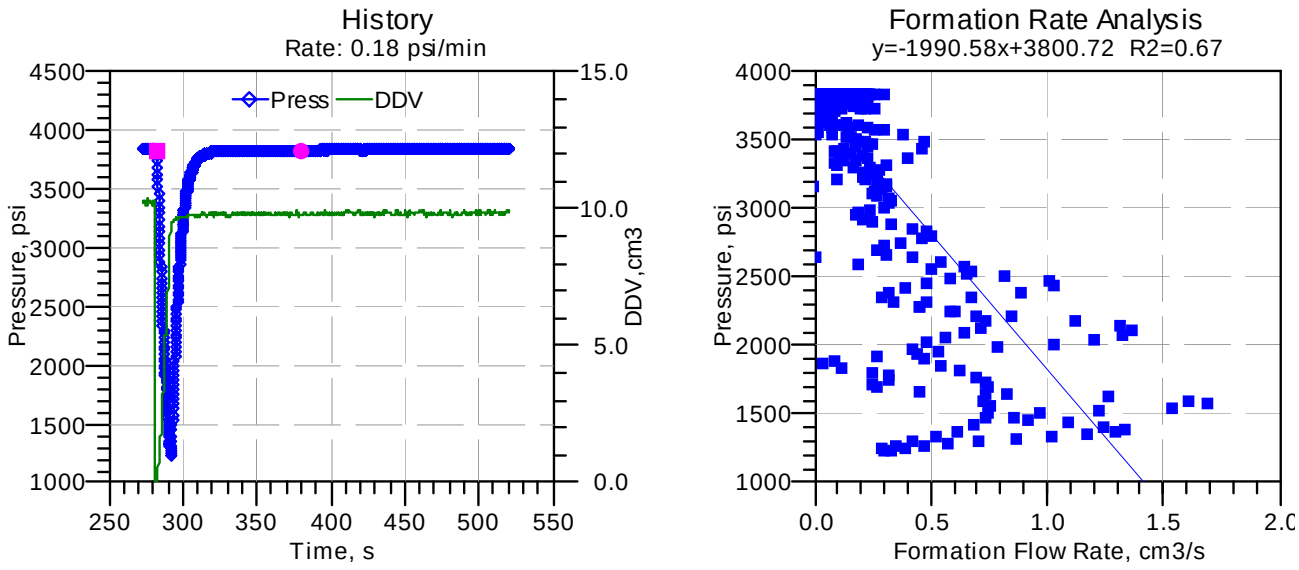
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
06_1	3185.8	2774.3	4.8e-6	3772.1	2.2	3.1	3837.1

Figure 26 File no. i800g06_2: Depth 3185.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

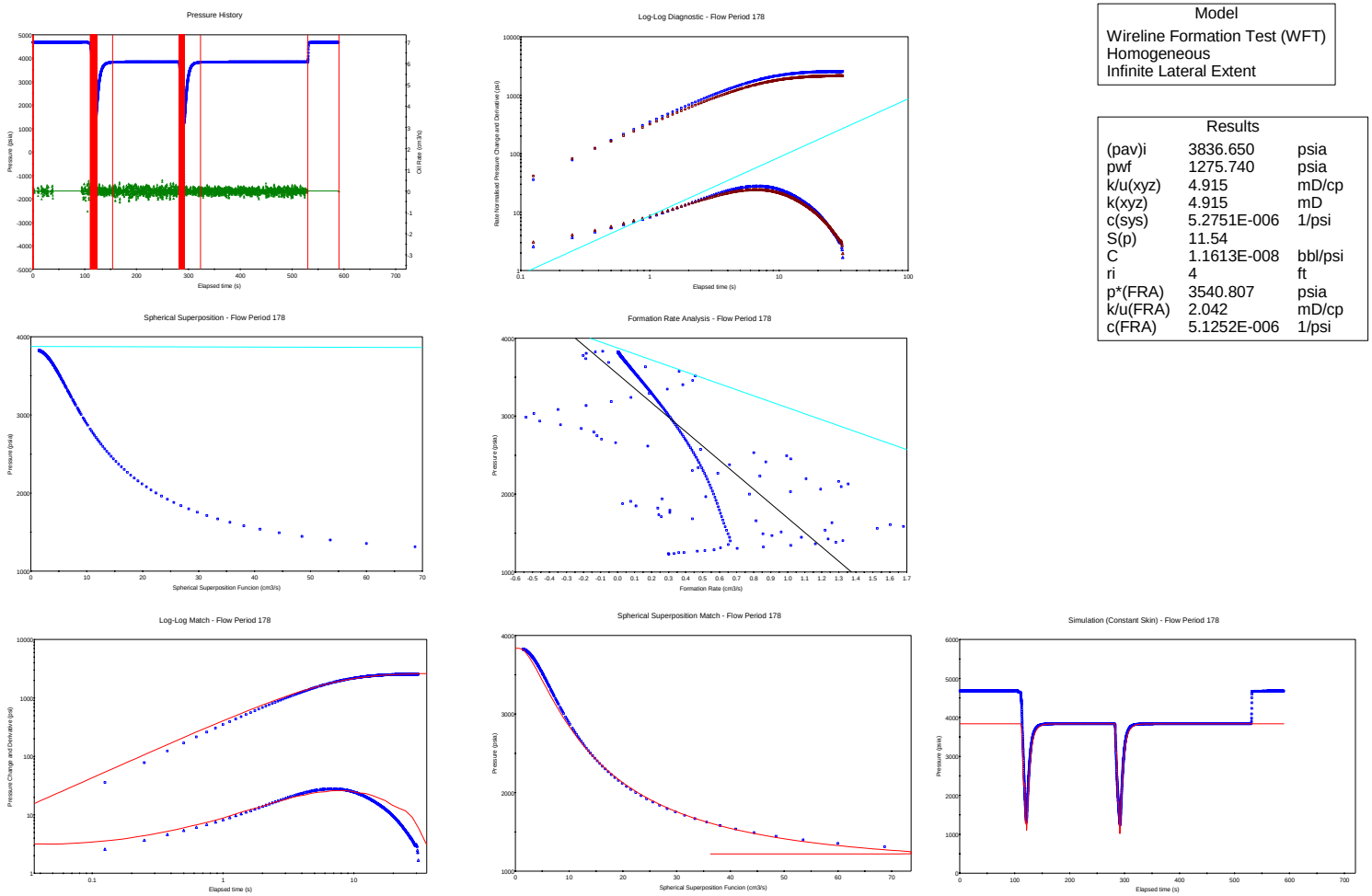
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
06_2	3185.8	2774.3	5.0e-6	3800.7	1.7	2.2	3836.6

Figure 27 File no. i800g06: Depth 3185.8 m-MD



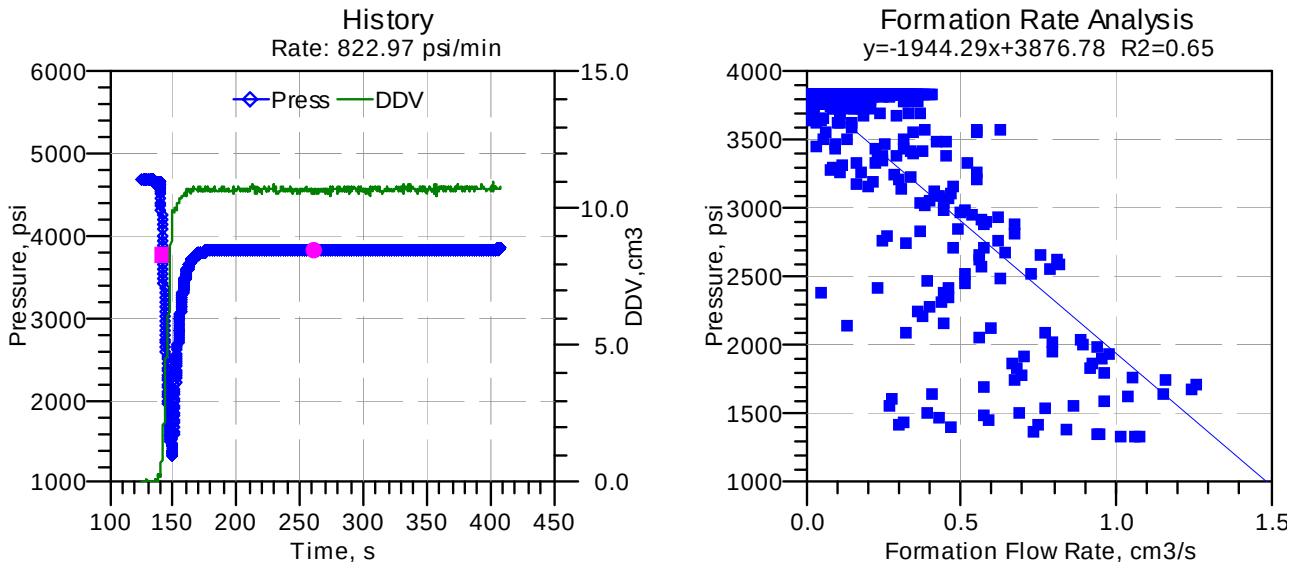
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3836.650	psia
pwf	1275.740	psia
k/u(xyz)	4.915	mD/cp
k(xyz)	4.915	mD
c(sys)	5.2751E-006	1/psi
S(p)	11.54	
C	1.1613E-008	bbl/psi
ri	4	ft
p*(FRA)	3540.807	psia
k/u(FRA)	2.042	mD/cp
c(FRA)	5.1252E-006	1/psi

Figure 28 File no. i800g07_1: Depth 3185.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

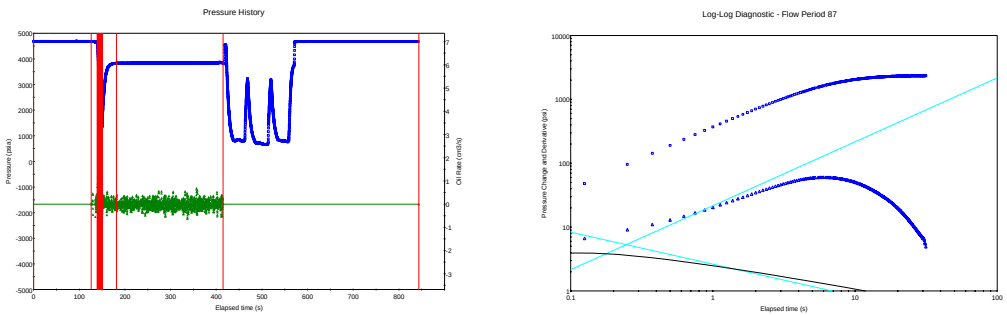
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-NOT FRA Compliant

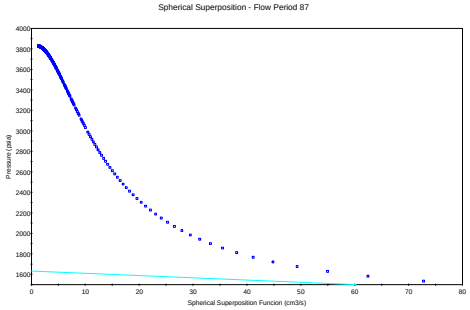
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
07_1	3185.7	2774.3	4.8e-6	3876.8	1.8	1.7	3861.7

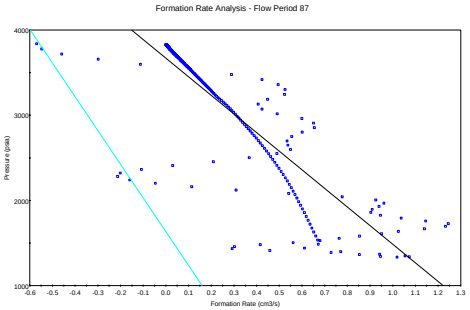
Figure 29 File no. i800g07: Depth 3185.7 m-MD

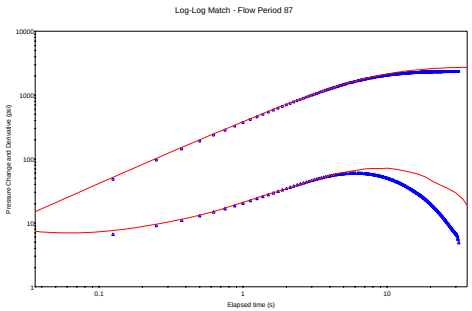


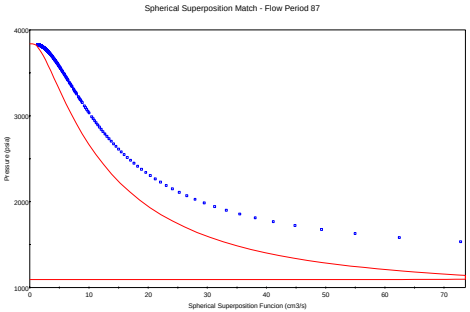
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3838.786	psia
pwf	1485.306	psia
k/u(xyz)	0.9537	mD/cp
k(xyz)	0.9537	mD
c(sys)	5.2873E-006	1/psi
S(p)	1.73	
C	1.164E-008	bbl/psi
ri	2	ft
p*(FRA)	3670.181	psia
k/u(FRA)	1.728	mD/cp
c(FRA)	5.0008E-006	1/psi









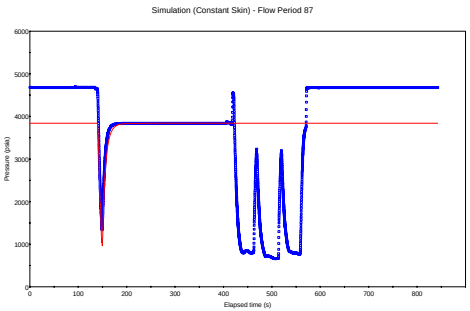
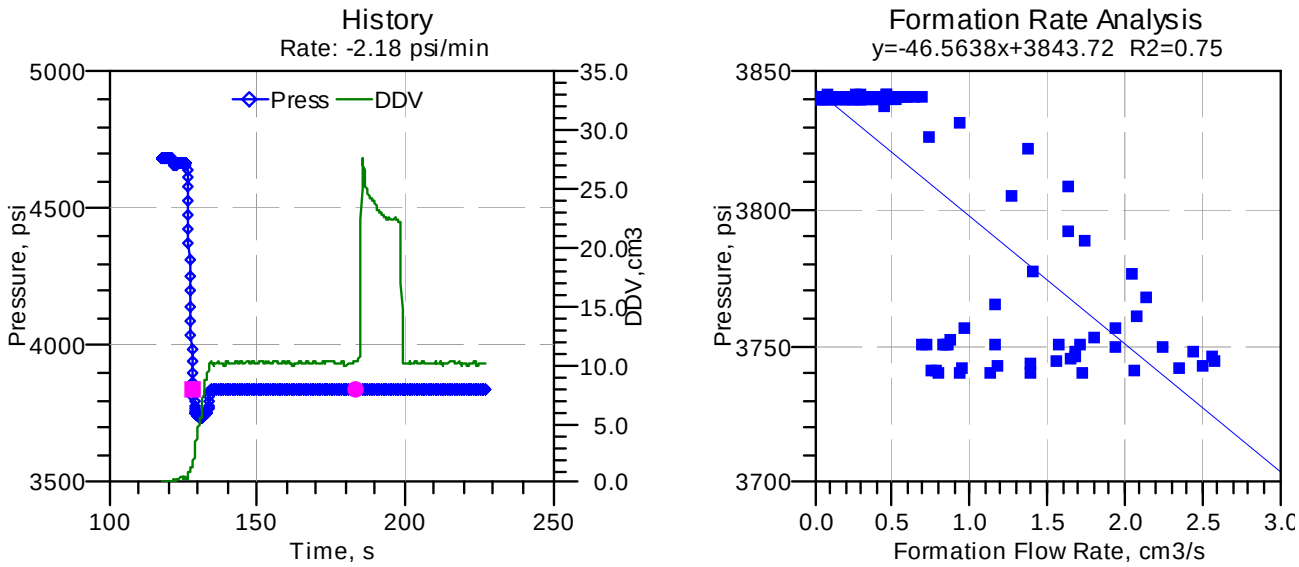


Figure 30 File no. i800g09_1: Depth 3190.4 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



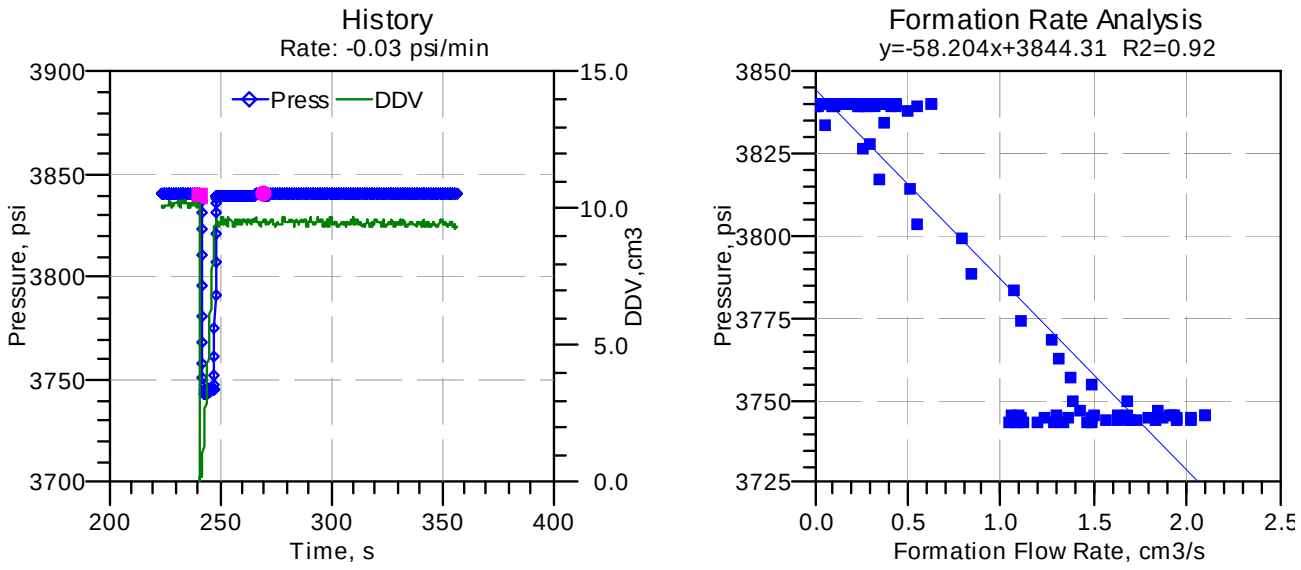
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
09_1	3190.4	2919.3	6.0e-6	3843.7	73.9	88.1	3840.4

Figure 31 File no. i800g09_2: Depth 3190.4 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

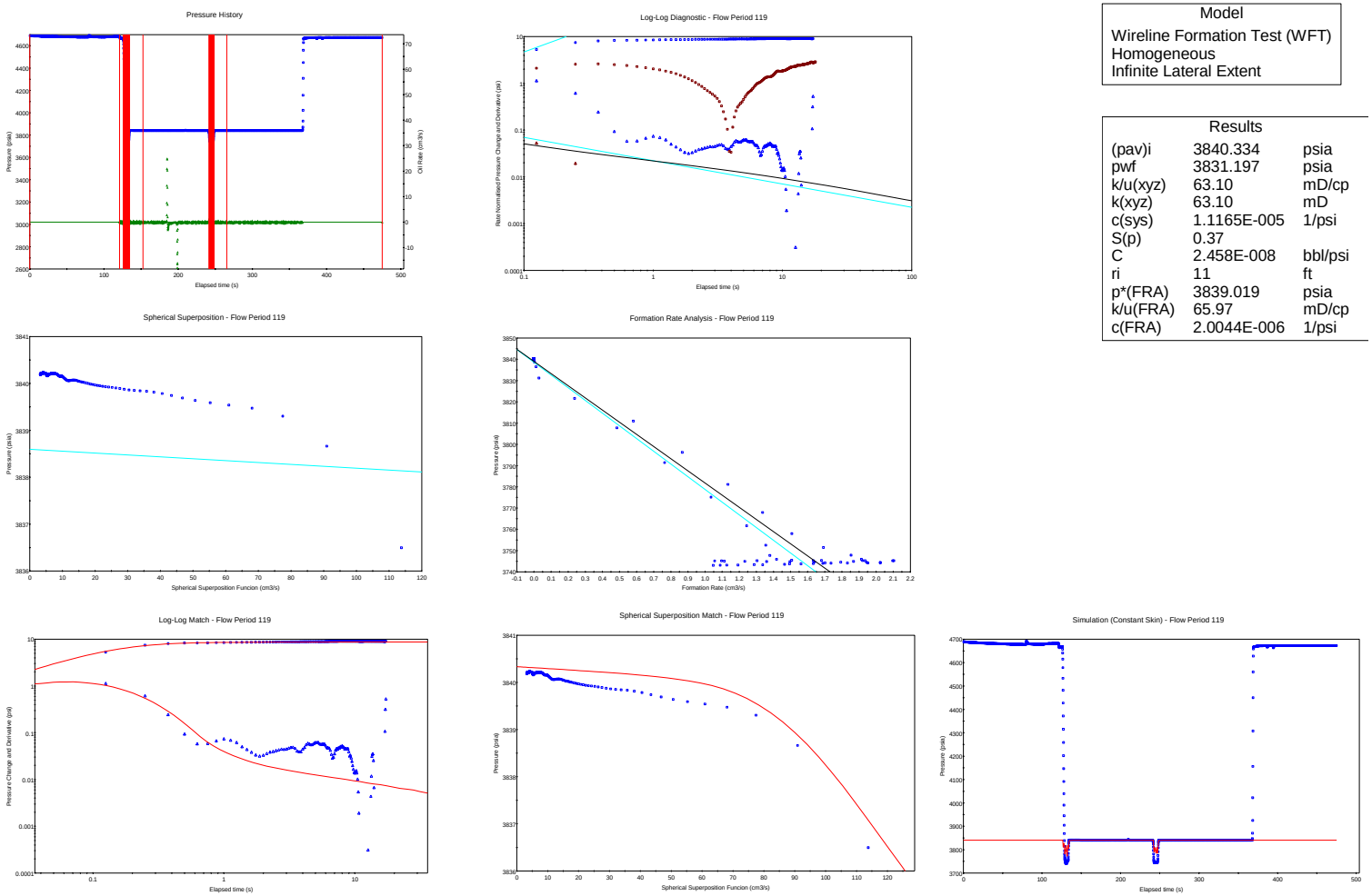
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
9_2	3190.4	2919.3	2.7e-6	3844.3	59.1	74.5	3840.3

Figure 32 File no. i800g09: Depth 3190.4 m-MD



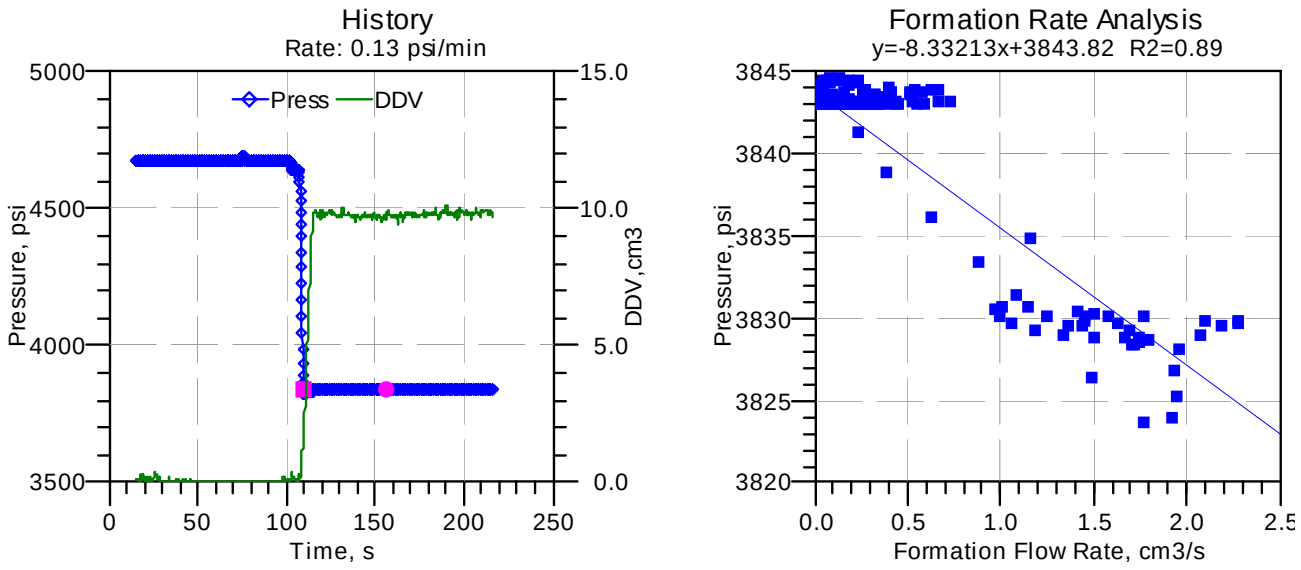
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3840.334	psia
pwf	3831.197	psia
k/u(xyz)	63.10	mD/cp
k(xyz)	63.10	mD
c(sys)	1.1165E-005	1/psi
S(p)	0.37	
C	2.458E-008	bbl/psi
ri	11	ft
p*(FRA)	3839.019	psia
k/u(FRA)	65.97	mD/cp
c(FRA)	2.0044E-006	1/psi

Figure 33 File no. i800g10_1: Depth 3192.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



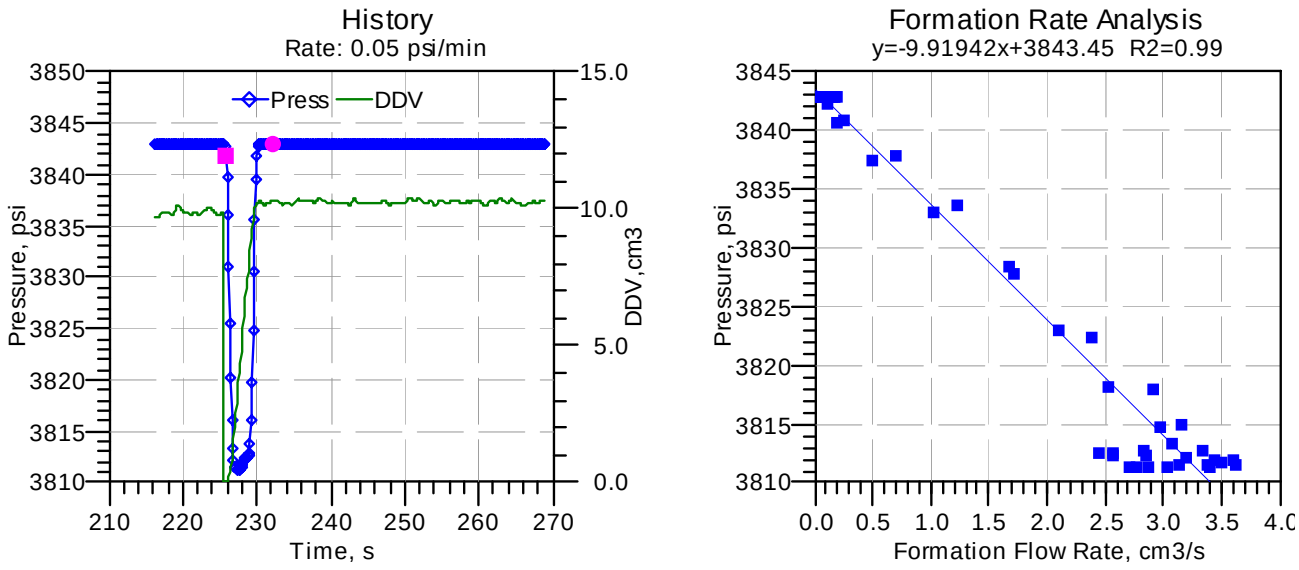
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
10_1	3192.2	2779.9	-1.1e-6	3843.8	413.2	398.1	3843.0

Figure 34 File no. i800g10_2: Depth 3192.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

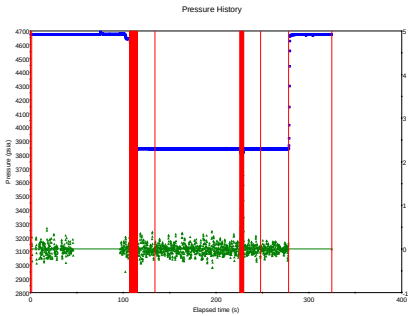
Wireline Formation Test Analyzer (WFTA^{SM})

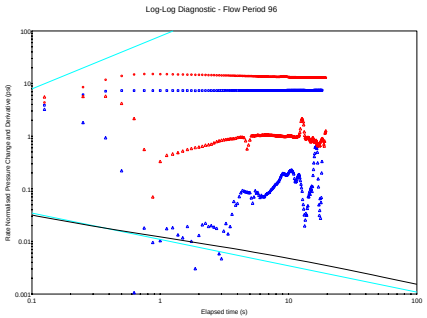


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
10__2	3192.2	2779.9	-2.3e-5	3843.5	347.0	393.6	3843.1

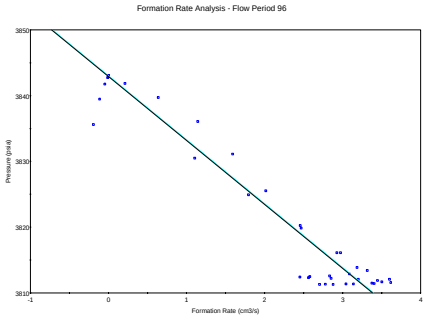
Figure 35 File no. i800g10: Depth 3192.2 m-MD

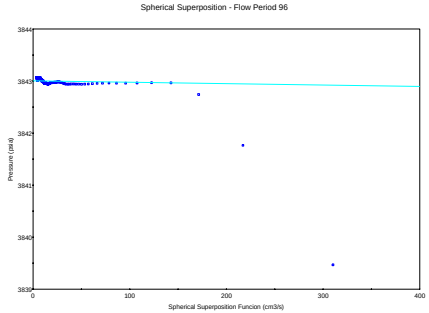


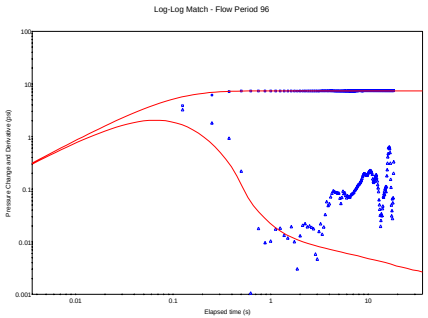


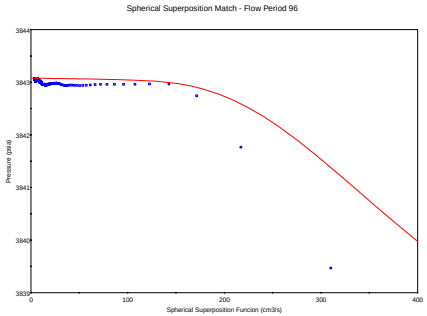
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3843.077	psia
pwf	3835.611	psia
k/u(xyz)	388.2	mD/cp
k(xyz)	388.2	mD
c(sys)	4.9019E-005	1/psi
S(p)	0.44	
C	1.0792E-007	bbl/psi
ri	27	ft
p*(FRA)	3842.898	psia
k/u(FRA)	388.2	mD/cp
c(FRA)	-1.7836E-005	1/psi









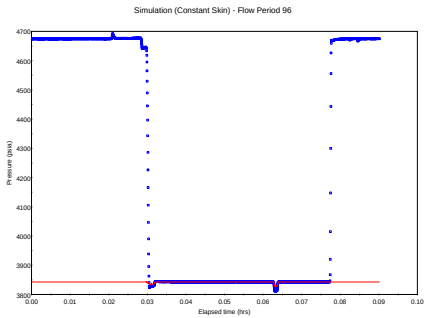
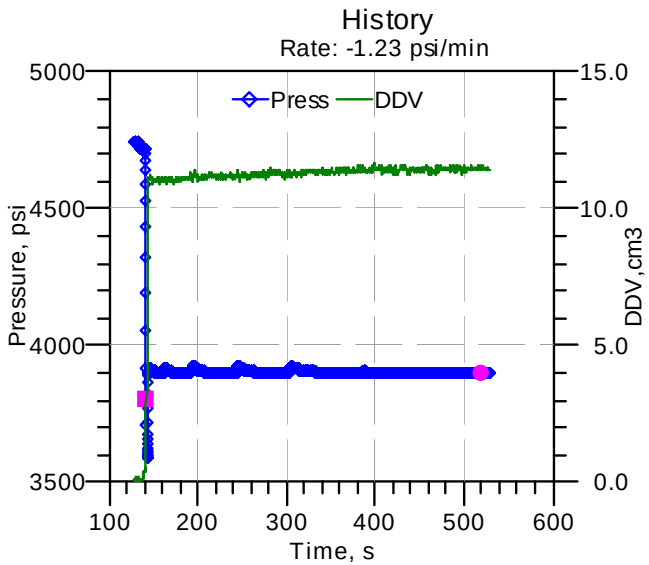
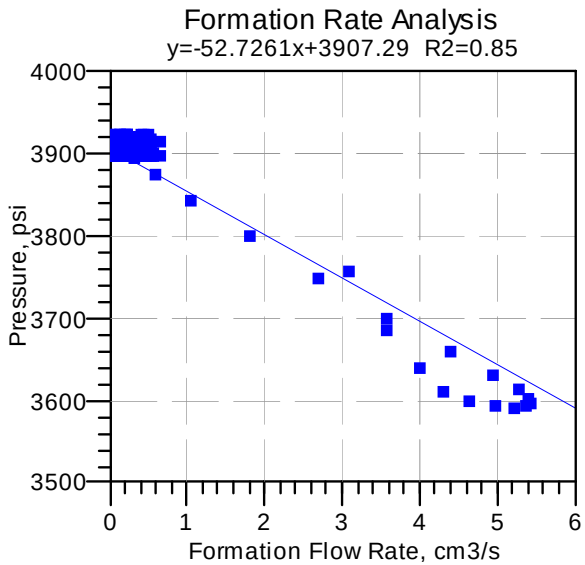


Figure 36 File no. i800g11_1: Depth 3234.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





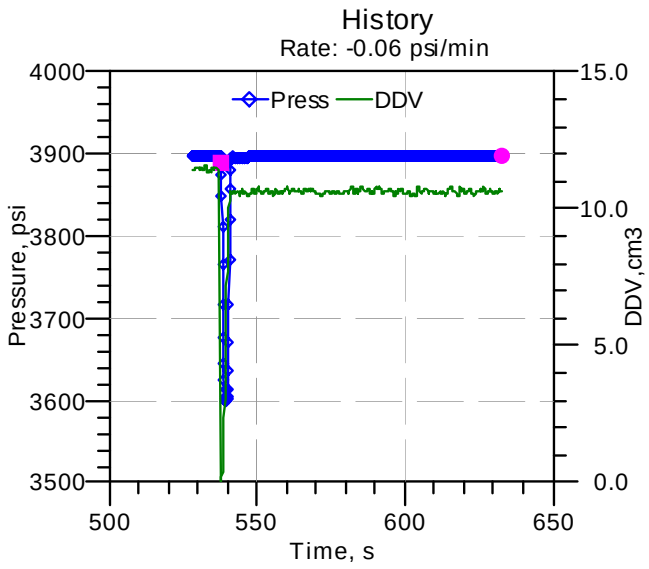
Pressure Test Results-FRA Compliant

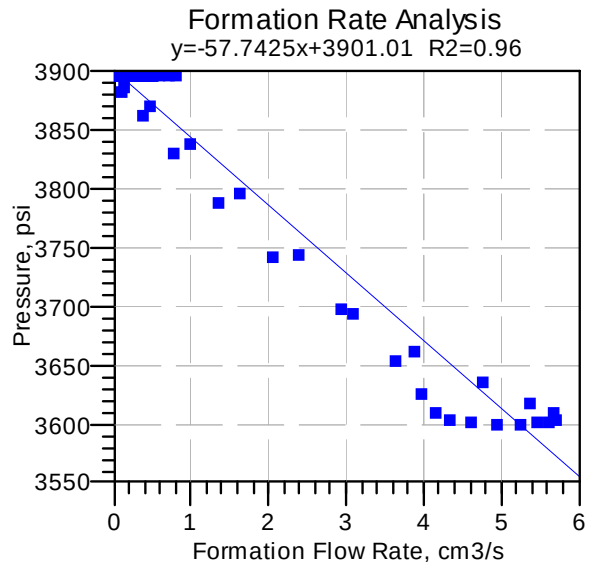
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
11_1	3234.6	2817.4	2.8e-6	3907.3	65.3	60.7	3899.1

Figure 37 File no. i800g11_2: Depth 3234.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





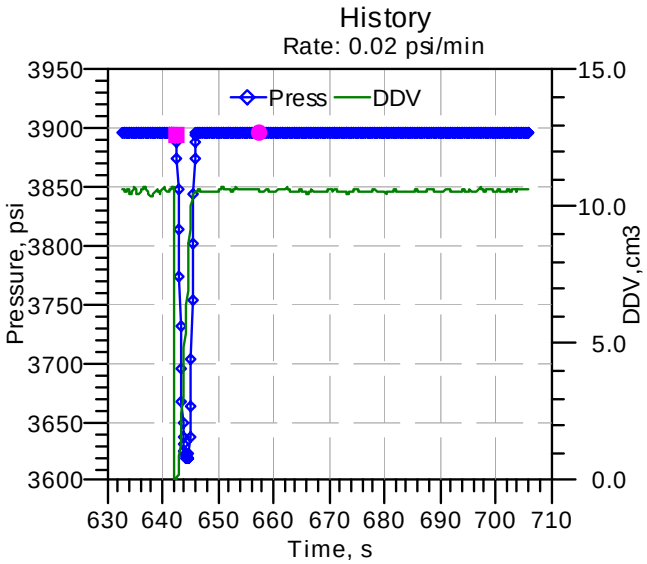
Pressure Test Results-FRA Compliant

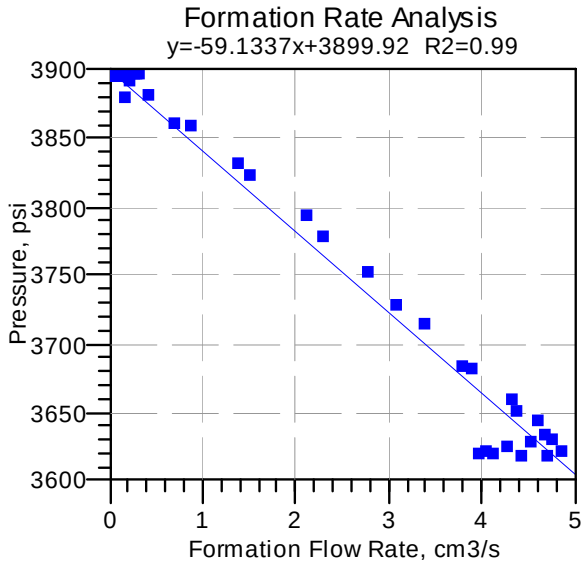
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
11_2	3234.6	2817.4	2.2e-6	3901.0	59.6	66.4	3896.9

Figure 38 File no. i800g11_3: Depth 3234.6 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

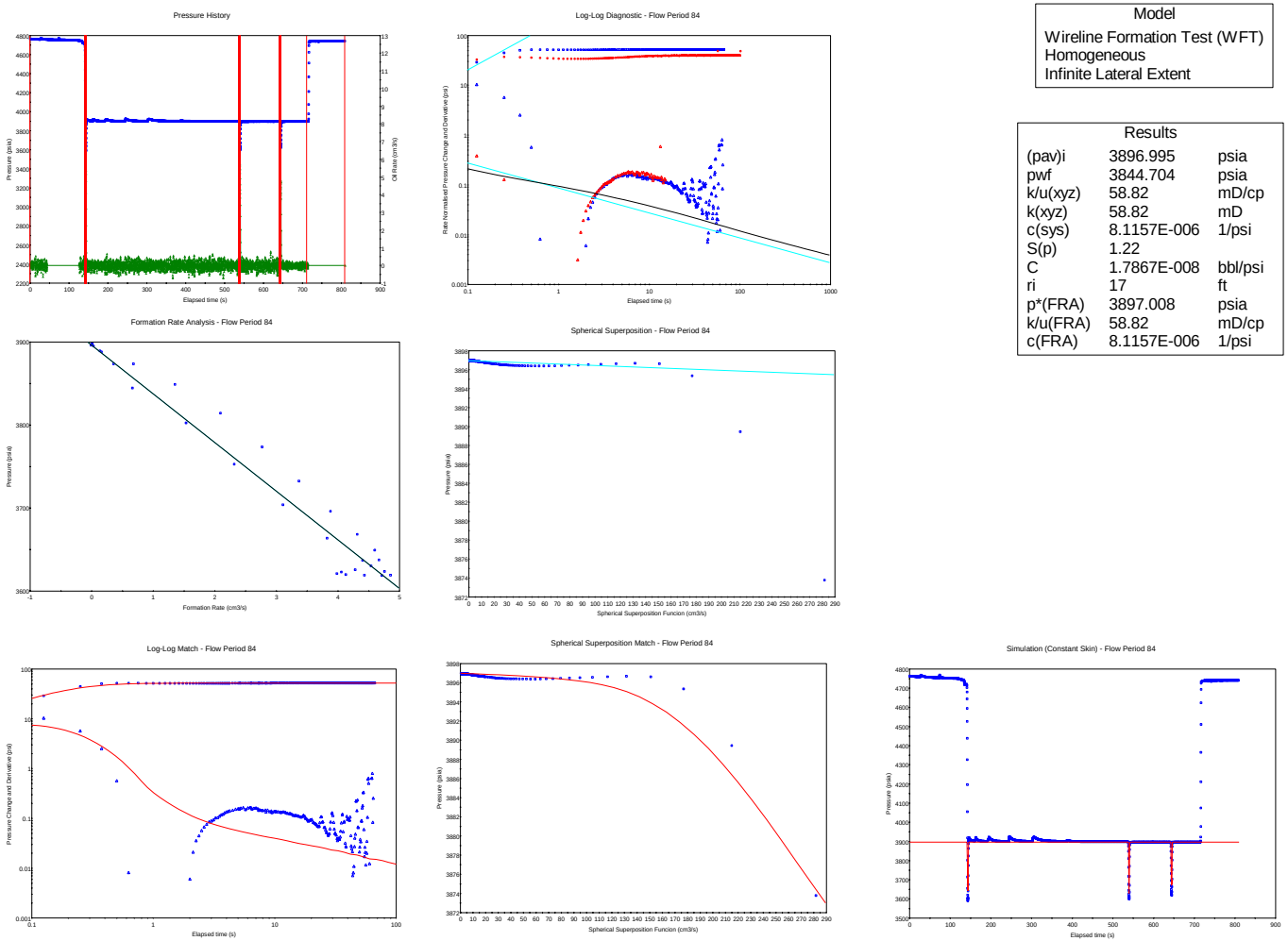




Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
11_3	3234.6	2817.4	7.9e-6	3899.9	58.2	60.0	3897.0

Figure 39 File no. i800g11: Depth 3234.6 m-MD



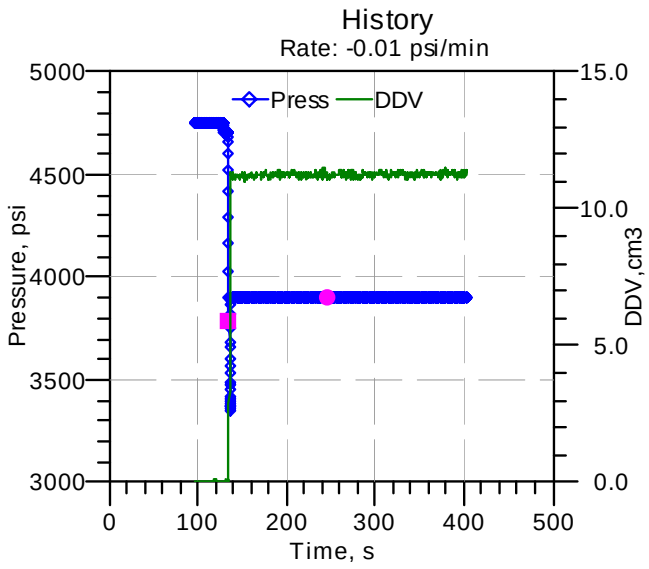
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

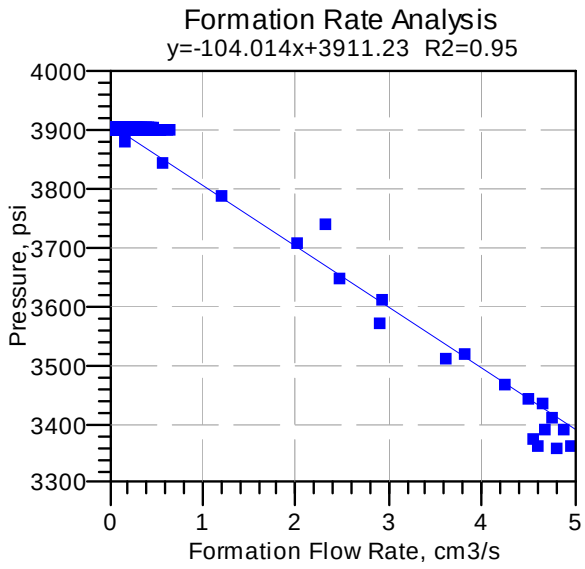
Results		
(pav)i	3896.995	psia
pwf	3844.704	psia
k/u(xyz)	58.82	mD/cp
k(xyz)	58.82	mD
c(sys)	8.1157E-006	1/psi
S(p)	1.22	
C	1.7867E-008	bbl/psi
ri	17	ft
p*(FRA)	3897.008	psia
k/u(FRA)	58.82	mD/cp
c(FRA)	8.1157E-006	1/psi

Figure 40 File no. i800g12_1: Depth 3239.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





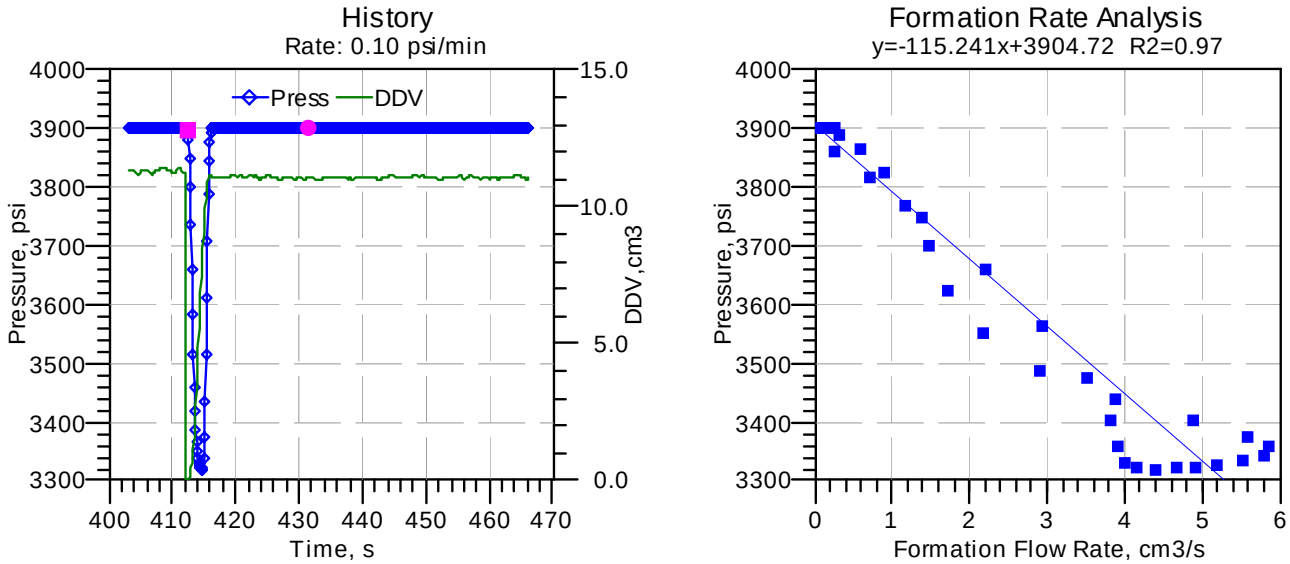
Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
12_1	3239.8	2821.8	4.0e-6	3911.2	33.1	31.2	3903.3

Figure 41 File no. i800g12_2: Depth 3239.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

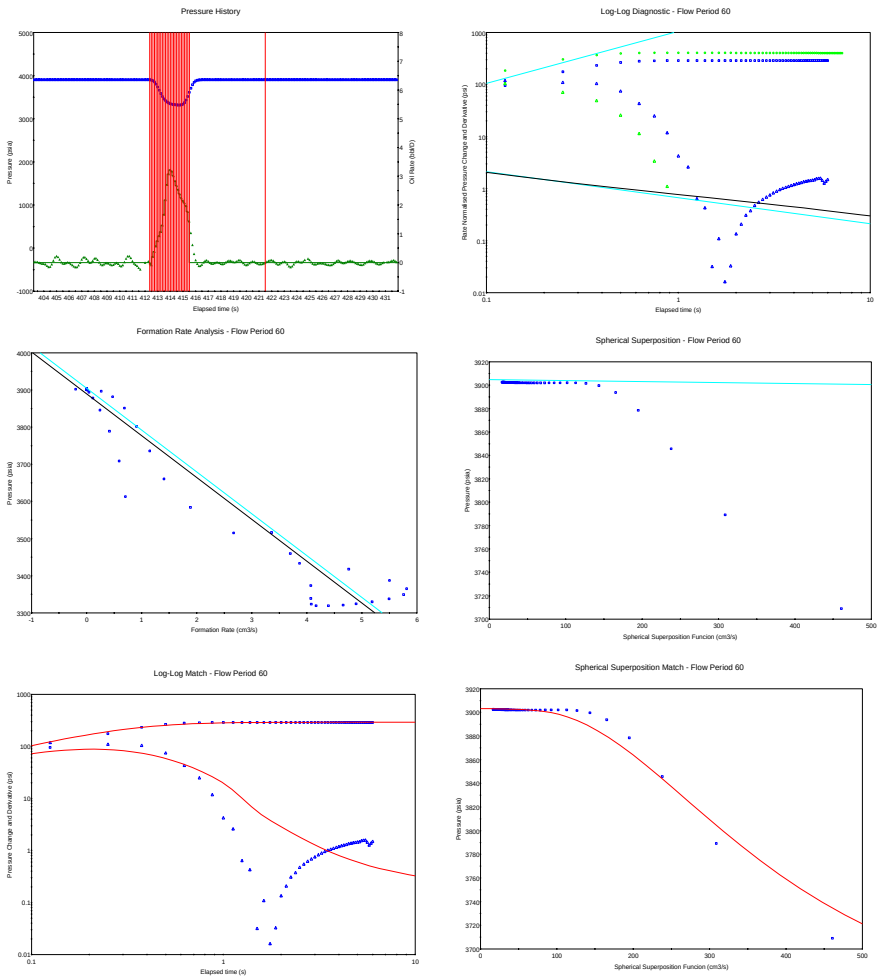
Wireline Formation Test Analyzer (WFTA^{SM})

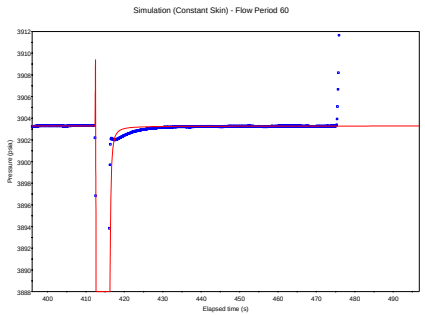


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
12_2	3239.8	2821.8	1.1e-6	3904.7	29.9	34.7	3903.3

Figure 42 File no. i800g12: Depth 3239.8 m-MD





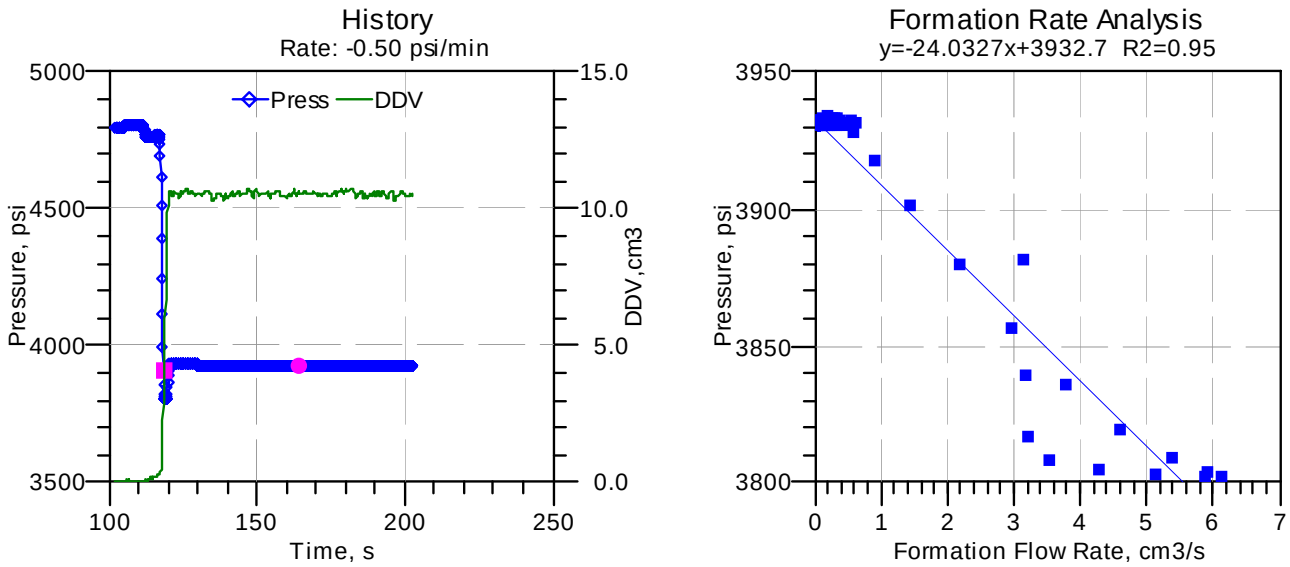
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3903.281	psia
pwf	3613.342	psia
k/u(xyz)	33.50	mD/cp
k(xyz)	33.50	mD
c(sys)	7.1747E-006	1/psi
S(p)	1.38	
C	1.5795E-008	bbl/psi
ri	6	ft
p*(FRA)	3889.741	psia
k/u(FRA)	33.50	mD/cp
c(FRA)	2.63E-006	1/psi

Figure 43 File no. i800g13_1: Depth 3259.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



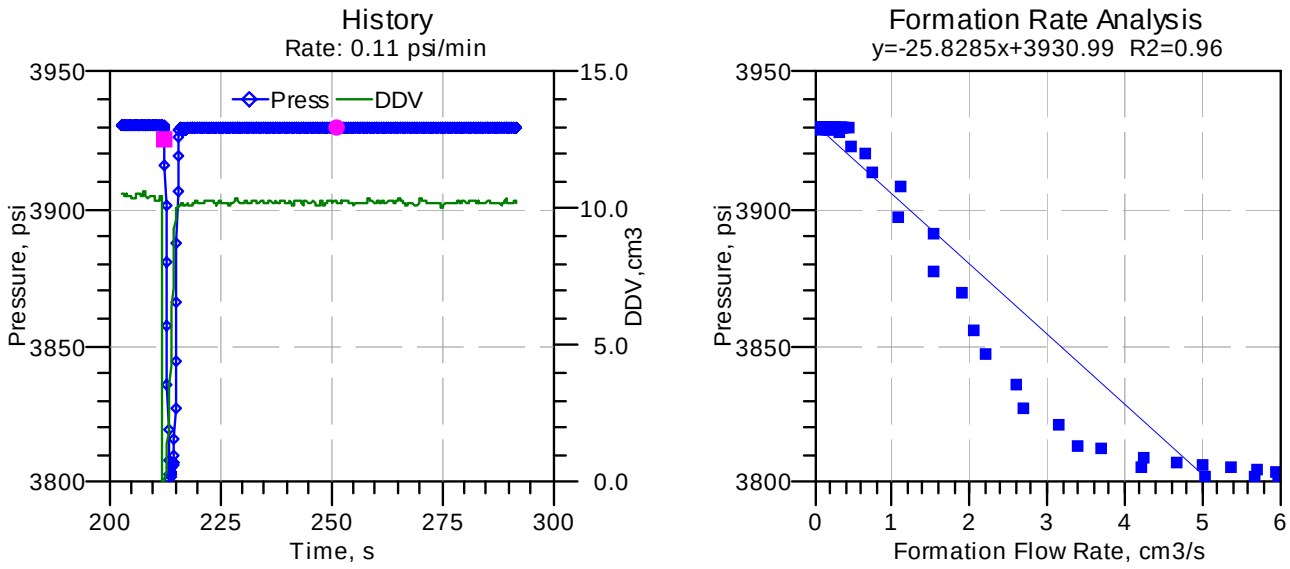
Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
13_1	3259.7	2839.4	7.7e-6	3932.7	143.2	164.6	3930.2

Figure 44 File no. i800g13_2: Depth 3259.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

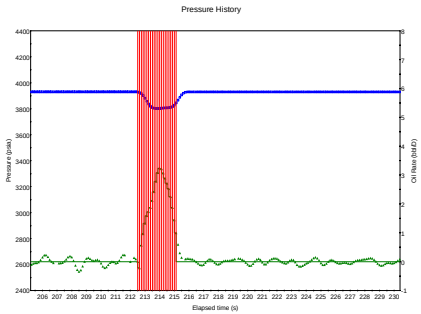
Wireline Formation Test Analyzer (WFTA^{SM})

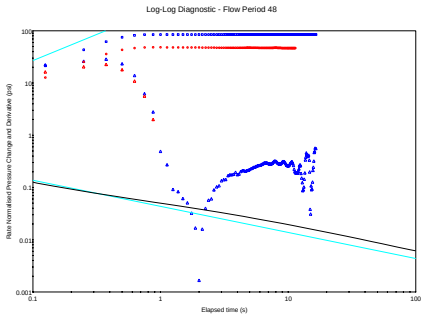


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
13_2	3259.7	2839.4	1.6e-5	3931.0	133.3	161.3	3929.7

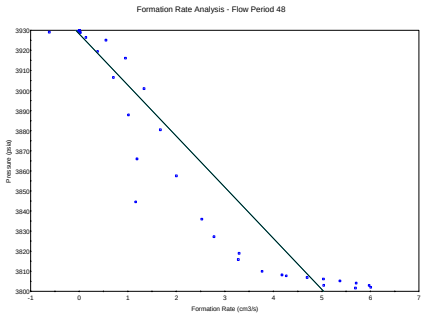
Figure 45 File no. i800g13: Depth 3259.7 m-MD

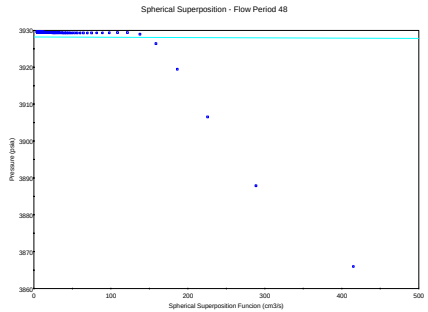


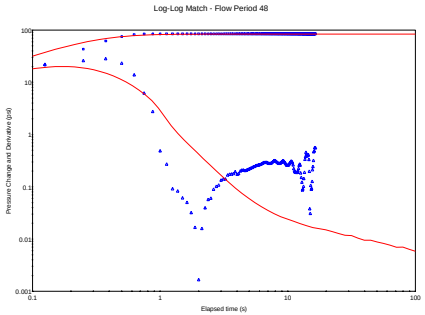


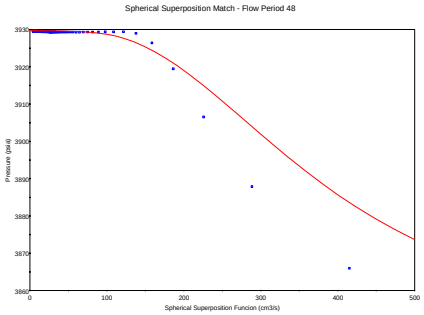
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3929.692	psia
pwf	3844.598	psia
k/u(xyz)	148.3	mD/cp
k(xyz)	148.3	mD
c(sys)	1.9417E-005	1/psi
S(p)	2.57	
C	4.2746E-008	bbl/psi
ri	22	ft
p*(FRA)	3928.212	psia
k/u(FRA)	148.3	mD/cp
c(FRA)	1.9417E-005	1/psi









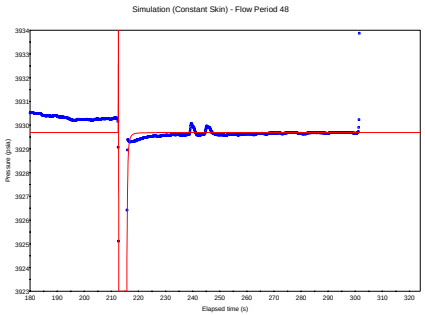
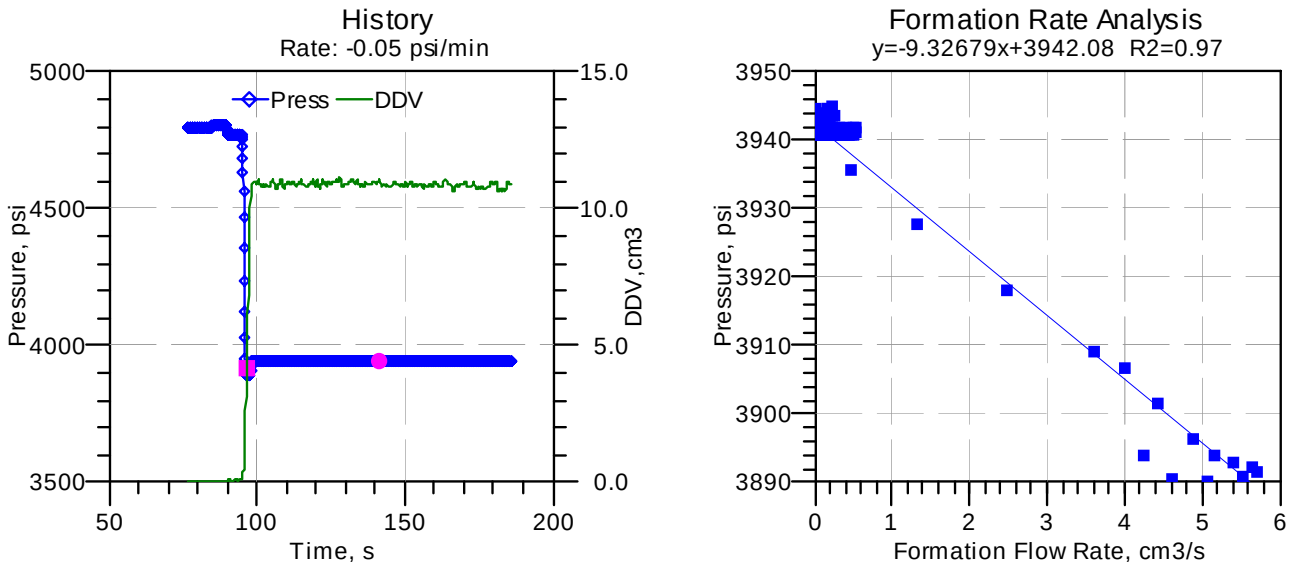


Figure 46 File no. i800g14_1: Depth 3268.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

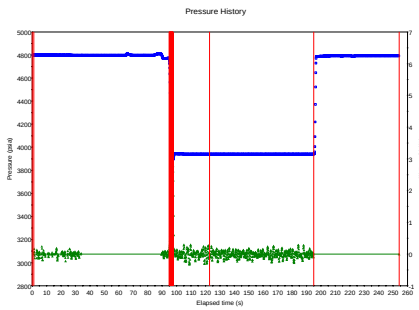
Wireline Formation Test Analyzer (WFTA^{SM})

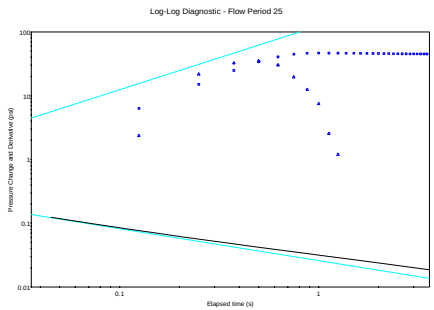


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
14_1	3268.7	2847.4	8.5e-6	3942.1	369.1	388.2	3940.7

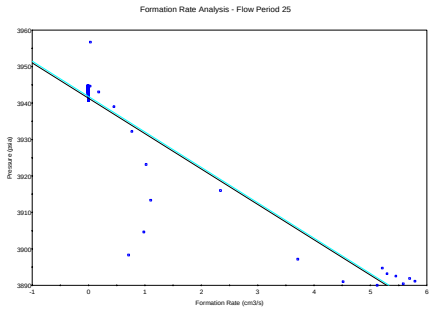
Figure 47 File no. i800g14: Depth 3268.7 m-MD

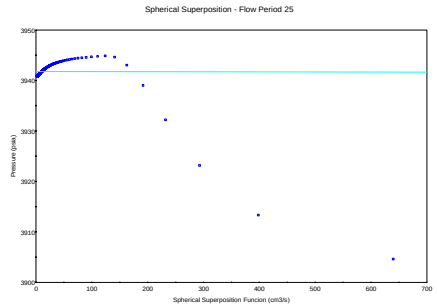


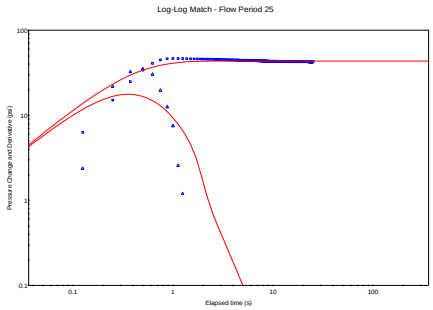


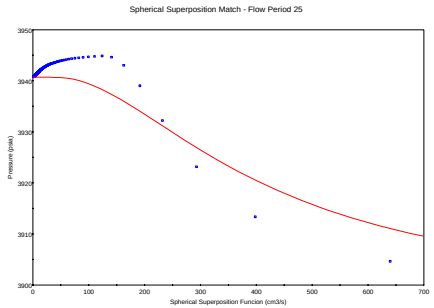
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3940.728	psia
pwf	3898.323	psia
k/u(xyz)	388.9	mD/cp
k(xyz)	388.9	mD
c(sys)	0.00011083	1/psi
S(p)	1.60	
C	2.4399E-007	bbl/psi
ri	46	ft
p*(FRA)	3941.304	psia
k/u(FRA)	388.9	mD/cp
c(FRA)	4.0161E-005	1/psi









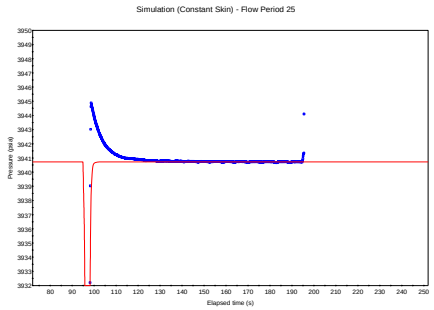
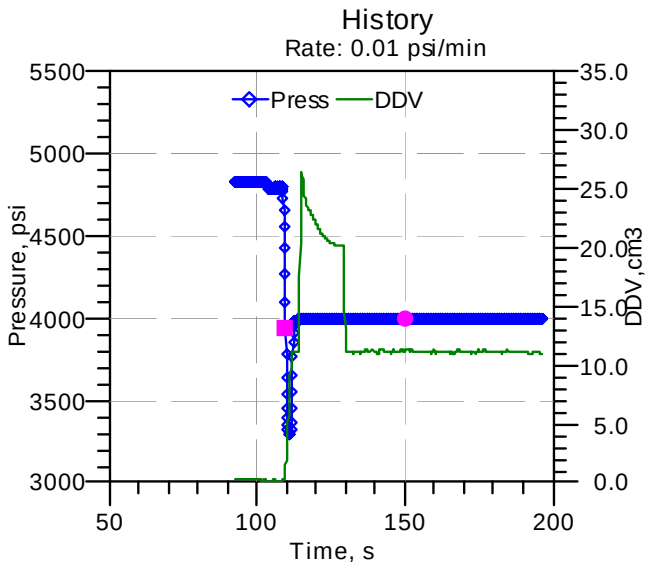
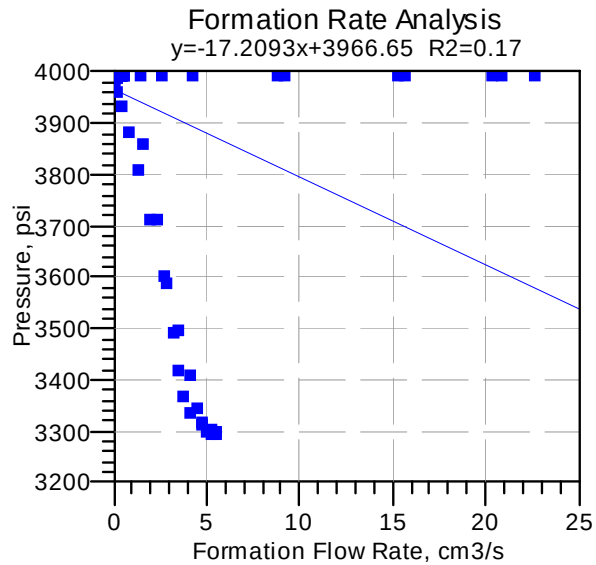


Figure 48 File no. i800g16_1: Depth 3307.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





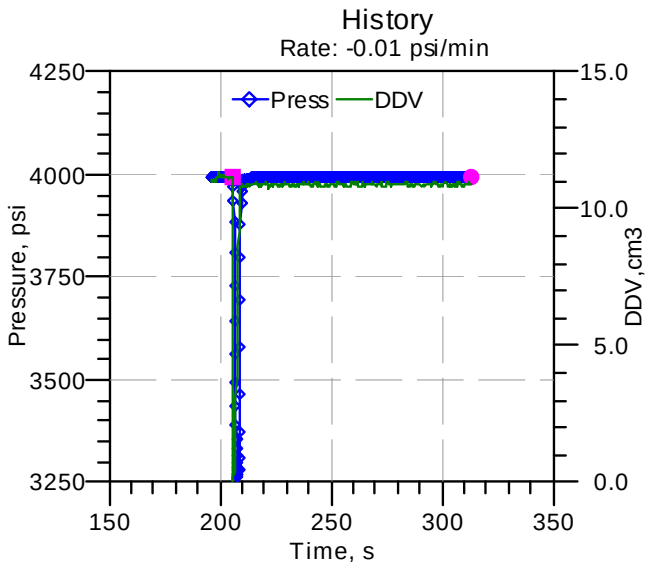
Pressure Test Results-NOT FRA Compliant

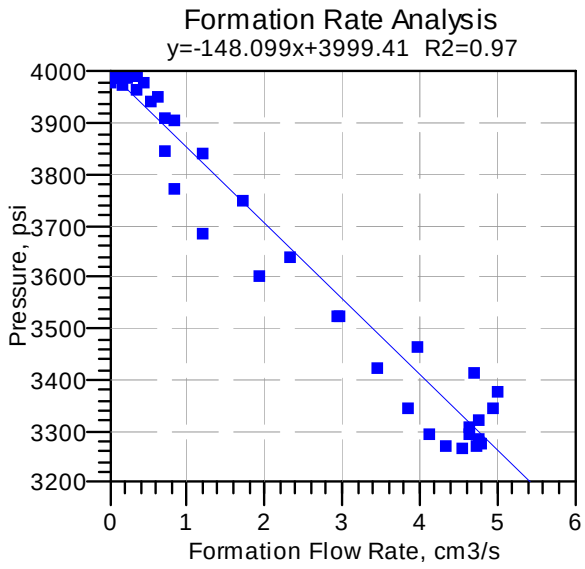
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
16_1	3307.0	2881.5	4.5e-6	3966.6	200.0	111.9	3993.0

Figure 49 File no. i800g16_2: Depth 3307.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

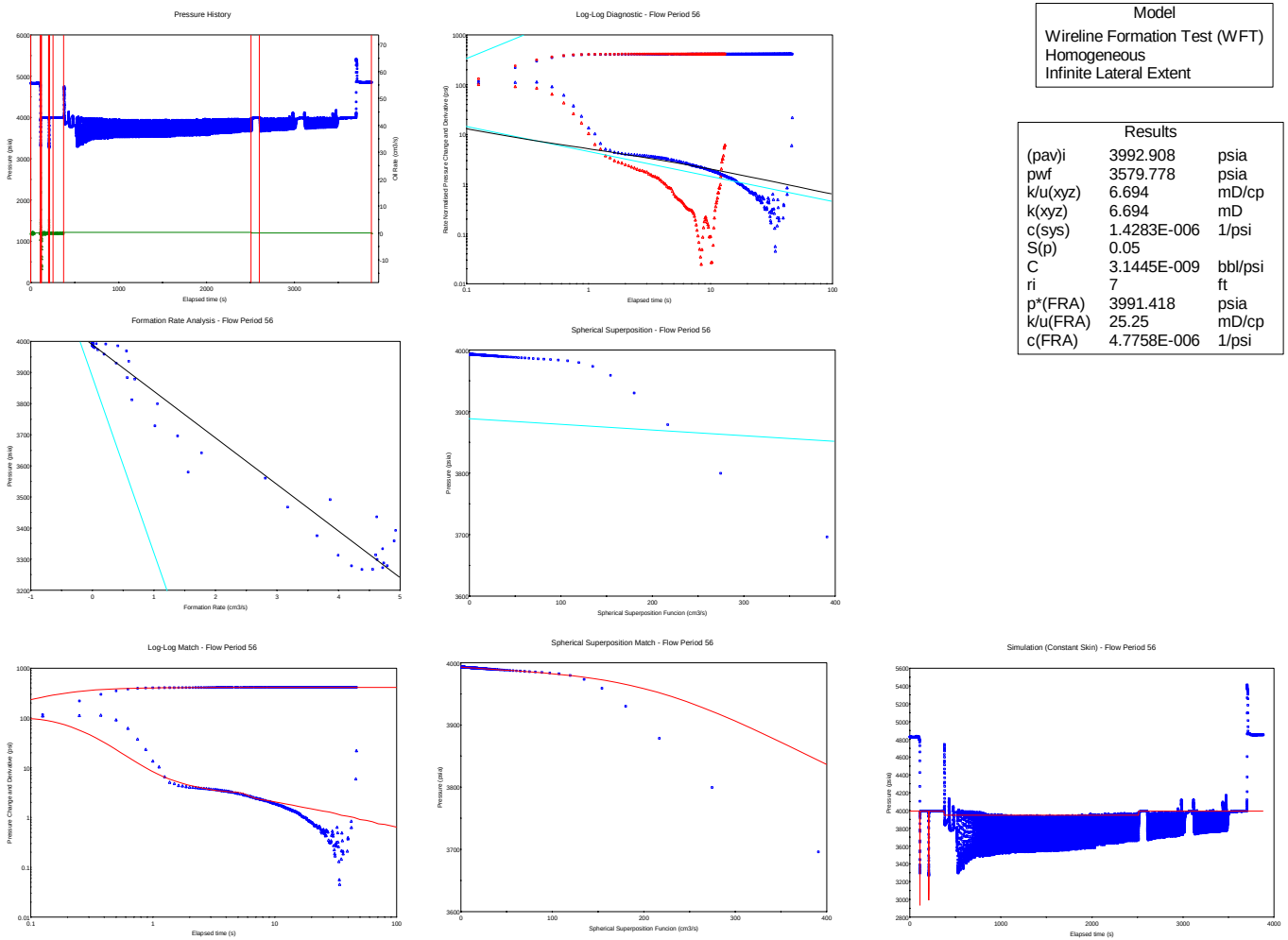




Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
16_2	3307.0	2881.5	1.7e-7	3821.5	49.4	25.4	3993.1

Figure 50 File no. i800g16: Depth 3307.0 m-MD



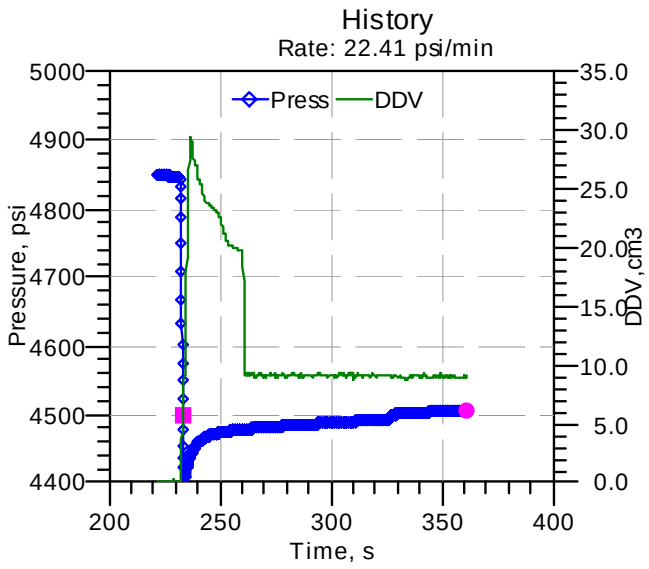
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

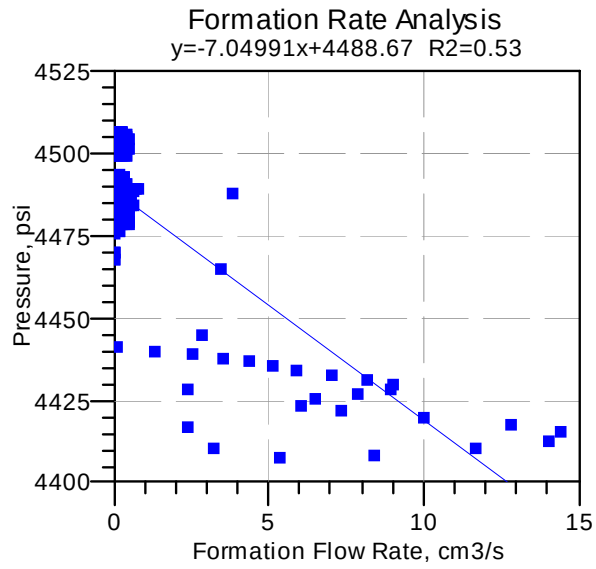
Results		
(pav)i	3992.908	psia
pwf	3579.778	psia
k/u(xyz)	6.694	mD/cp
k(xyz)	6.694	mD
c(sys)	1.4283E-006	1/psi
S(p)	0.05	
C	3.1445E-009	bbl/psi
ri	7	ft
p*(FRA)	3991.418	psia
k/u(FRA)	25.25	mD/cp
c(FRA)	4.7758E-006	1/psi

Figure 51 File no. i800g17_1: Depth 3307.9 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





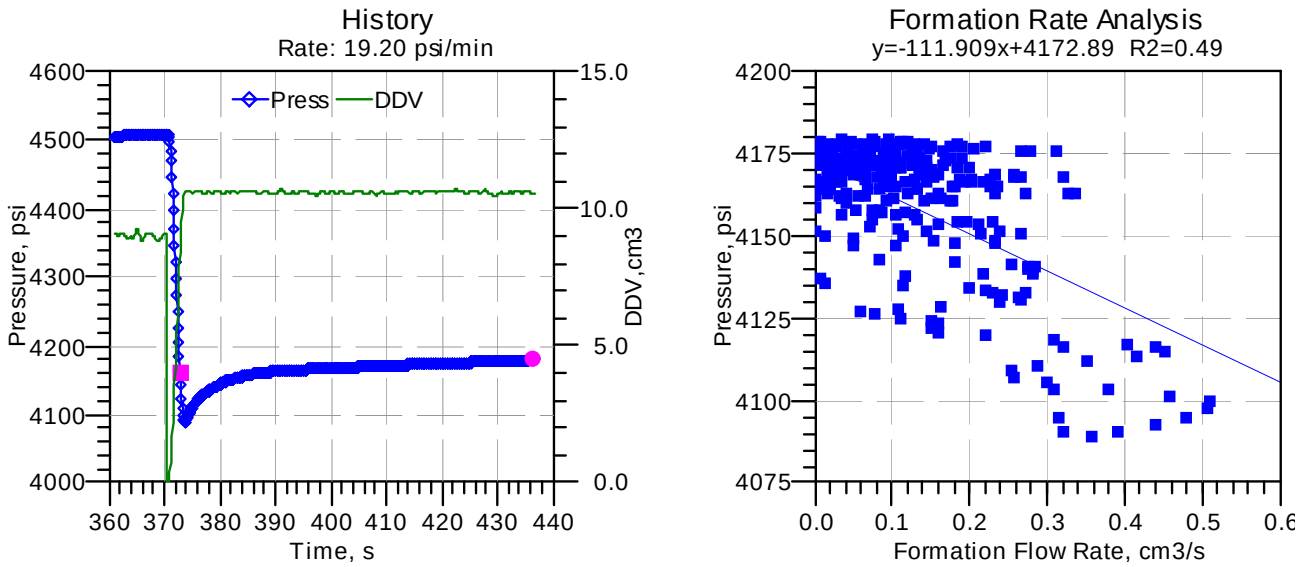
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
17_1	3307.9	2882.3	2.9e-5	4488.7	488.3	501.5	4506.6

Figure 52 File no. i800g17_2: Depth 3307.9 m-MD

Company: **BASS STRAIT OIL COMPANY LTD**
Field: **EXPLORATION**
Well: **ZANE GREY-1/ST1/ST2**

Wireline Formation Test Analyzer (WFTA^{SM})



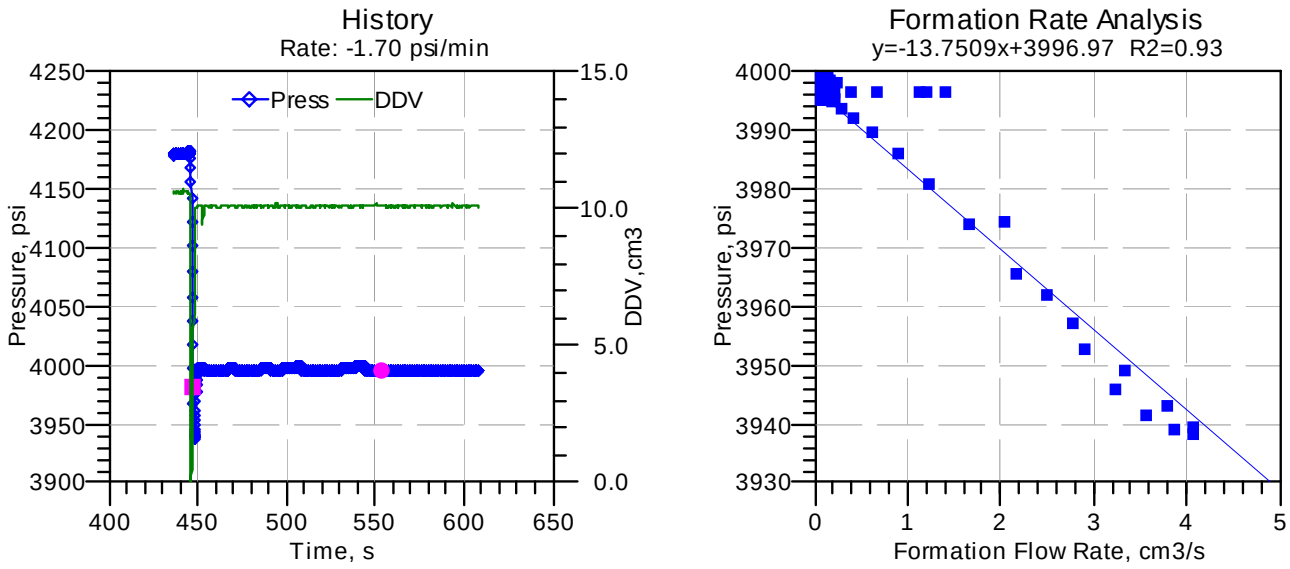
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
17_2	3307.9	2882.3	7.7e-5	4172.9	30.8	19.4	4179.6

Figure 53 File no. i800g17_3: Depth 3307.9 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



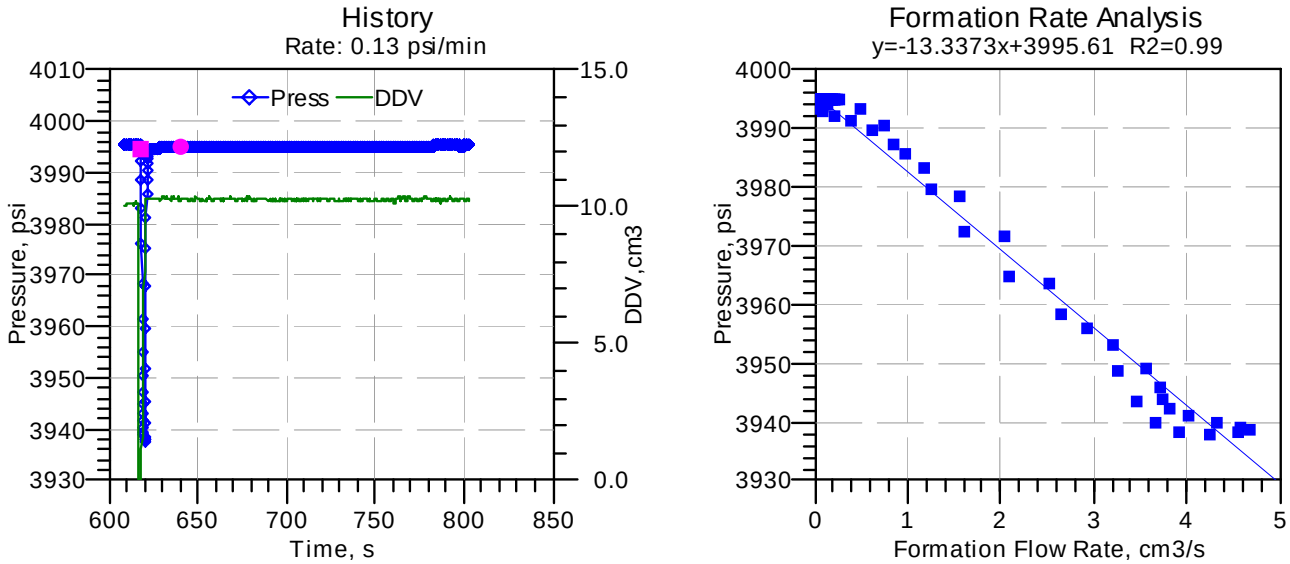
Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
17_3	3307.9	2882.3	6.4e-5	3997.0	250.3	244.7	3995.4

Figure 54 File no. i800g17_4: Depth 3307.9 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

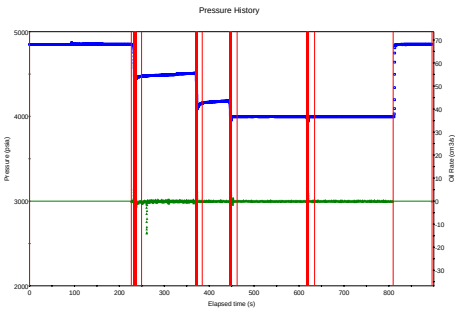
Wireline Formation Test Analyzer (WFTA^{SM})

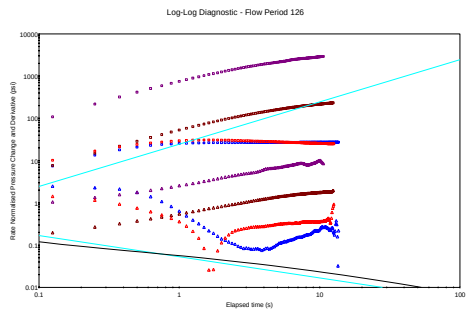


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
17_4	3307.9	2882.3	9.5e-5	3995.6	258.1	281.1	3995.3

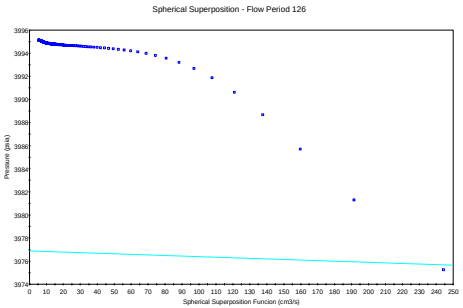
Figure 55 File no. i800g17: Depth 3307.9 m-MD

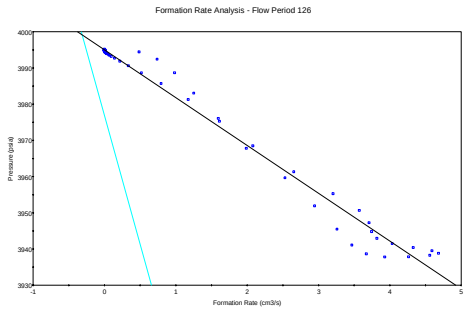


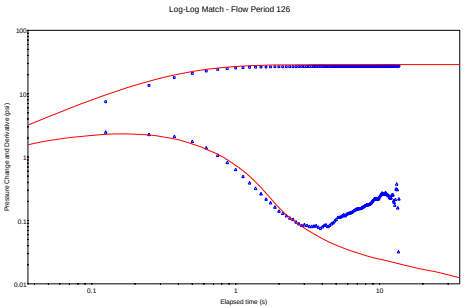


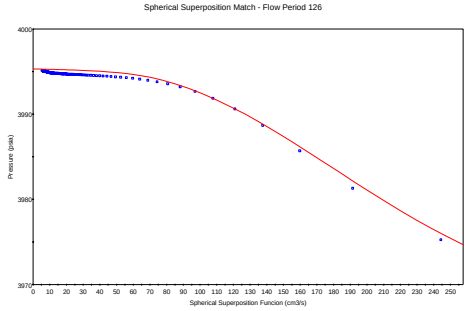
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3995.318	psia
pwf	3967.809	psia
k/u(xyz)	52.98	mD/cp
k(xyz)	52.98	mD
c(sys)	4.2051E-005	1/psi
S(p)	-0.19	
C	9.2575E-008	bbl/psi
ri	9	ft
p*(FRA)	3995.015	psia
k/u(FRA)	285.9	mD/cp
c(FRA)	9.5261E-005	1/psi









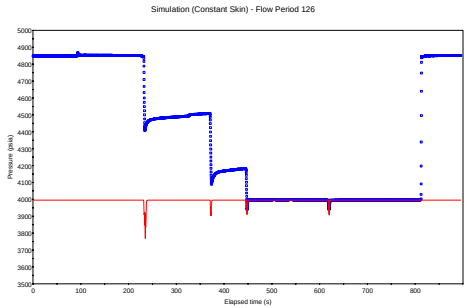
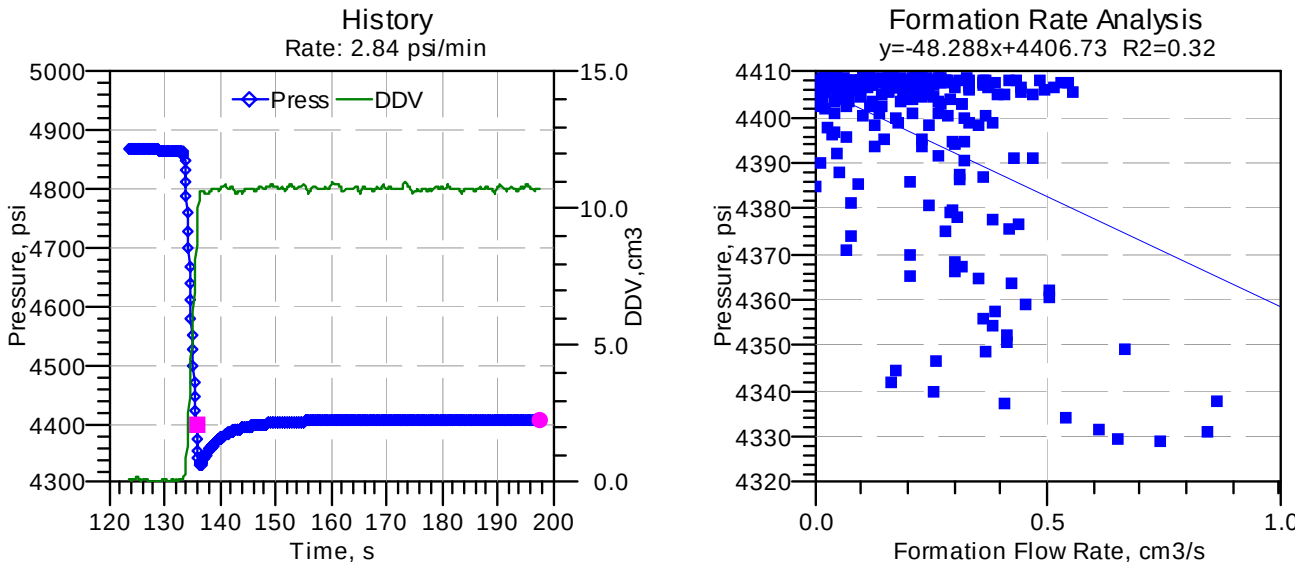


Figure 56 File no. i800g18_1: Depth 3309.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



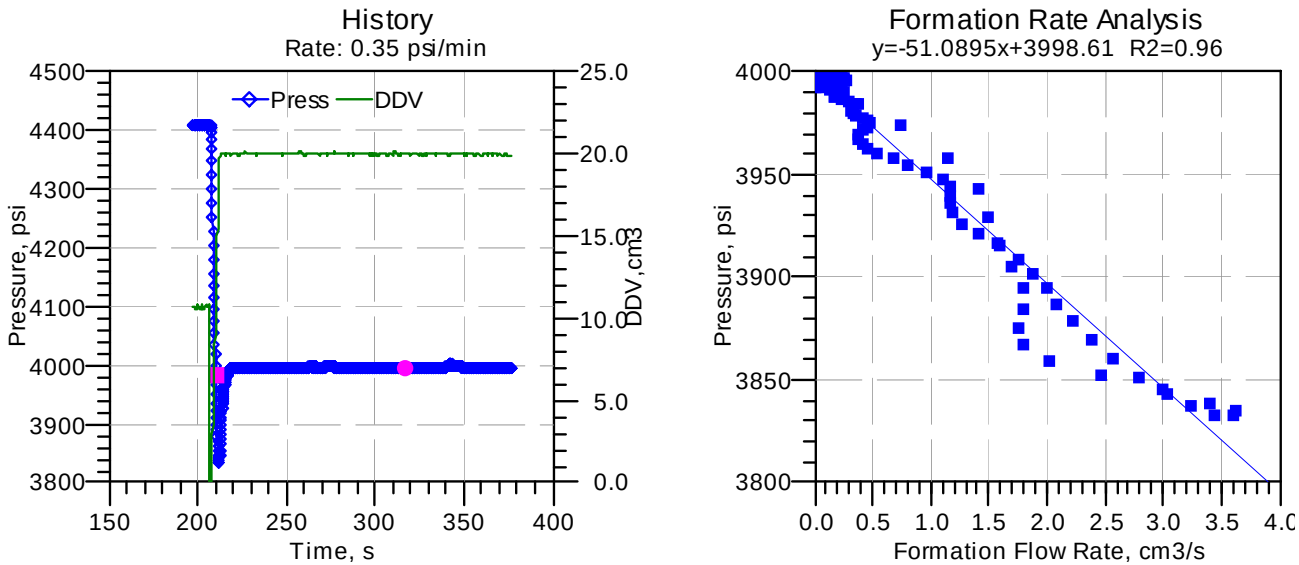
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
18_1	3309.1	2883.4	6.5e-5	4406.7	71.3	37.4	4408.6

Figure 57 File no. i800g18_2: Depth 3309.1 m-MD

Company: **BASS STRAIT OIL COMPANY LTD**
Field: **EXPLORATION**
Well: **ZANE GREY-1/ST1/ST2**

Wireline Formation Test Analyzer (WFTA^{SM})



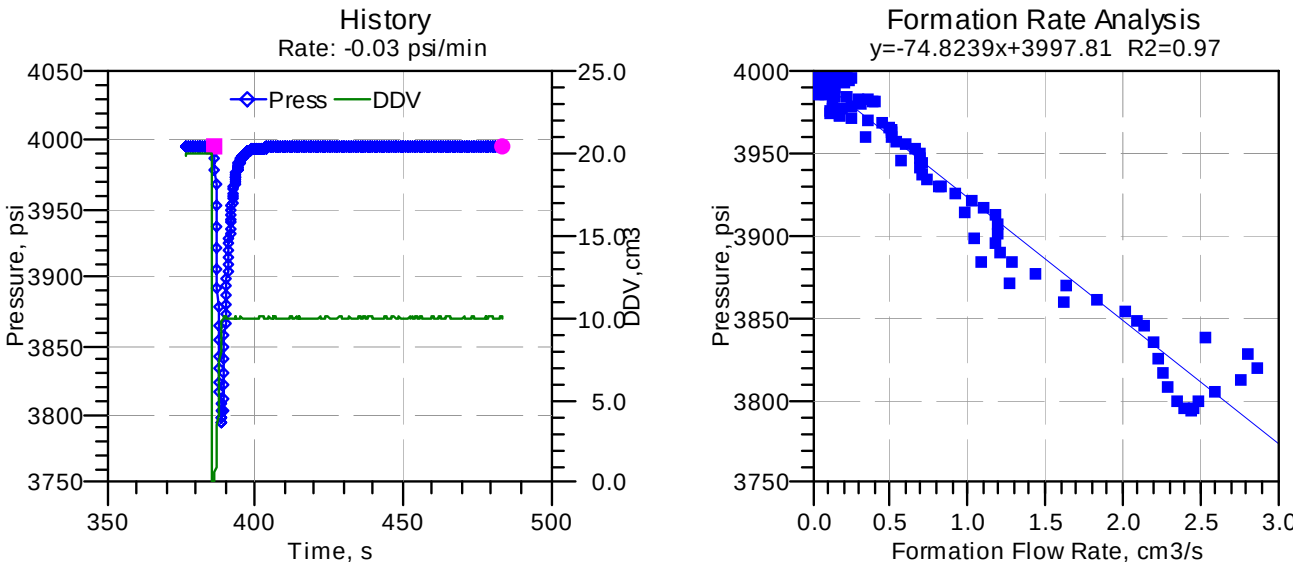
Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
18_2	3309.1	2883.4	9.3e-5	3998.6	67.4	75.9	3996.3

Figure 58 File no. i800g18_3: Depth 3309.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

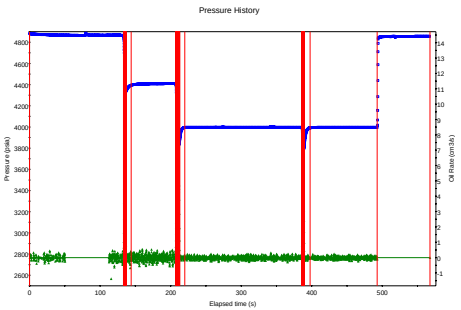
Wireline Formation Test Analyzer (WFTA^{SM})

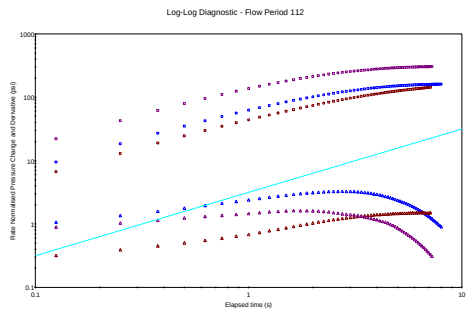


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
18_3	3309.1	2883.4	7.9e-5	3997.8	46.0	49.0	3995.7

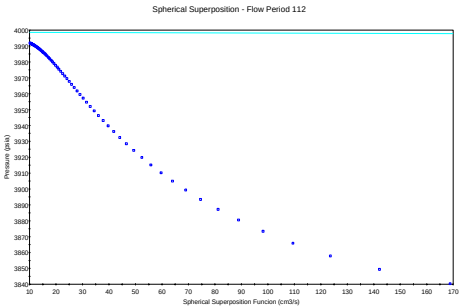
Figure 59 File no. i800g18: Depth 3309.1 m-MD

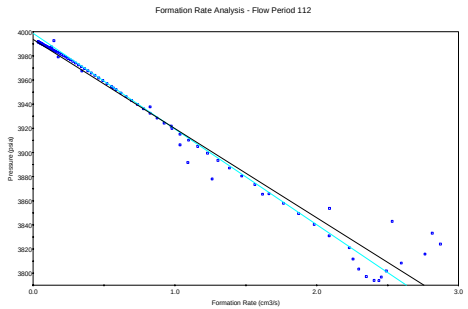


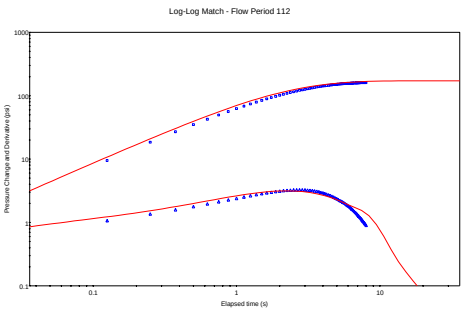


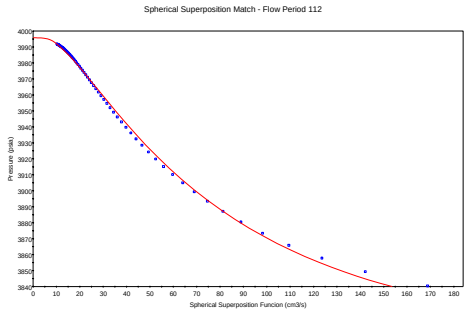
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3995.766	psia
pwf	3830.876	psia
k/u(xyz)	47.62	mD/cp
k(xyz)	47.62	mD
c(sys)	7.2664E-005	1/psi
S(p)	1.94	
C	1.5997E-007	bbl/psi
ri	7	ft
p*(FRA)	3993.731	psia
k/u(FRA)	51.07	mD/cp
c(FRA)	7.877E-005	1/psi









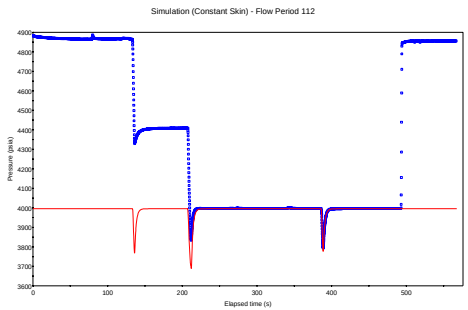
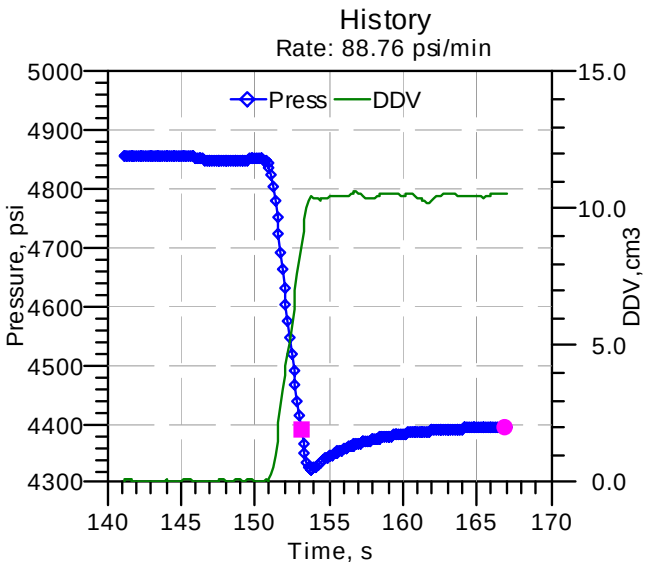
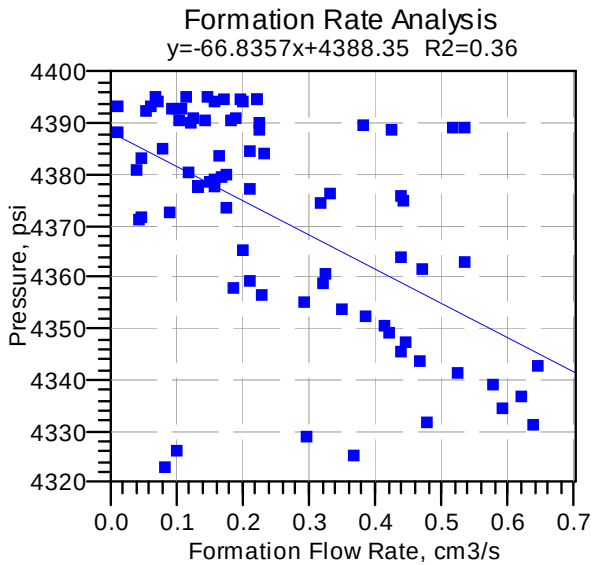


Figure 60 File no. i800g19_1: Depth 3311.4 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





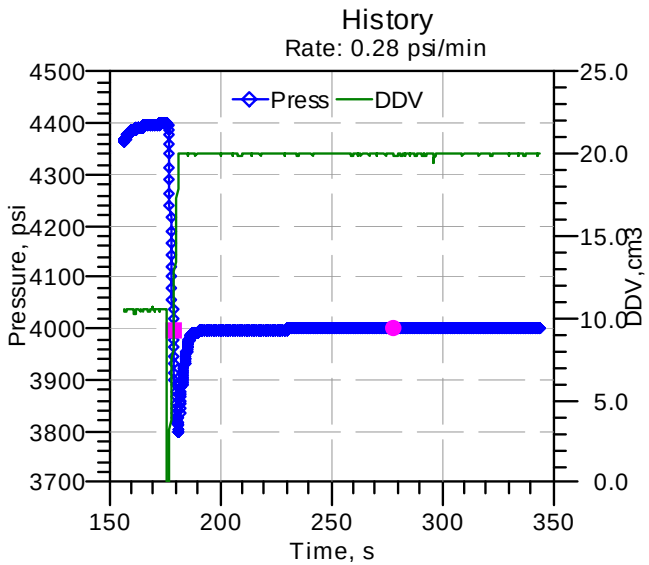
Pressure Test Results-NOT FRA Compliant

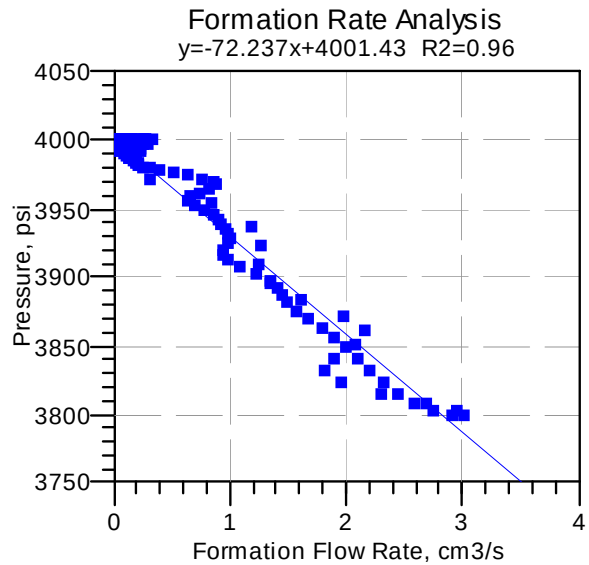
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
19_1	3311.4	2885.4	6.5e-5	4388.4	51.5	30.6	4395.6

Figure 61 File no. i800g19_2: Depth 3311.4 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

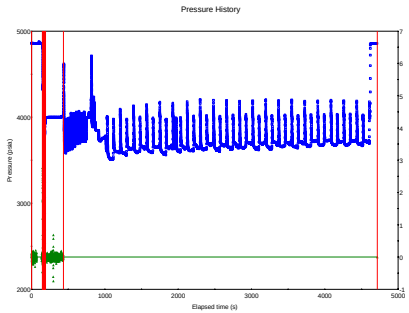


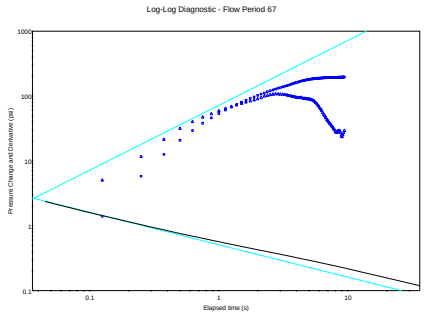


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
19_2	3311.4	2885.4	2.1e-7	3727.2	-35.3	82.0	3722.0

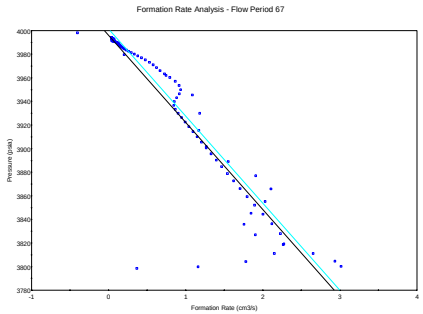
Figure 62 File no. i800g19: Depth 3311.4 m-MD

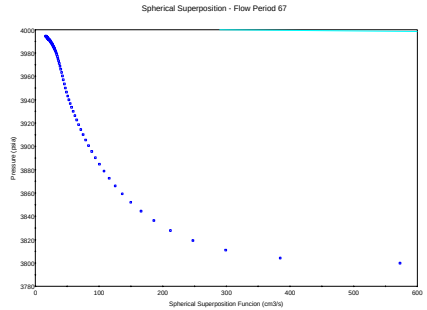


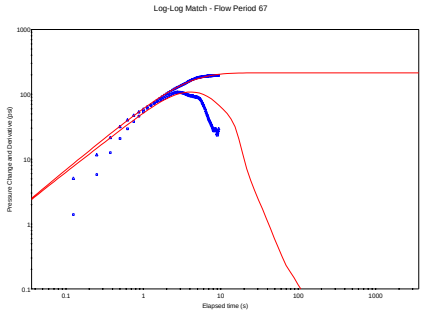


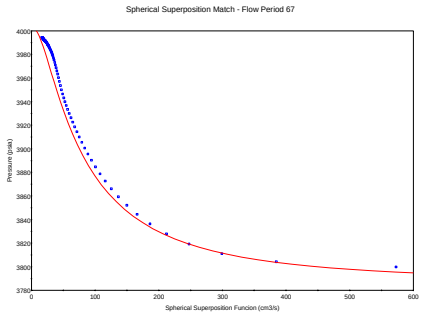
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4000.897	psia
pwf	3798.488	psia
k/u(xyz)	51.13	mD/cp
k(xyz)	51.13	mD
c(sys)	0.0001383	1/psi
S(p)	1.56	
C	3.0447E-007	bbl/psi
ri	8	ft
p*(FRA)	3996.008	psia
k/u(FRA)	51.13	mD/cp
c(FRA)	9.3753E-005	1/psi









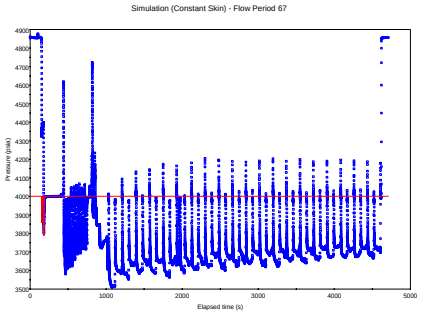
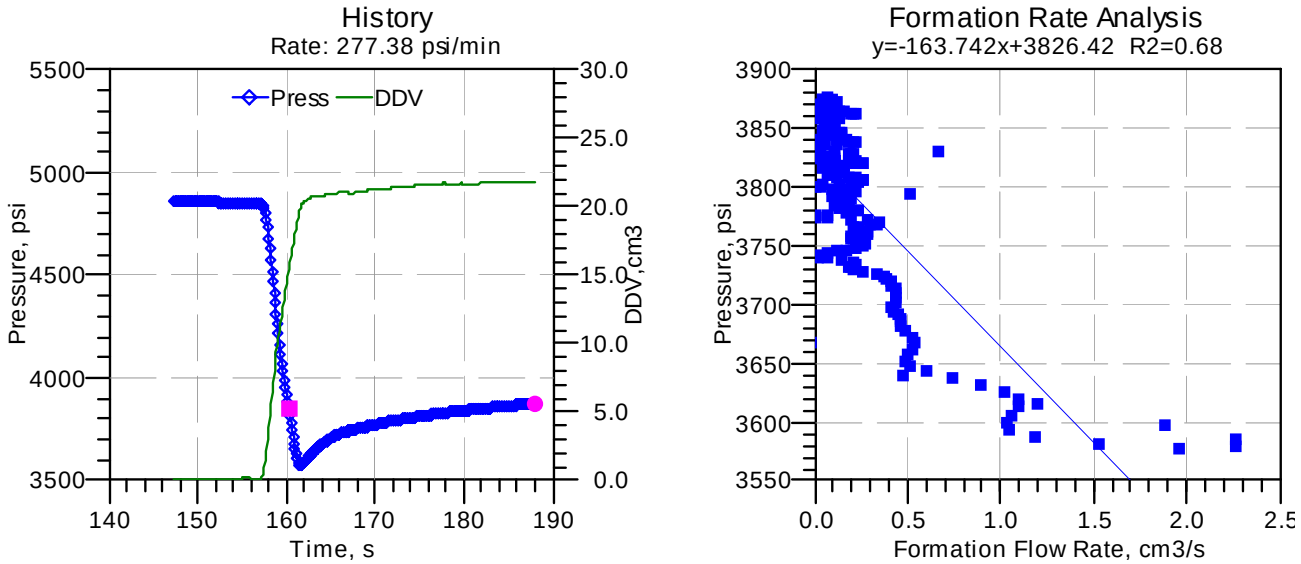


Figure 63 File no. i800g20_1: Depth 3309.4 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

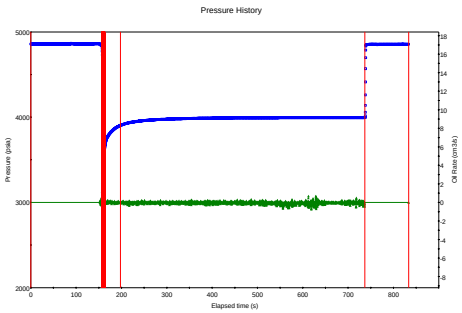
Wireline Formation Test Analyzer (WFTA^{SM})

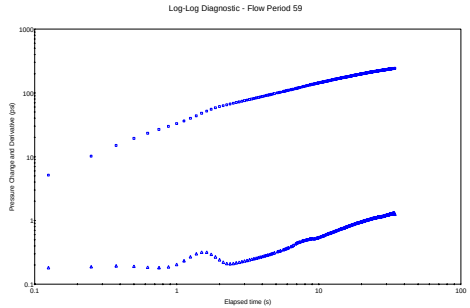


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
20_1	3309.4	2883.7	3.5e-5	3826.4	21.0	26.1	3876.1

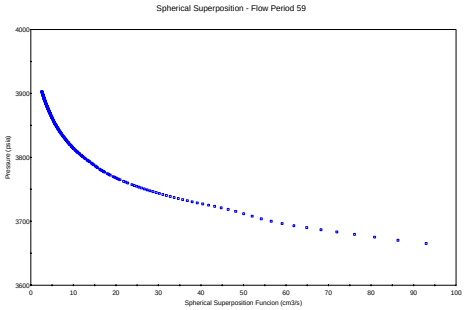
Figure 64 File no. i800g20: Depth 3309.4 m-MD

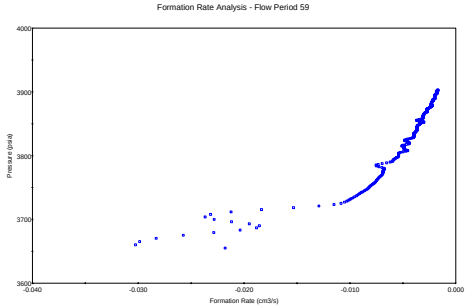


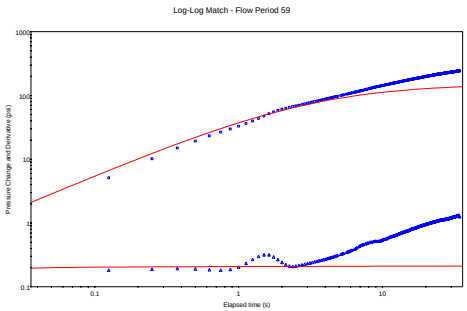


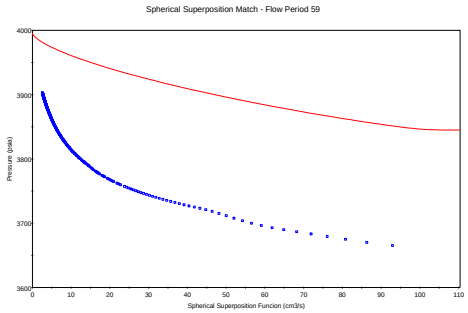
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	3995.531	psia
pwf	3660.062	psia
k/u(xyz)	0.06332	mD/cp
k(xyz)	0.06332	mD
c(sys)	3.5461E-007	1/psi
S(p)	-0.98	
C	7.8068E-010	bbl/psi
ri	1	ft
p*(FRA)	0.000	psia
k/u(FRA)	0.00	mD/cp
c(FRA)	0.00	1/psi









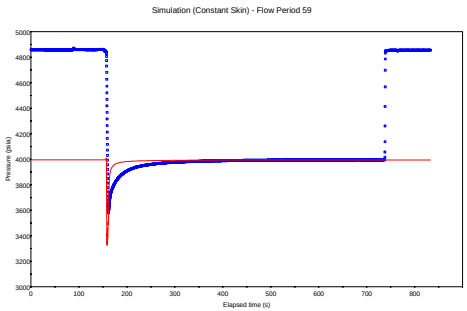
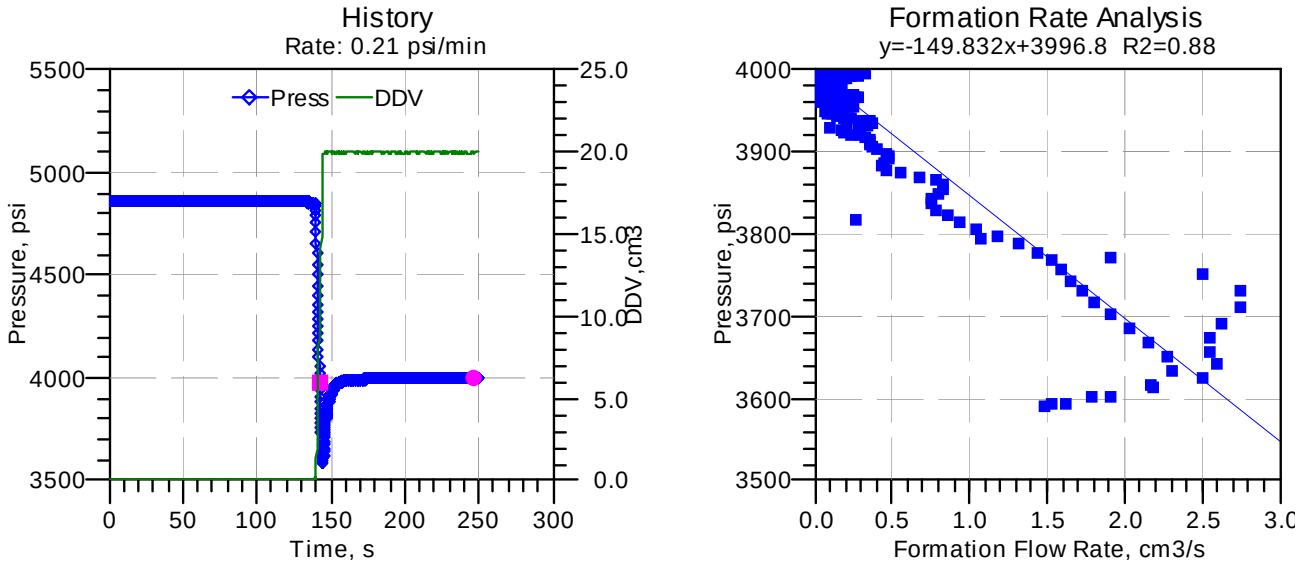


Figure 65 File no. i800g21_1: Depth 3309.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

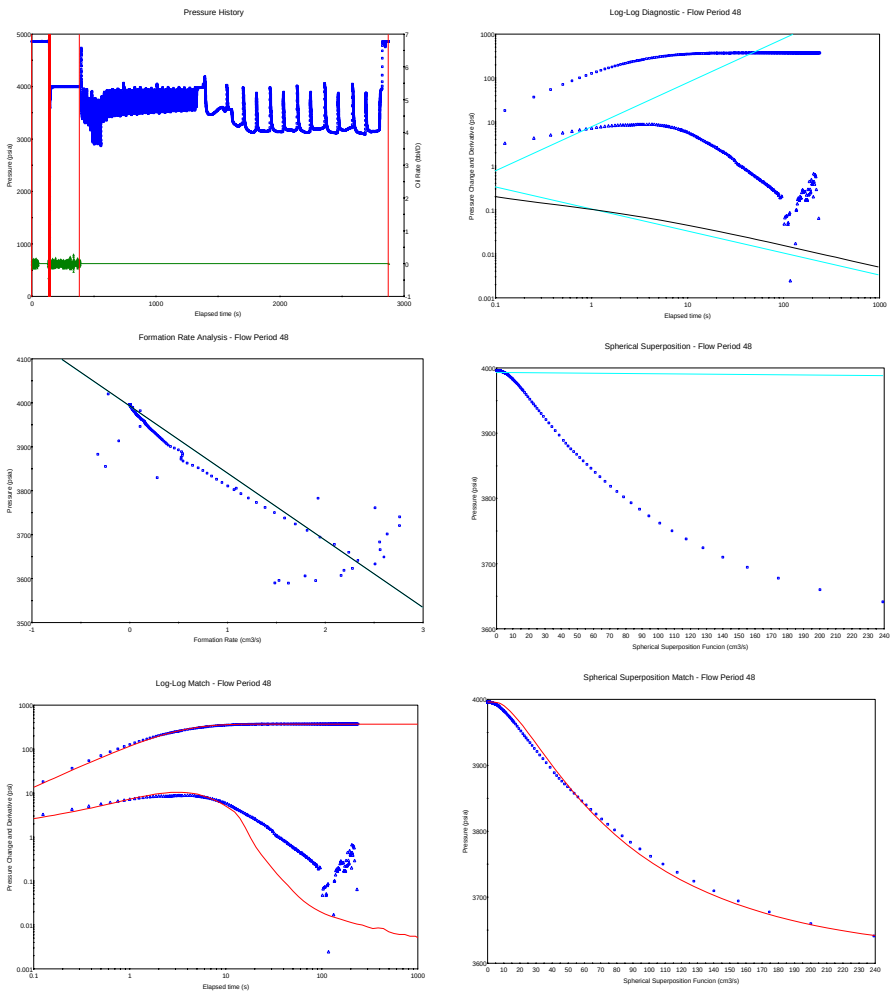
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
21_1	3309.2	2883.4	4.5e-5	3996.8	23.0	23.3	3996.1

Figure 66 File no. i800g21: Depth 3309.2 m-MD



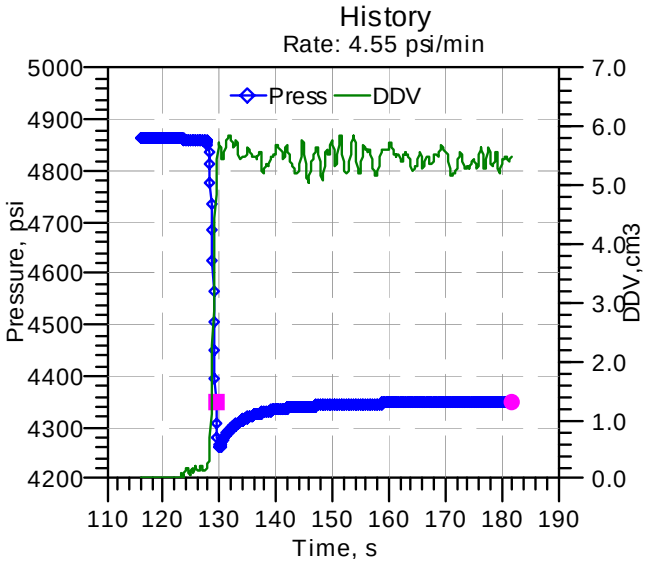
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

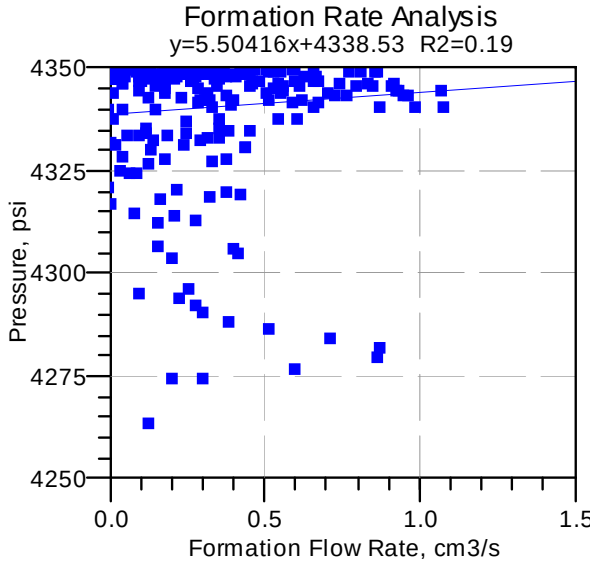
Results		
(pav)i	3996.216	psia
pwf	3623.238	psia
k/u(xyz)	22.58	mD/cp
k(xyz)	22.58	mD
c(sys)	6.1744E-005	1/psi
S(p)	1.25	
C	1.3593E-007	bbl/psi
ri	20	ft
p*(FRA)	3994.506	psia
k/u(FRA)	22.58	mD/cp
c(FRA)	4.4855E-005	1/psi

Figure 67 File no. i800g22_1: Depth 3312.8 m-MD

Company: **BASS STRAIT OIL COMPANY LTD**
Field: **EXPLORATION**
Well: **ZANE GREY-1/ST1/ST2**

Wireline Formation Test Analyzer (WFTA^{SM})





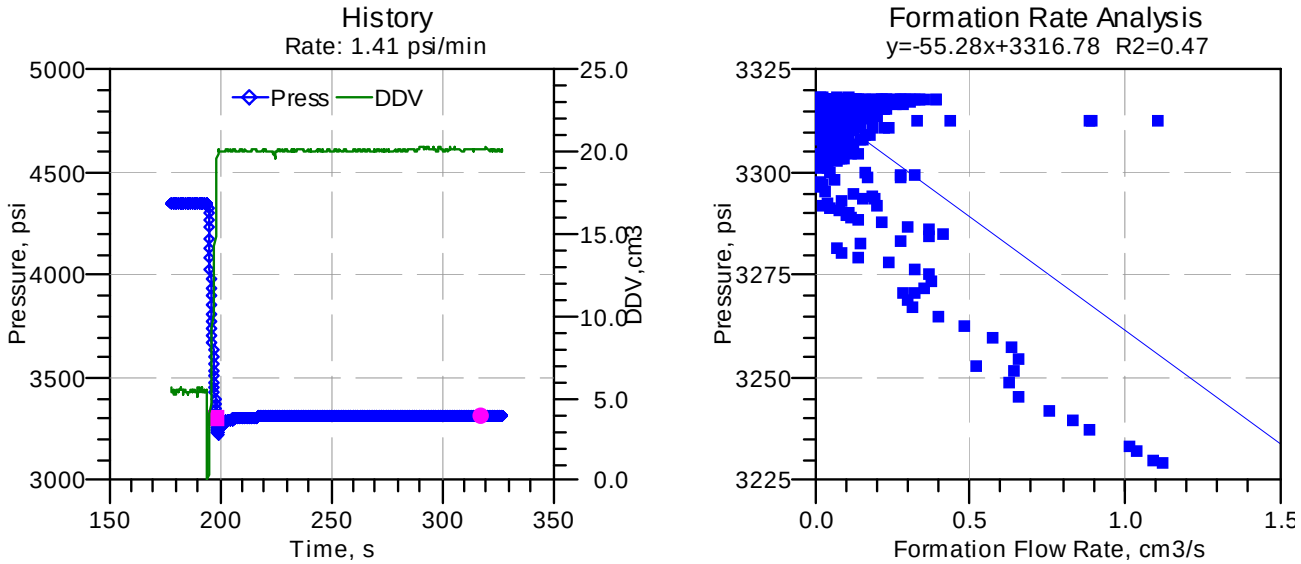
Pressure Test Results-Tight

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
22_1	3312.8	2886.7	2.5e-5	4338.5	-625.4	41.5	4349.6

Figure 68 File no. i800g22_2: Depth 3312.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



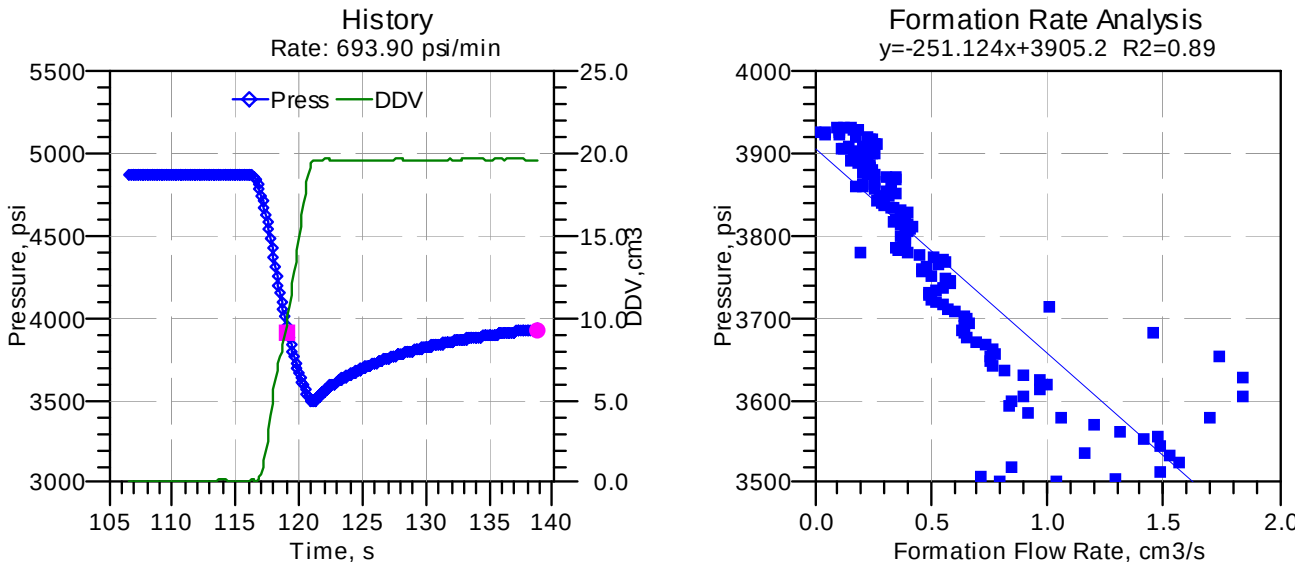
Pressure Test Results-Tight

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
22_2	3312.8	2886.7	7.6e-5	3316.8	62.3	43.1	3318.3

Figure 69 File no. i800g24_1: Depth 3319.4 m-MD

Company: **BASS STRAIT OIL COMPANY LTD**
Field: **EXPLORATION**
Well: **ZANE GREY-1/ST1/ST2**

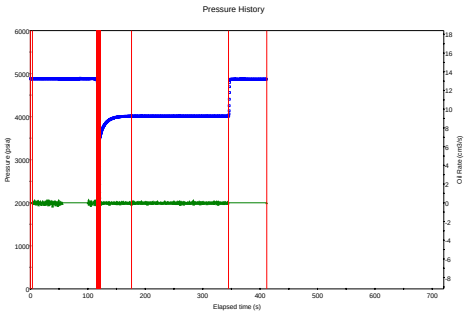
Wireline Formation Test Analyzer (WFTA^{SM})

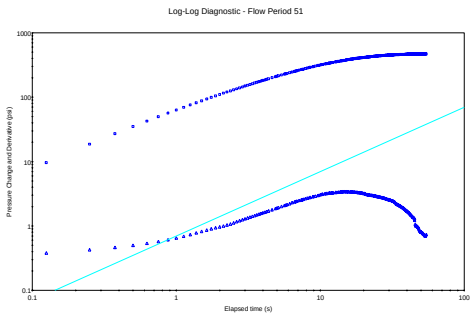


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
24_1	3319.4	2892.6	5.2e-5	3905.2	13.7	14.6	3934.1

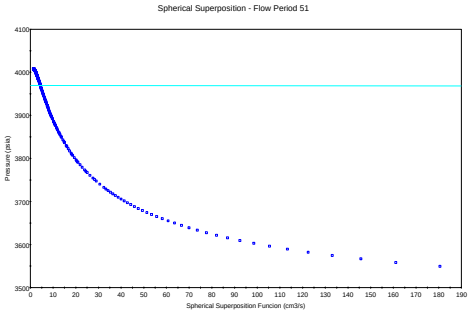
Figure 70 File no. i800g24: Depth 3319.4 m-MD

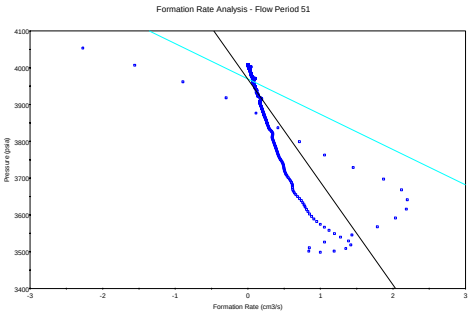


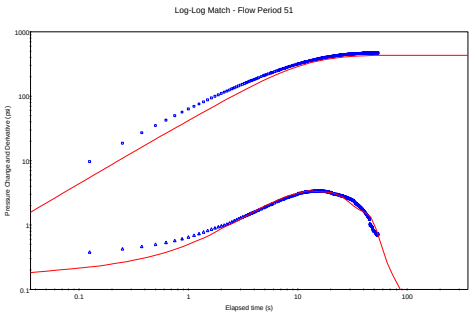


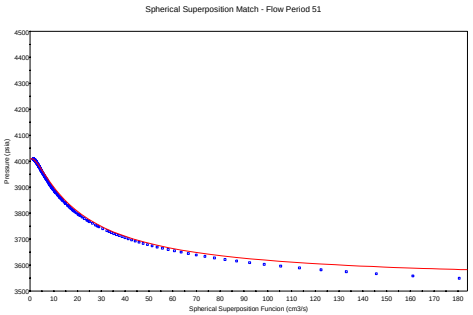
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4009.441	psia
pwf	3539.574	psia
k/u(xyz)	39.33	mD/cp
k(xyz)	39.33	mD
c(sys)	9.8299E-005	1/psi
S(p)	7.44	
C	2.1641E-007	bbl/psi
ri	21	ft
p*(FRA)	3969.122	psia
k/u(FRA)	13.50	mD/cp
c(FRA)	4.7431E-005	1/psi









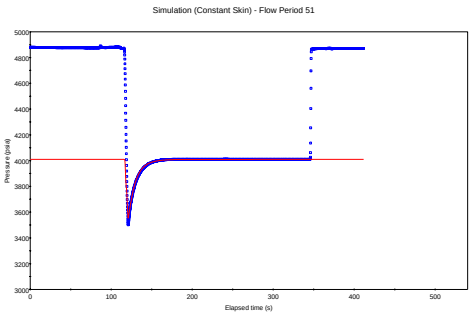
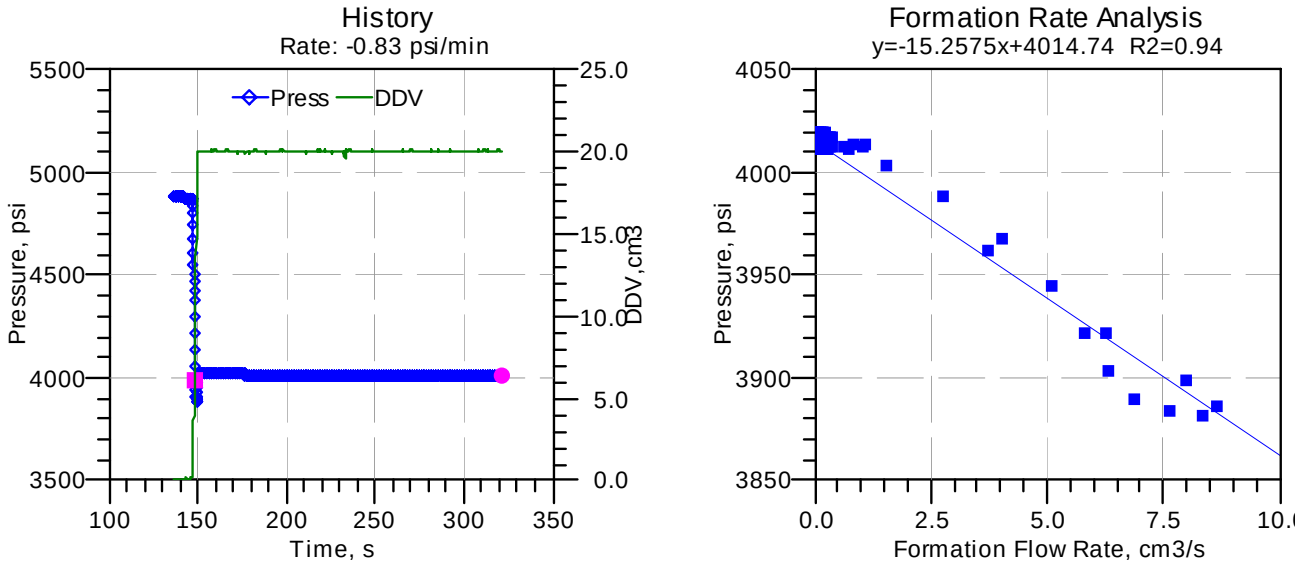


Figure 71 File no. i800g25_1: Depth 3321.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

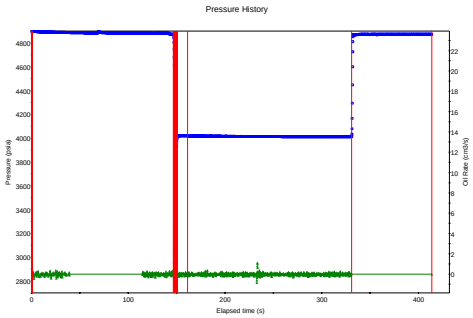
Wireline Formation Test Analyzer (WFTA^{SM})

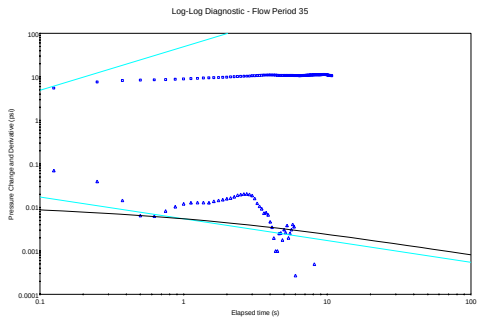


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
25_1	3321.0	2893.9	4.8e-5	4014.7	225.6	228.7	4011.7

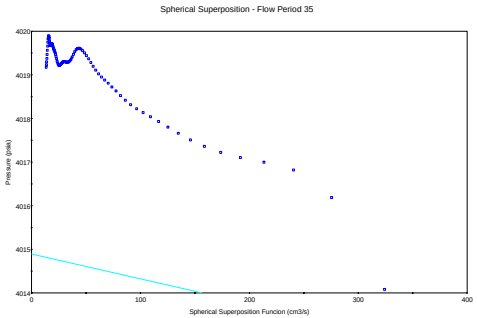
Figure 72 File no. i800g25: Depth 3321.0 m-MD

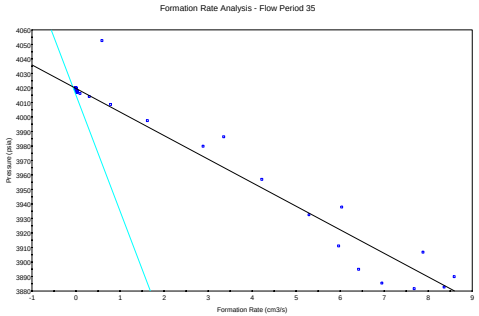


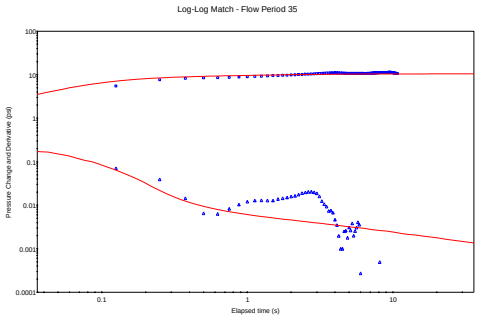


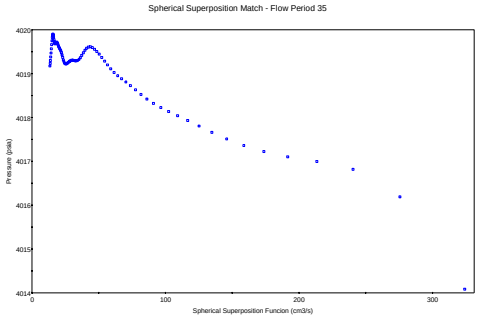
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4011.715	psia
pwf	4008.571	psia
k/u(xyz)	47.31	mD/cp
k(xyz)	47.31	mD
c(sys)	1.8586E-006	1/psi
S(p)	2.30	
C	4.0918E-009	bbl/psi
ri	8	ft
p*(FRA)	4019.621	psia
k/u(FRA)	232.4	mD/cp
c(FRA)	5.105E-005	1/psi









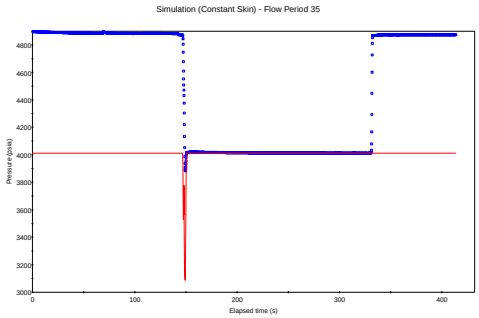
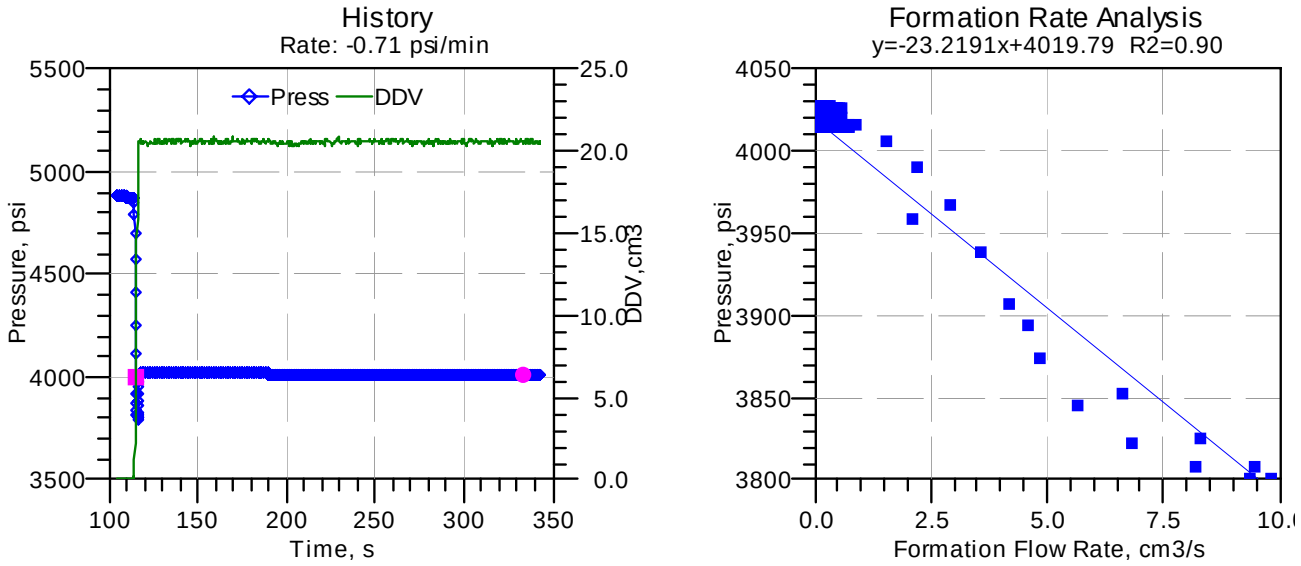


Figure 73 File no. i800g26_1: Depth 3323.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

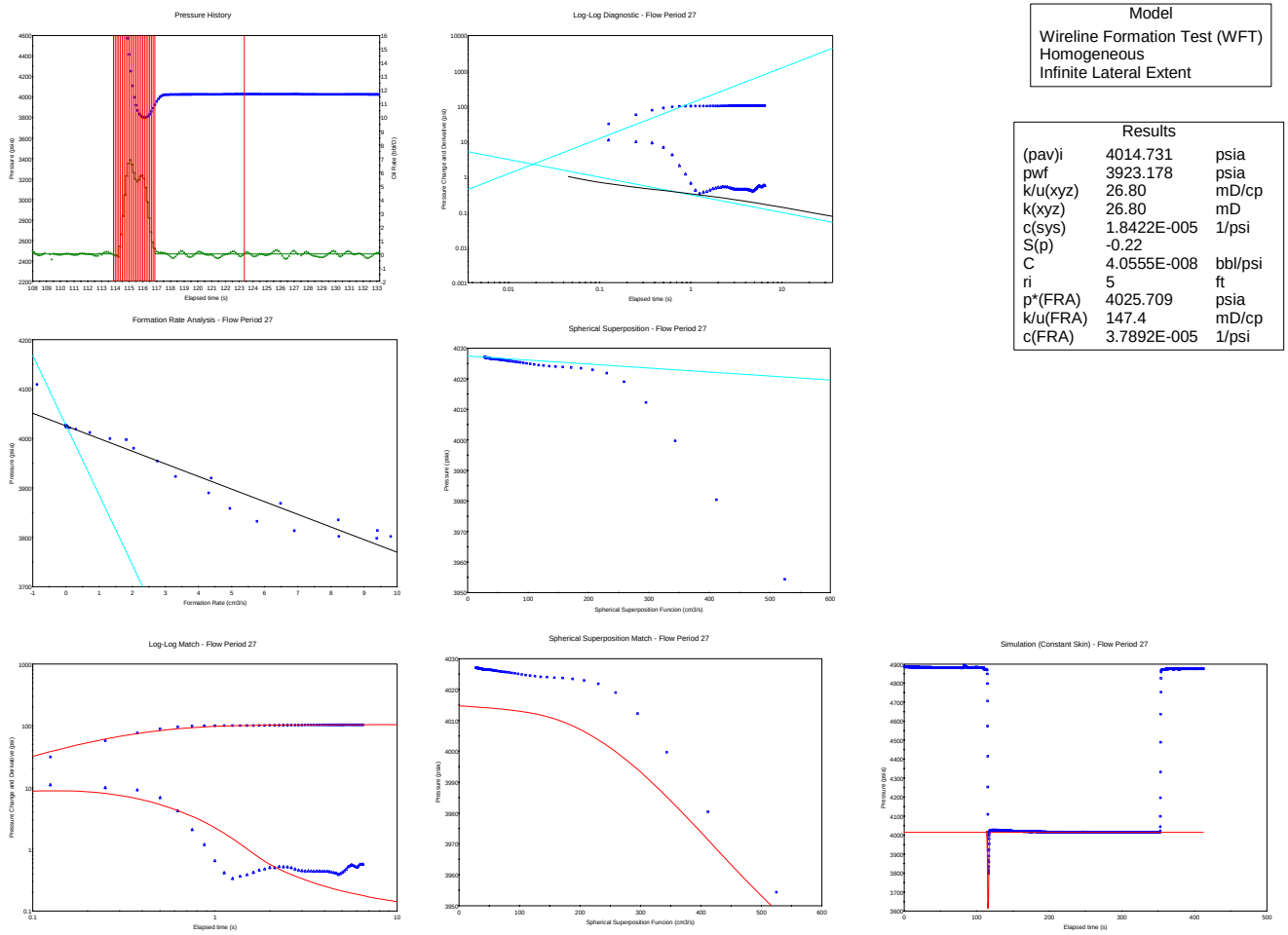
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
26_1	3323.7	2896.3	3.7e-5	4019.8	148.3	156.1	4014.7

Figure 74 File no. i800g26: Depth 3323.7 m-MD



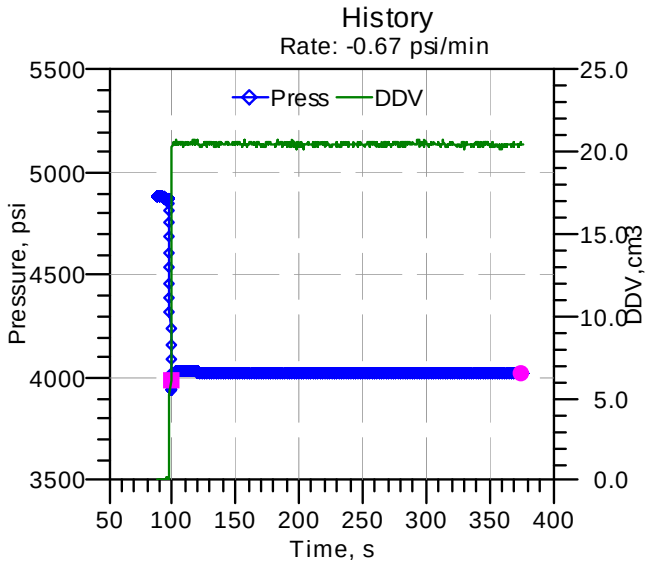
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

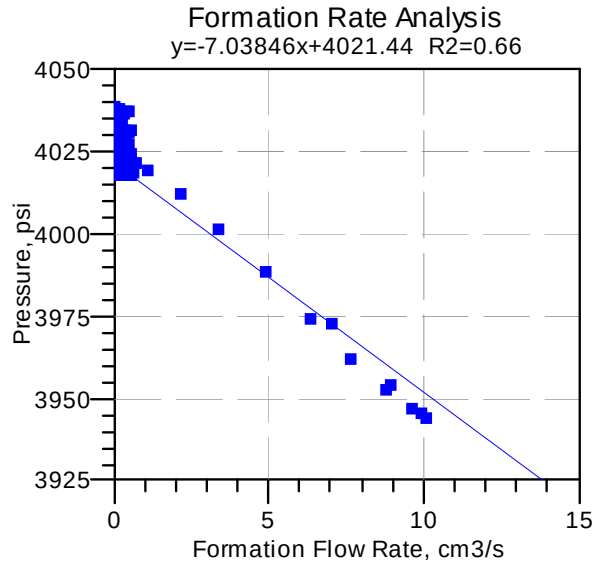
Results		
(pav)i	4014.731	psia
pwf	3923.178	psia
k/u(xyz)	26.80	mD/cp
k(xyz)	26.80	mD
c(sys)	1.8422E-005	1/psi
S(p)	-0.22	
C	4.0555E-008	bbl/psi
ri	5	ft
p*(FRA)	4025.709	psia
k/u(FRA)	147.4	mD/cp
c(FRA)	3.7892E-005	1/psi

Figure 75 File no. i800g27_1: Depth 3326.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

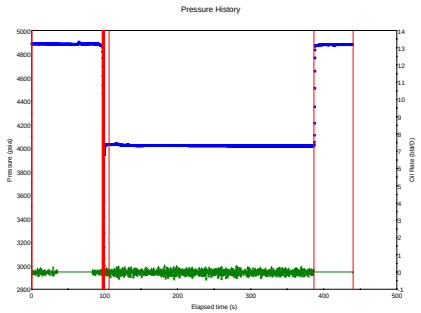


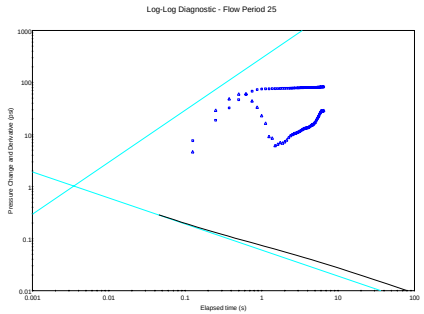


Pressure Test Results-Not FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
27_1	3326.1	2896.3	5.6e-5	4021.4	489.1	466.6	4018.0

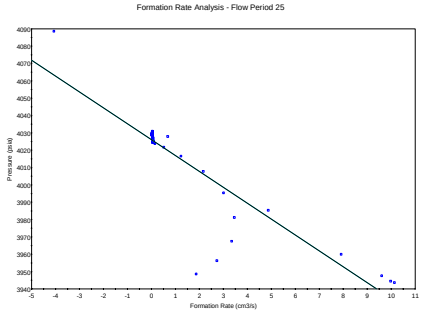
Figure 76 File no. i800g27: Depth 3326.1 m-MD

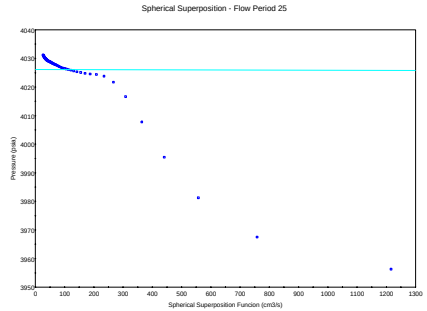


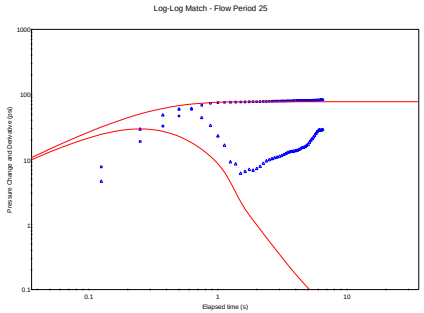


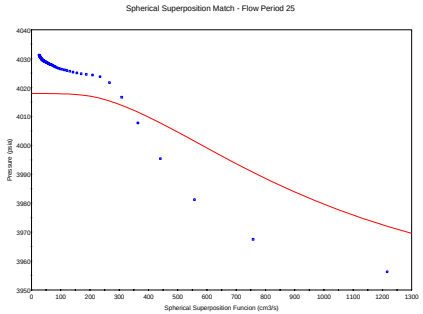
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4017.980	psia
pwf	3948.643	psia
k/u(xyz)	411.7	mD/cp
k(xyz)	411.7	mD
c(sys)	8.6937E-005	1/psi
S(p)	1.56	
C	1.9139E-007	bbl/psi
ri	18	ft
p*(FRA)	4026.085	psia
k/u(FRA)	411.7	mD/cp
c(FRA)	8.6937E-005	1/psi









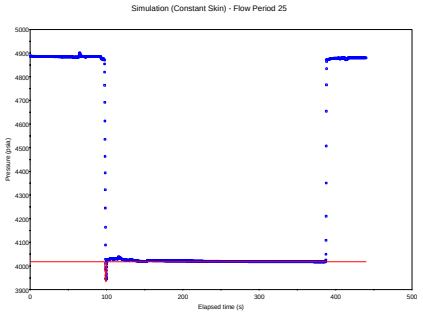
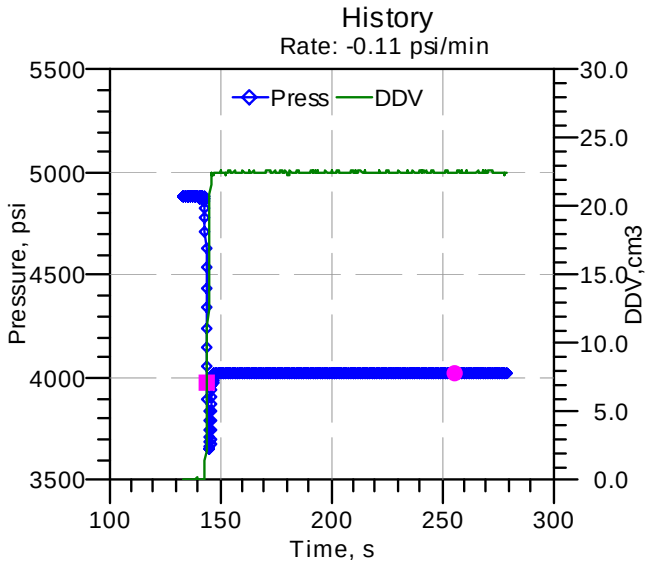
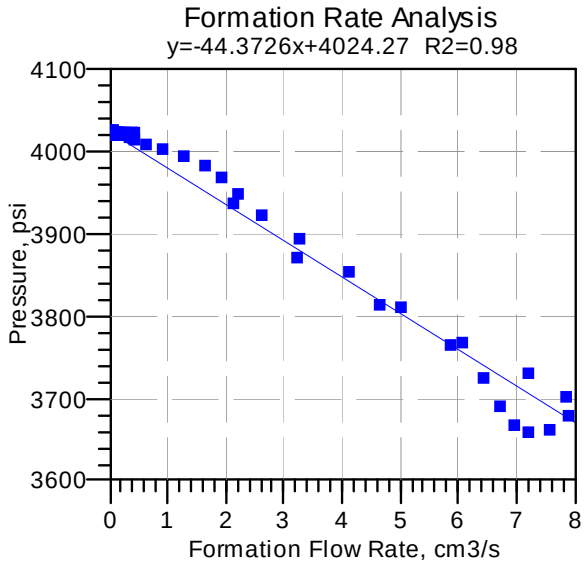


Figure 77 File no. i800g28_1: Depth 3328.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

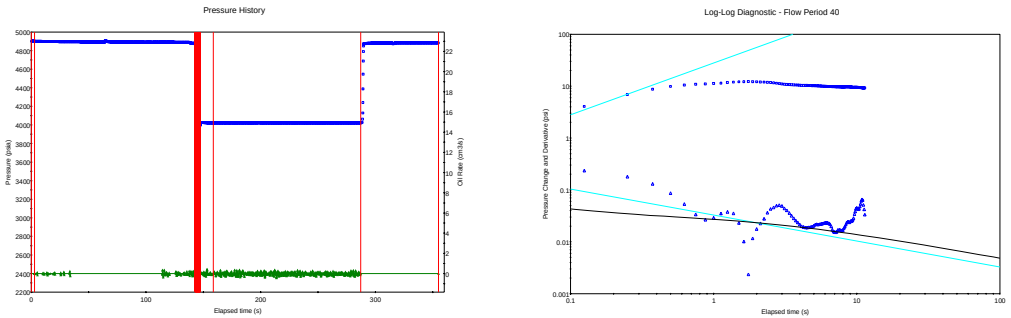




Pressure Test Results-FRA Compliant

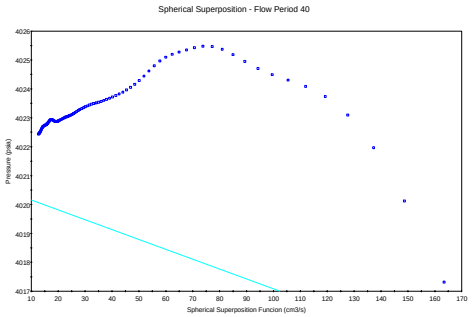
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
28_1	3328.7	2900.9	3.7e-5	4024.3	77.6	75.0	4021.1

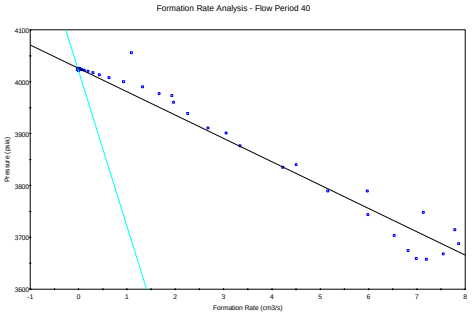
Figure 78 File no. i800g28: Depth 3328.7 m-MD

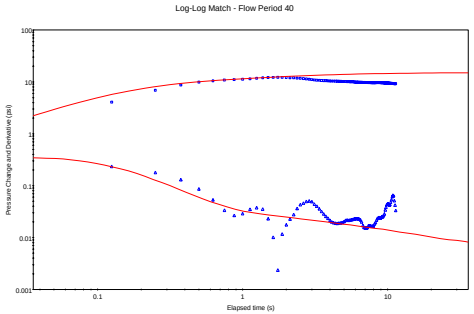


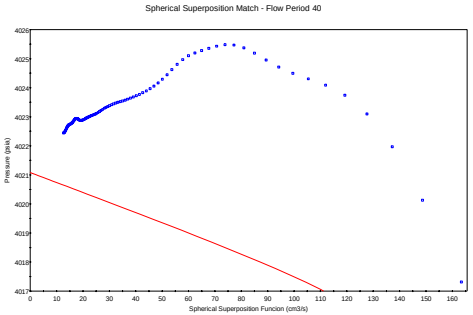
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4021.078	psia
pwf	4013.261	psia
k/u(xyz)	12.62	mD/cp
k(xyz)	12.62	mD
c(sys)	3.2693E-006	1/psi
S(p)	0.07	
C	7.1973E-009	bbl/psi
ri	5	ft
p*(FRA)	4025.705	psia
k/u(FRA)	83.86	mD/cp
c(FRA)	3.7904E-005	1/psi









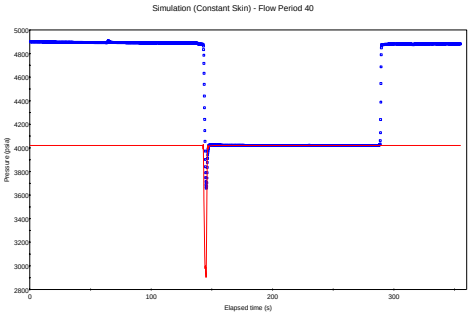
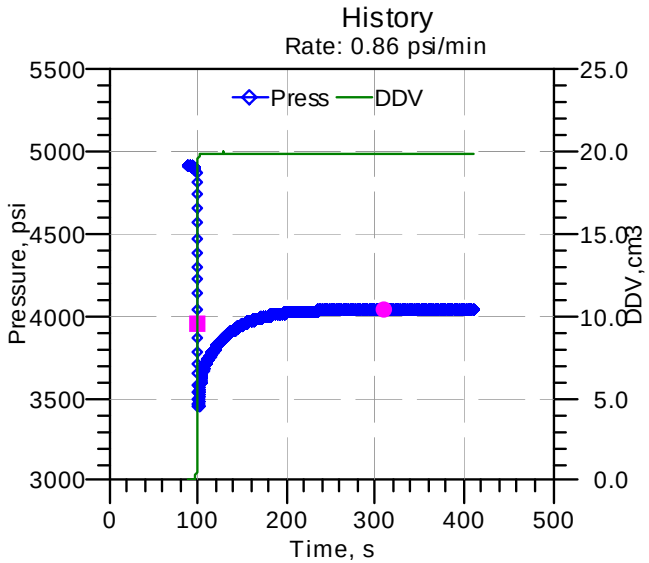
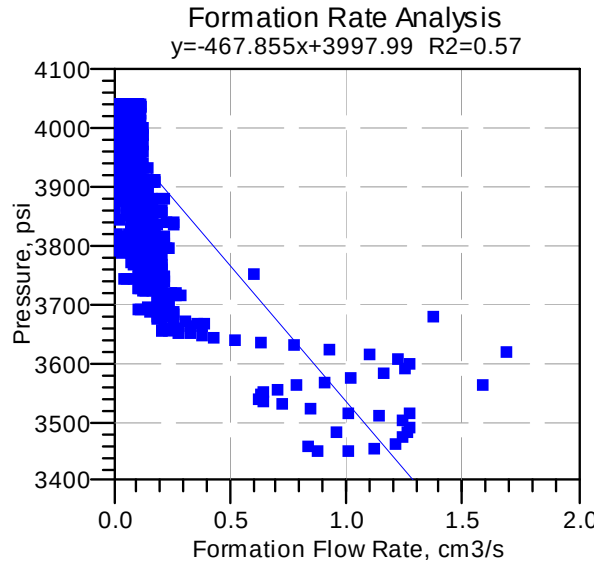


Figure 79 File no. i800g29_1: Depth 3345.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





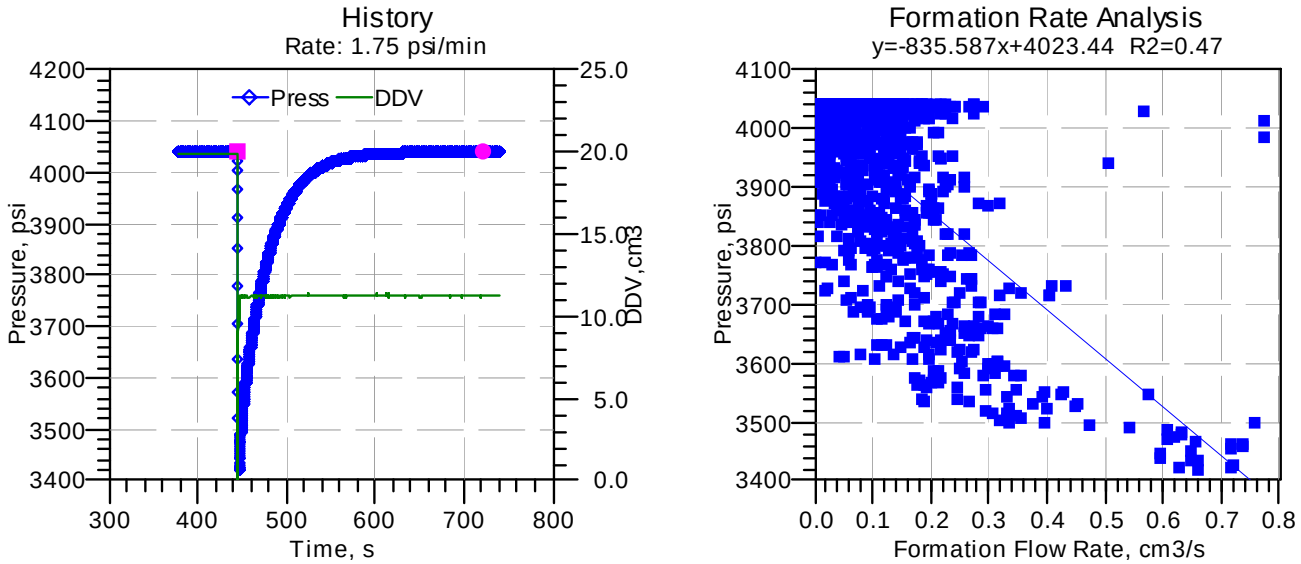
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
29_1	3345.2	2915.7	4.8e-5	3998.0	7.4	9.8	4041.3

Figure 80 File no. i800g29_2: Depth 3345.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

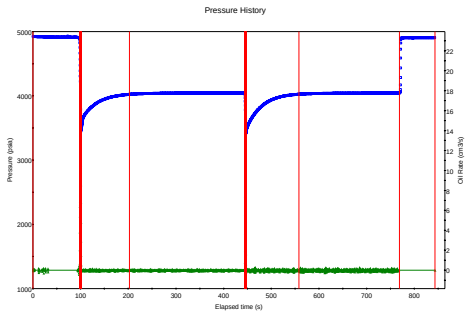
Wireline Formation Test Analyzer (WFTA^{SM})

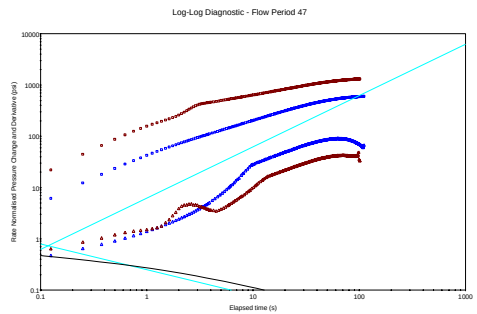


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
29_2	3345.2	2915.7	4.8e-5	4023.4	4.1	4.3	4040.9

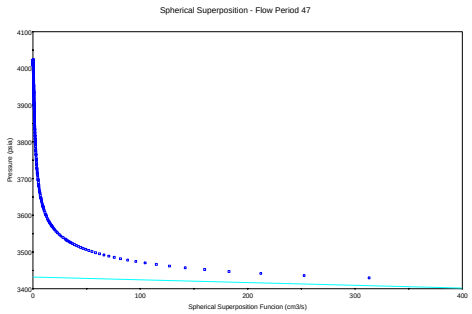
Figure 81 File no. i800g29: Depth 3345.2 m-MD

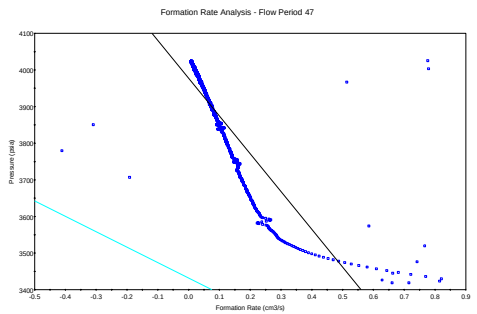


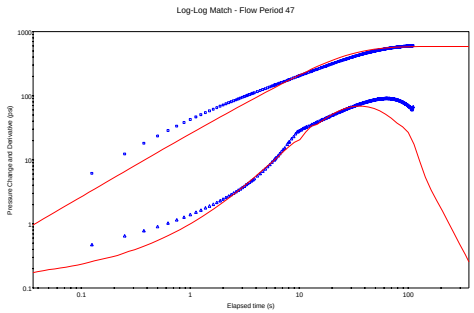


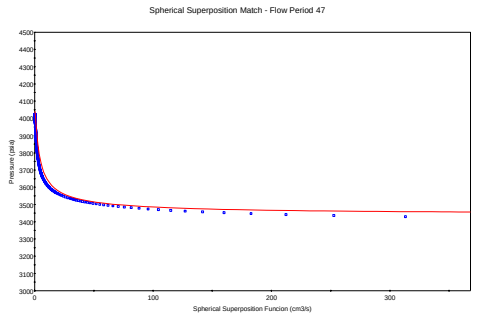
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4041.010	psia
pwf	3423.527	psia
k/u(xyz)	8.960	mD/cp
k(xyz)	8.960	mD
c(sys)	5.1413E-005	1/psi
S(p)	7.37	
C	1.1319E-007	bbl/psi
ri	10	ft
p*(FRA)	3977.168	psia
k/u(FRA)	3.661	mD/cp
c(FRA)	4.7459E-005	1/psi









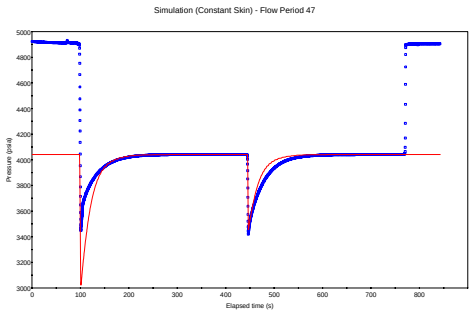
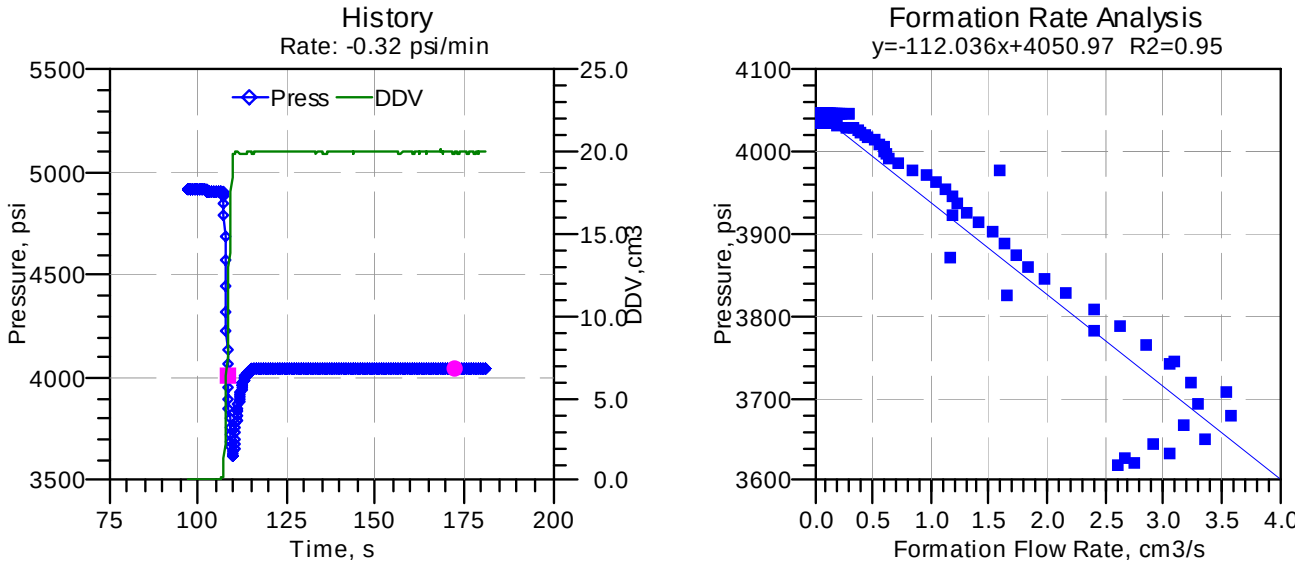


Figure 82 File no. i800g30_1: Depth 3349.2 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

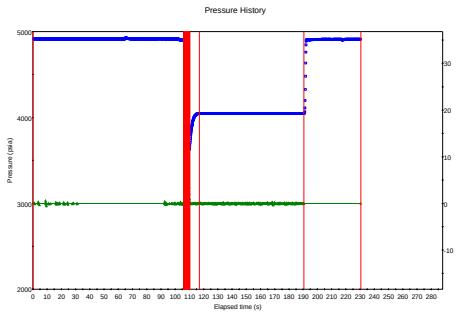
Wireline Formation Test Analyzer (WFTA^{SM})

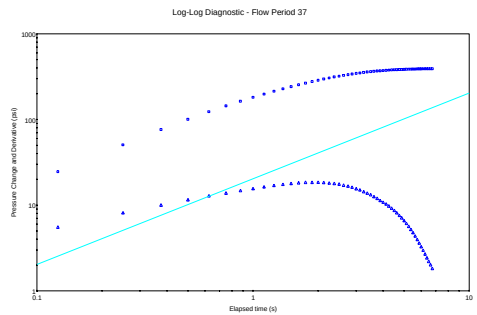


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
30_1	3349.2	2919.3	4.4e-5	4051.0	30.7	28.8	4046.5

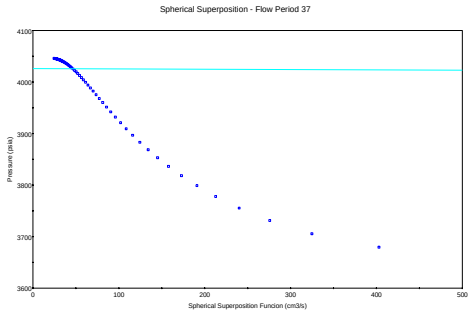
Figure 83 File no. i800g30: Depth 3349.2 m-MD

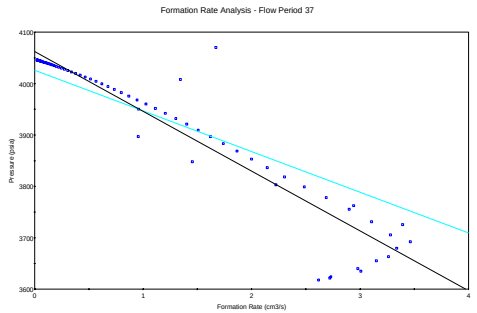


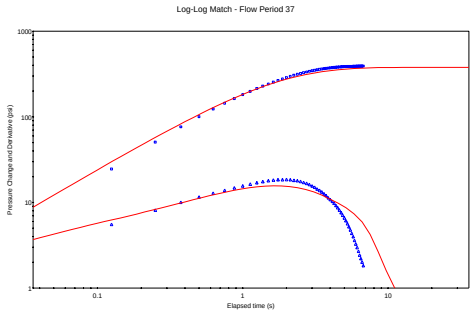


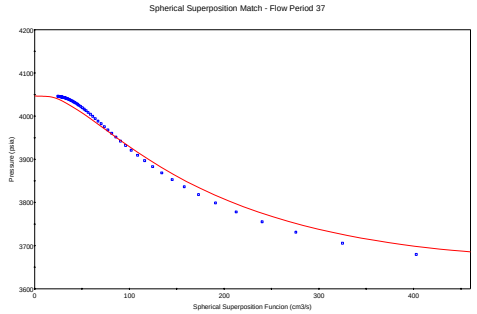
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4046.450	psia
pwf	3654.948	psia
k/u(xyz)	47.65	mD/cp
k(xyz)	47.65	mD
c(sys)	5.6247E-005	1/psi
S(p)	1.99	
C	1.2383E-007	bbl/psi
ri	6	ft
p*(FRA)	4062.497	psia
k/u(FRA)	32.42	mD/cp
c(FRA)	4.5826E-005	1/psi









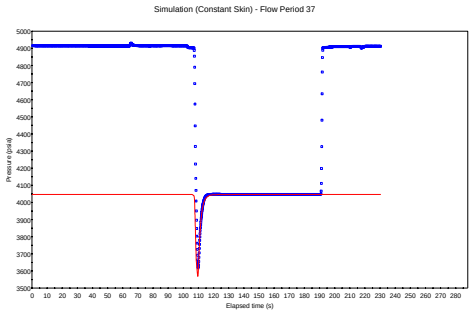
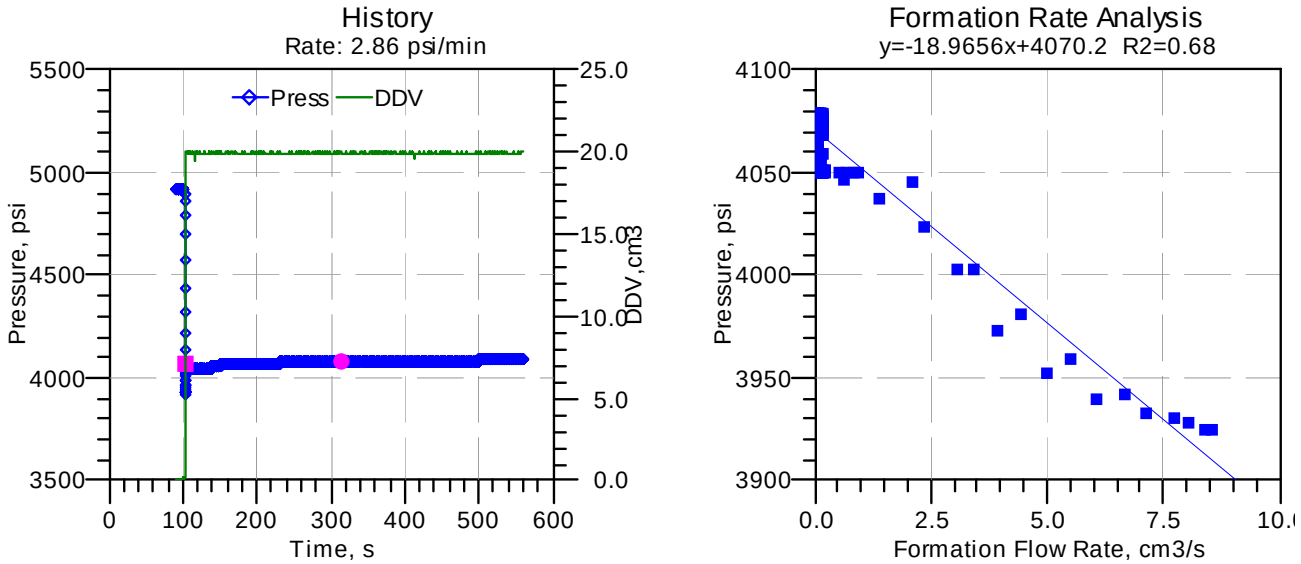


Figure 84 File no. i800g31_1: Depth 3351.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



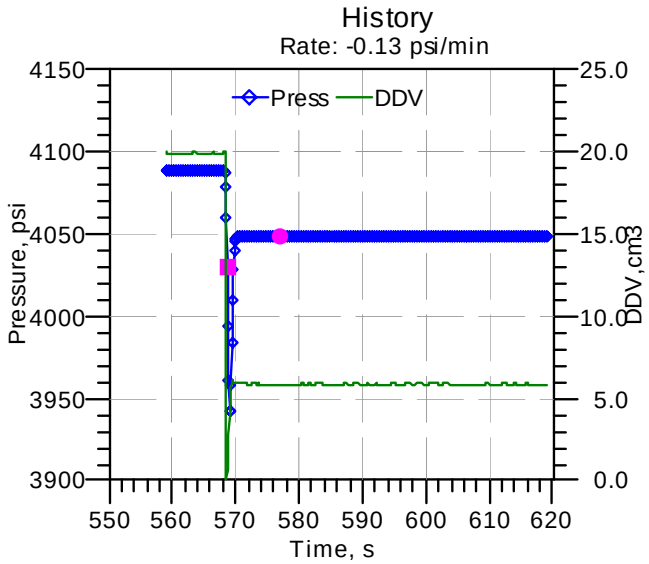
Pressure Test Results-NOT FRA Compliant

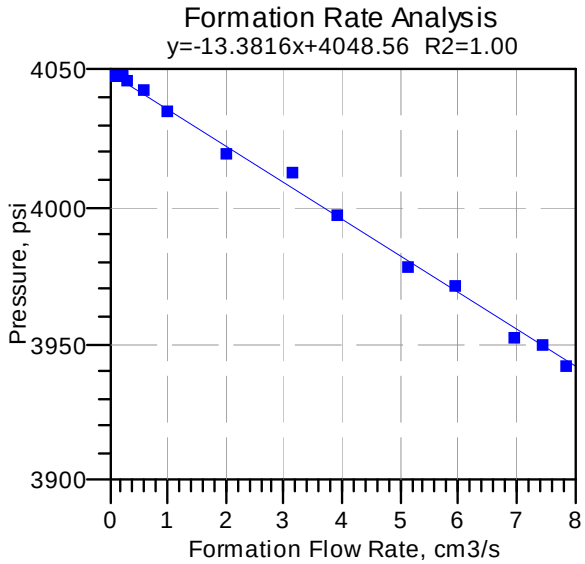
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
31_1	3351.0	2920.9	4.5e-5	4070.2	181.5	190.1	4089.2

Figure 85 File no. i800g31_2: Depth 3351.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

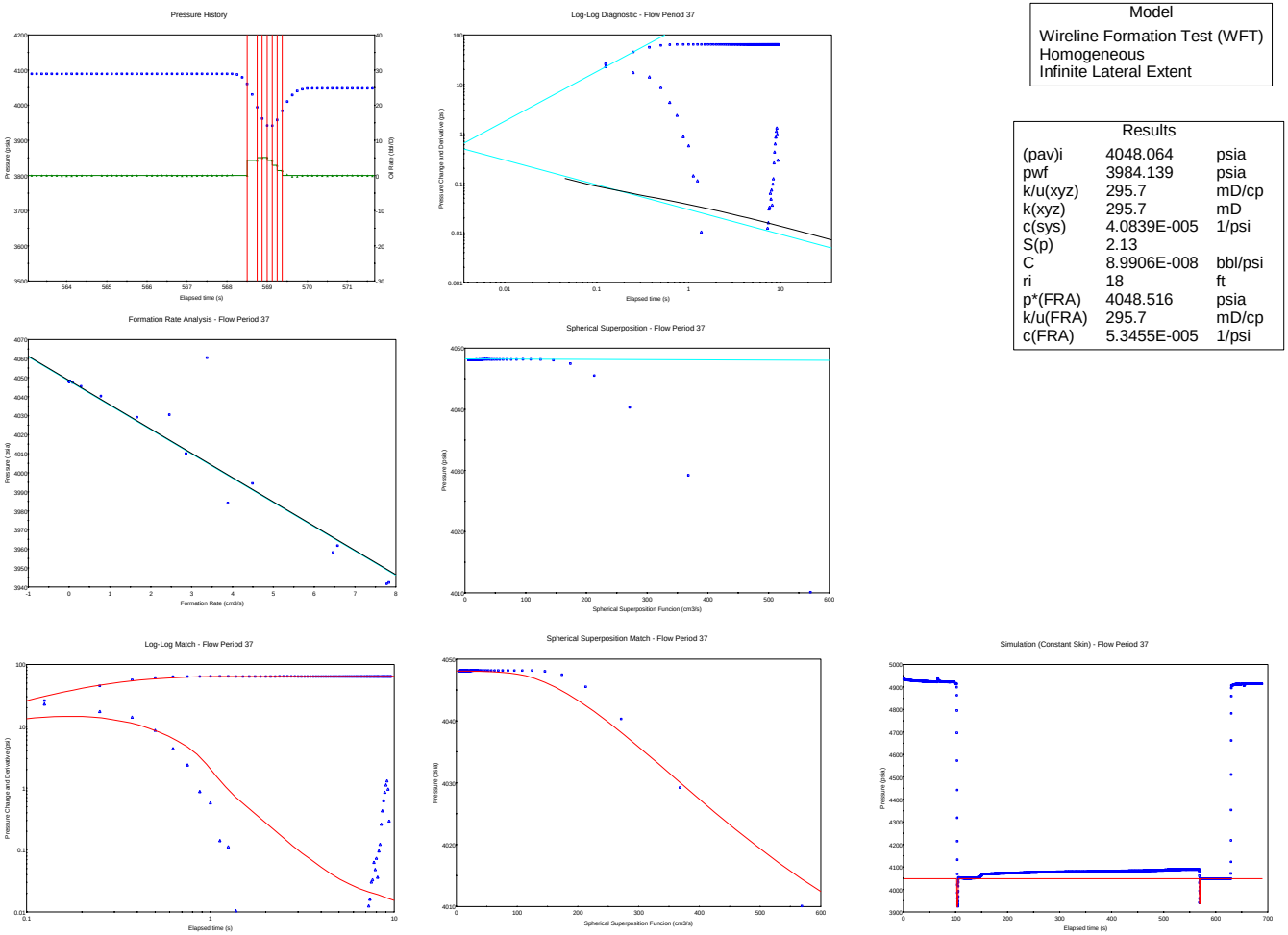




Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
31_2	3351.0	2920.9	4.7e-5	4048.6	257.3	253.8	4048.0

Figure 86 File no. i800g31: Depth 3351.0 m-MD



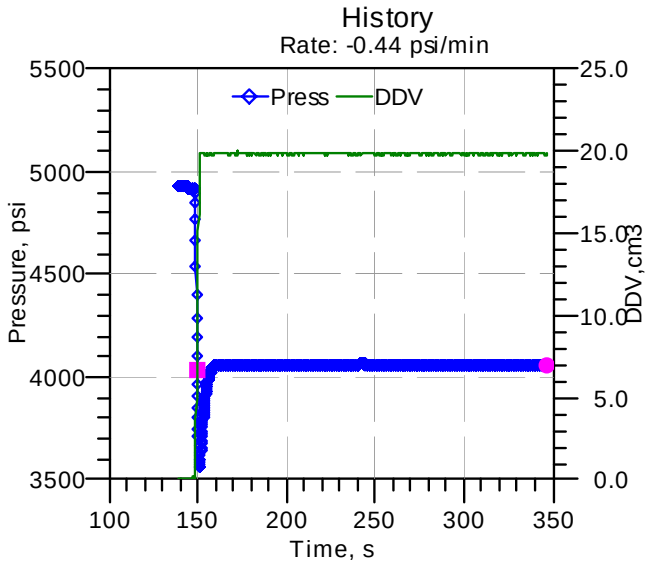
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

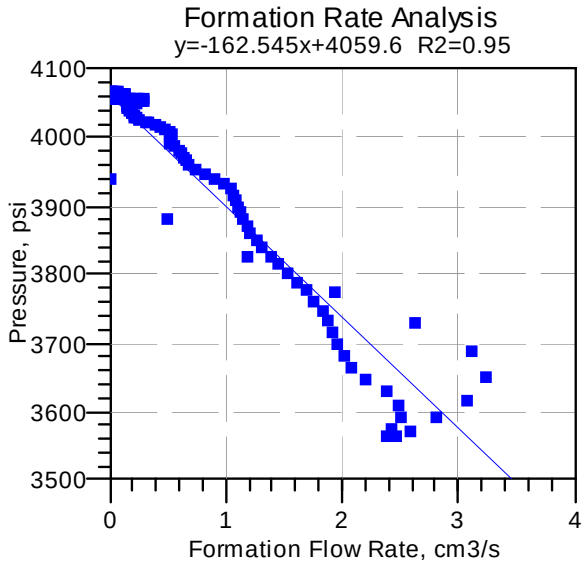
Results		
(pav)i	4048.064	psia
pwf	3984.139	psia
k/u(xyz)	295.7	mD/cp
k(xyz)	295.7	mD
c(sys)	4.0839E-005	1/psi
S(p)	2.13	
C	8.9906E-008	bbl/psi
ri	18	ft
p*(FRA)	4048.516	psia
k/u(FRA)	295.7	mD/cp
c(FRA)	5.3455E-005	1/psi

Figure 87 File no. i800g32_1: Depth 3357.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

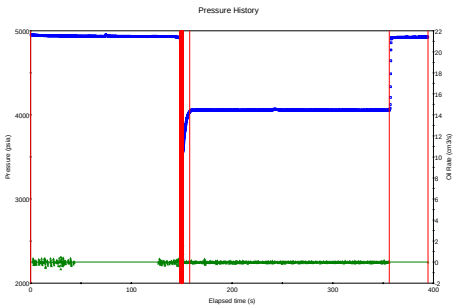


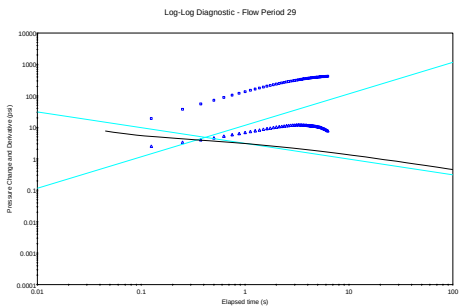


Pressure Test Results-FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
32_1	3357.0	2926.3	4.3e-5	4059.6	21.2	22.5	4055.8

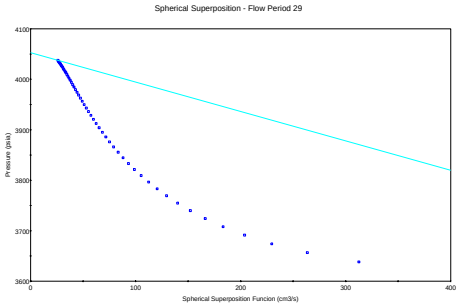
Figure 88 File no. i800g32: Depth 3357.0 m-MD

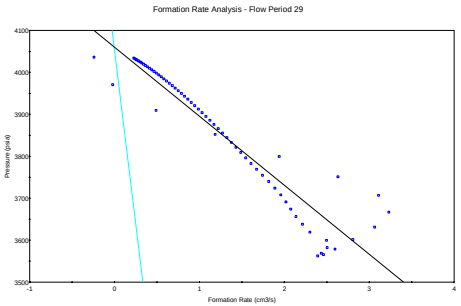


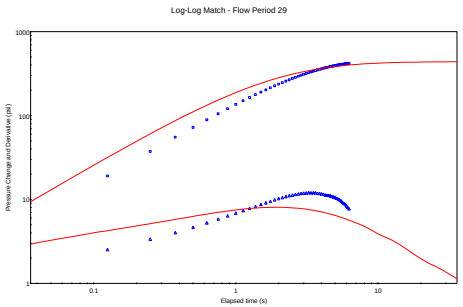


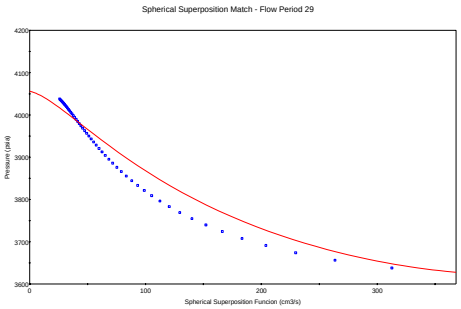
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4055.901	psia
pwf	3618.964	psia
k/u(xyz)	2.272	mD/cp
k(xyz)	2.272	mD
c(sys)	4.3179E-005	1/psi
S(p)	-0.77	
C	9.5058E-008	bbl/psi
ri	1	ft
p*(FRA)	4059.902	psia
k/u(FRA)	22.94	mD/cp
c(FRA)	4.3179E-005	1/psi









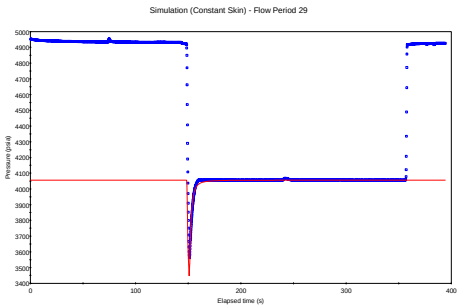
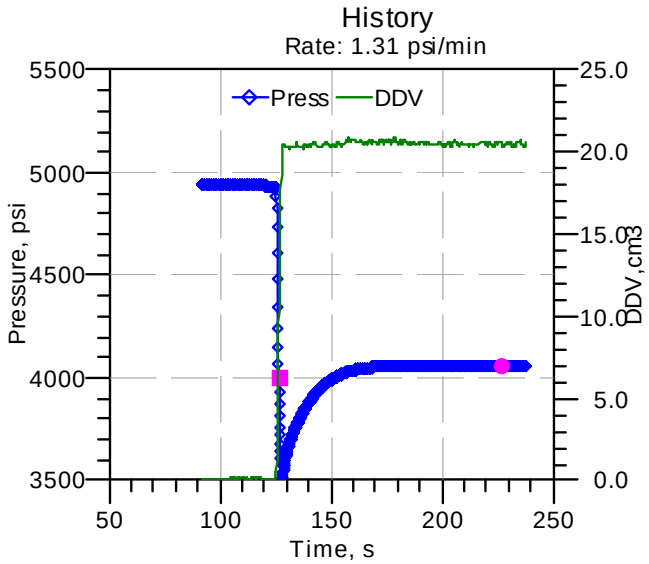
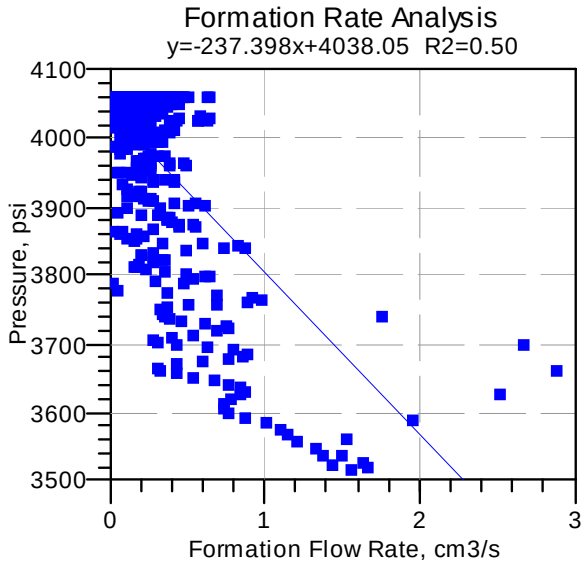


Figure 89 File no. i800g33_1: Depth 3360.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





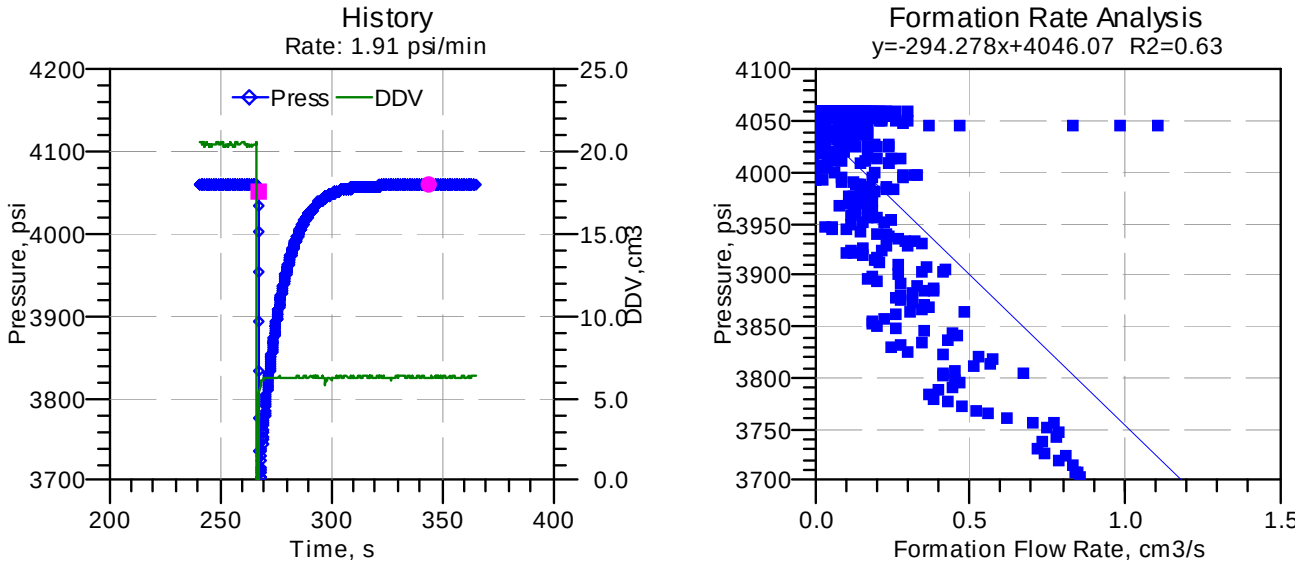
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
33_1	3360.7	2929.7	4.8e-5	4038.1	14.5	18.2	4060.8

Figure 90 File no. i800g33_2: Depth 3360.7 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

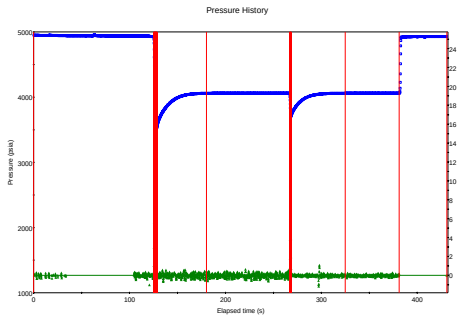
Wireline Formation Test Analyzer (WFTA^{SM})

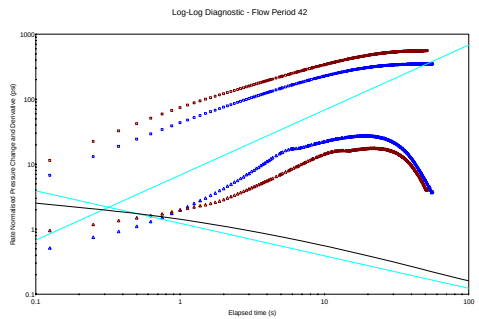


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
33_2	3360.7	2929.7	4.6e-5	4046.1	11.7	10.7	4060.4

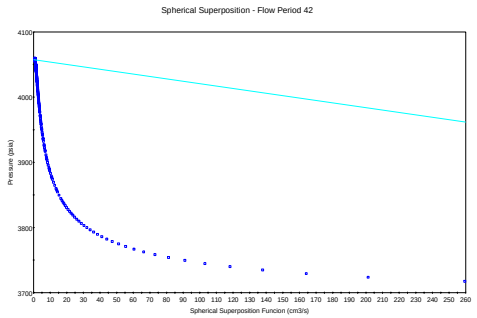
Figure 91 File no. i800g33: Depth 3360.7 m-MD

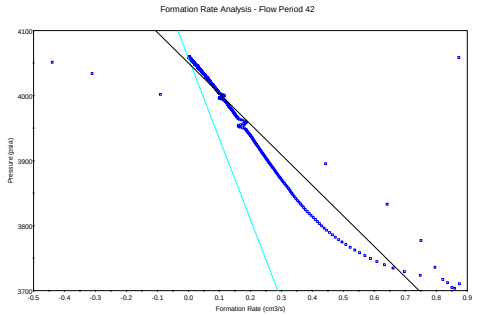


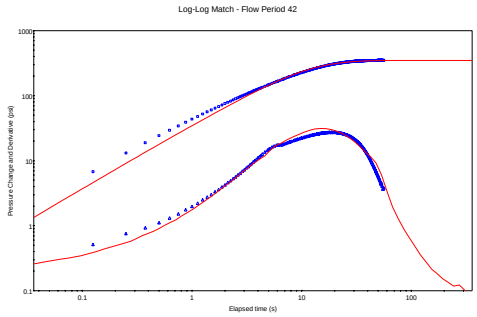


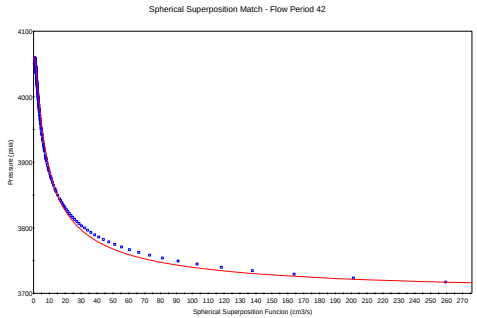
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4060.647	psia
pwf	3710.444	psia
k/u(xyz)	3.041	mD/cp
k(xyz)	3.041	mD
c(sys)	4.7067E-005	1/psi
S(p)	0.33	
C	1.0362E-007	bbl/psi
ri	4	ft
p*(FRA)	4050.125	psia
k/u(FRA)	8.020	mD/cp
c(FRA)	4.6303E-005	1/psi









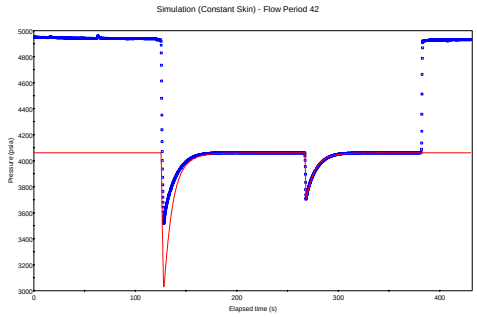
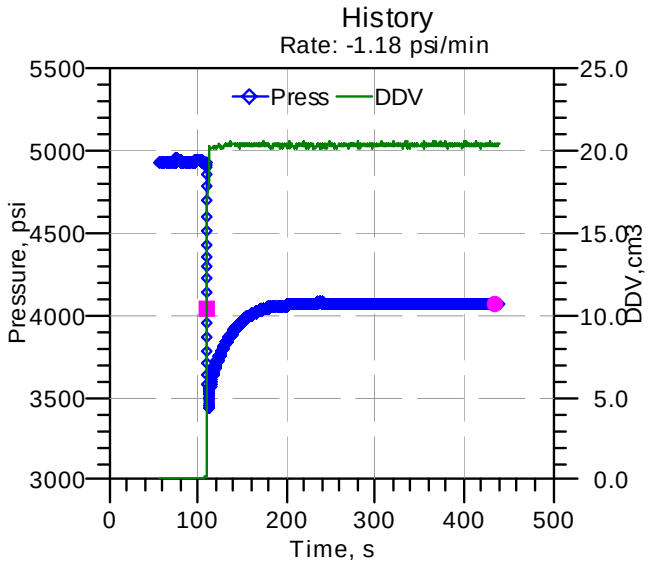
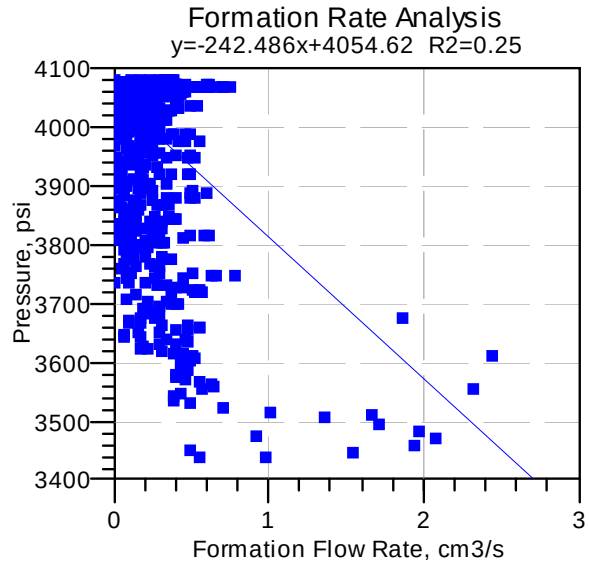


Figure 92 File no. i800g34_1: Depth 3366.3 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})





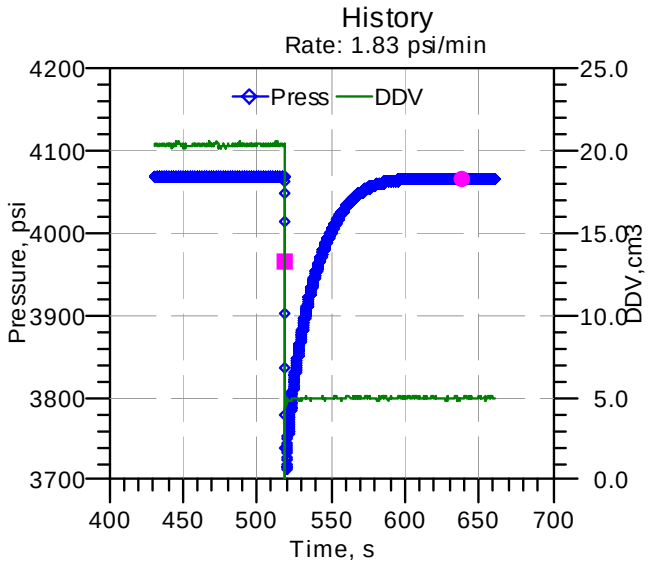
Pressure Test Results-NOT FRA Compliant

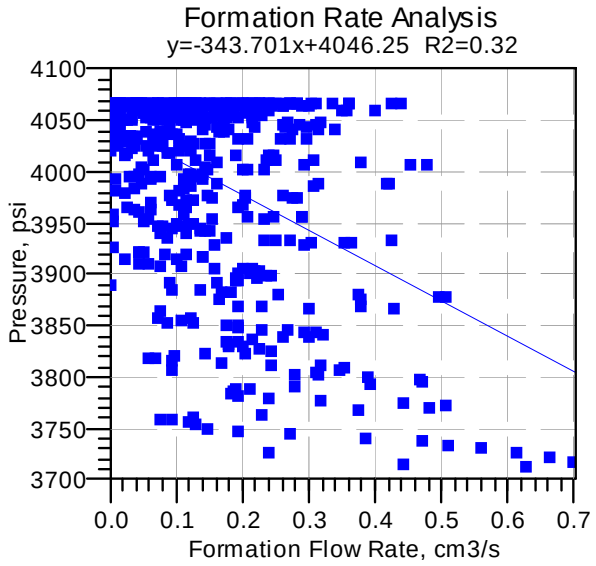
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
34_1	3366.3	2934.6	4.4e-5	4054.6	14.2	13.3	4069.0

Figure 93 File no. i800g34_2: Depth 3366.3 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

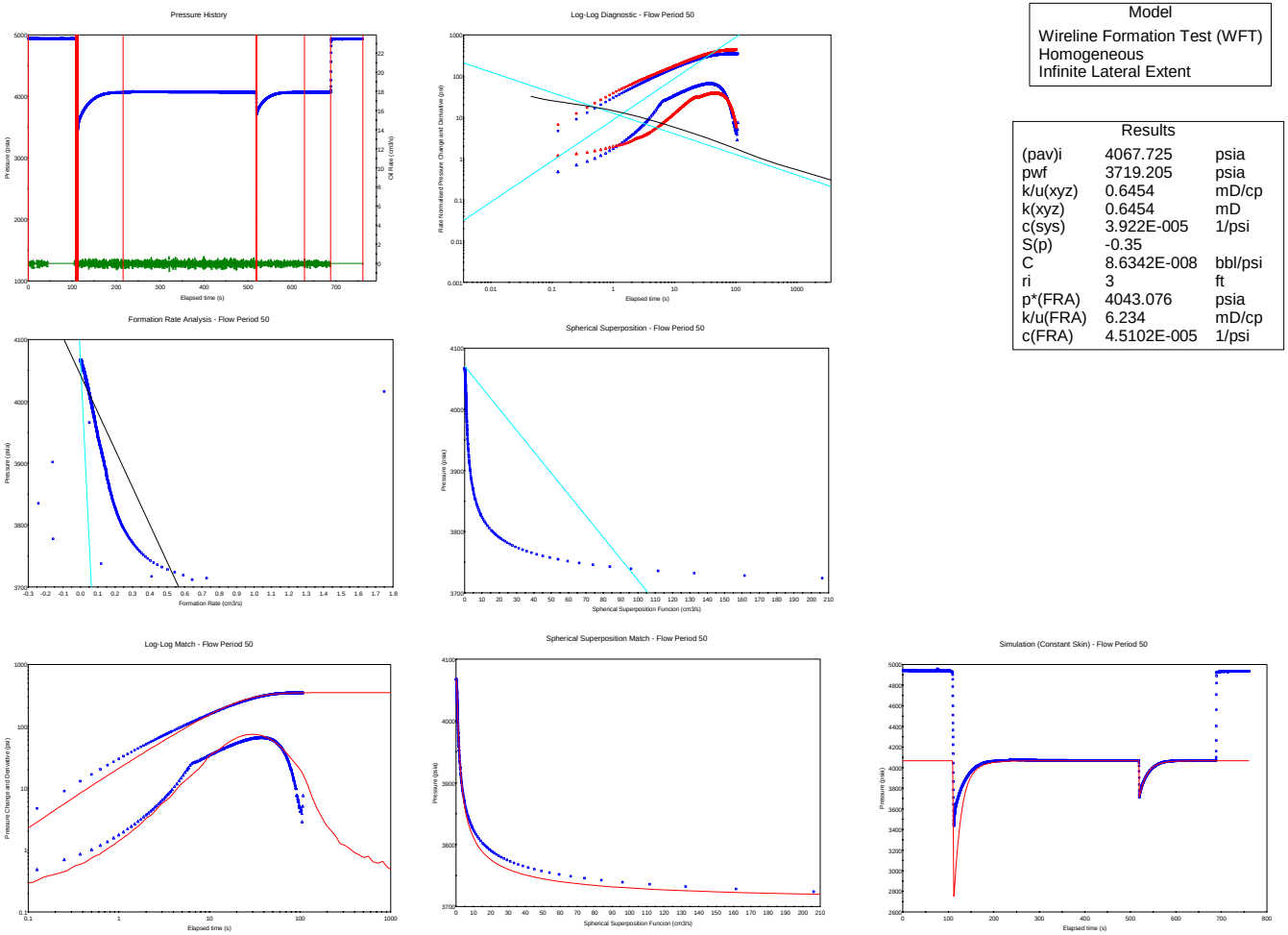




Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
34_2	3366.3	2934.6	4.3e-5	4046.3	10.0	6.8	4067.0

Figure 94 File no. i800g34: Depth 3366.3 m-MD



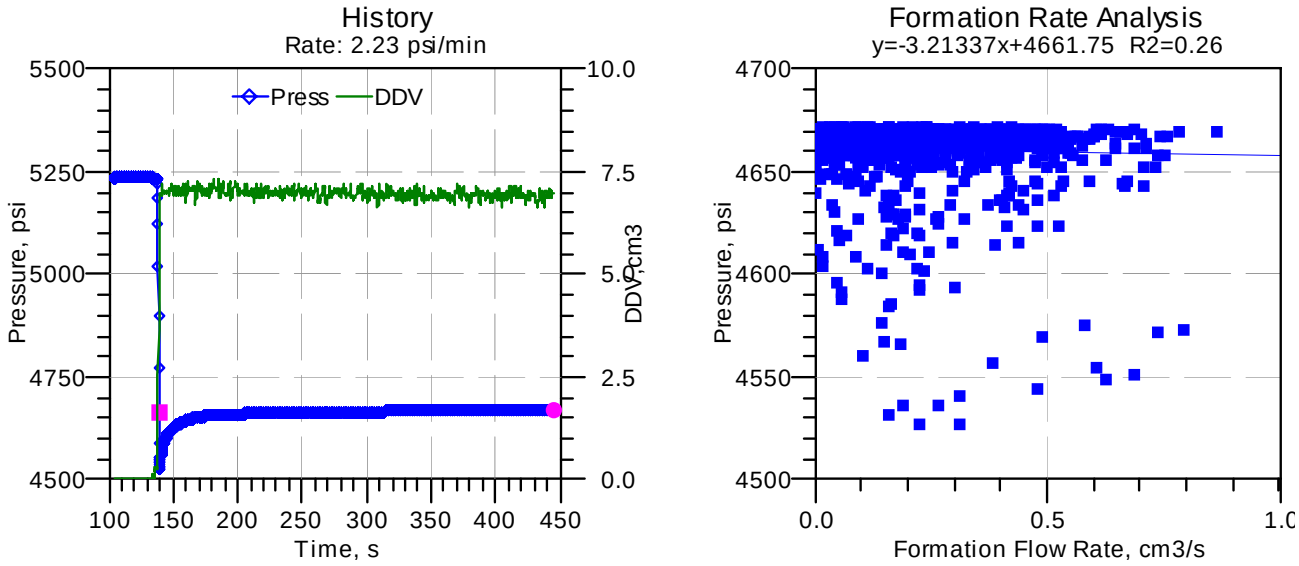
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4067.725	psia
pwf	3719.205	psia
k/u(xyz)	0.6454	mD/cp
k(xyz)	0.6454	mD
c(sys)	3.922E-005	1/psi
S(p)	-0.35	
C	8.6342E-008	bbl/psi
ri	3	ft
p*(FRA)	4043.076	psia
k/u(FRA)	6.234	mD/cp
c(FRA)	4.5102E-005	1/psi

Figure 95 File no. i800g36_1: Depth 3548.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



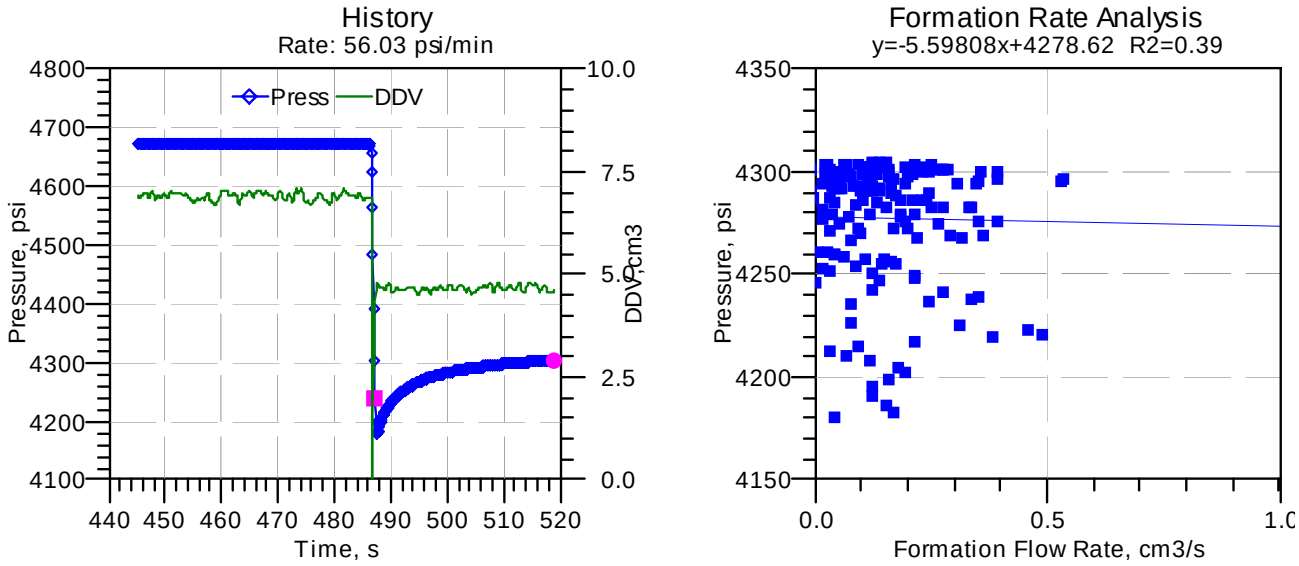
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
36_1	3548.1	3101.5	2.2e-5	4661.8	1071.3	20.4	4671.4

Figure 96 File no. i800g36_2: Depth 3548.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



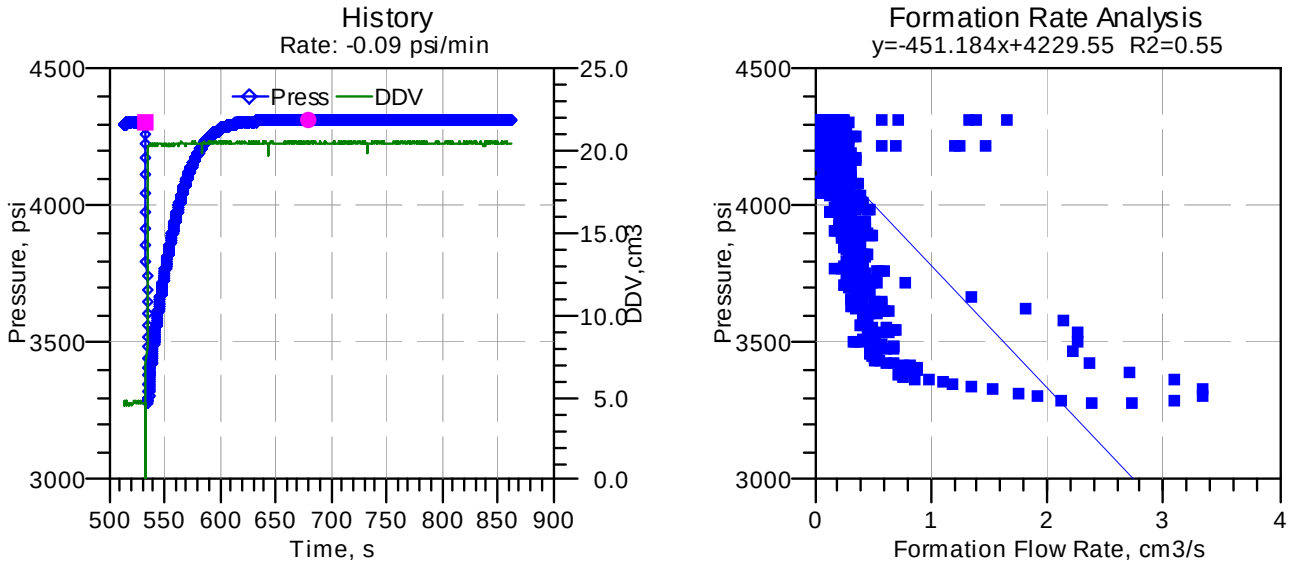
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
36_2	3548.1	3101.5	2.5e-5	4278.6	614.9	15.0	4304.2

Figure 97 File no. i800g36_3: Depth 3548.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})



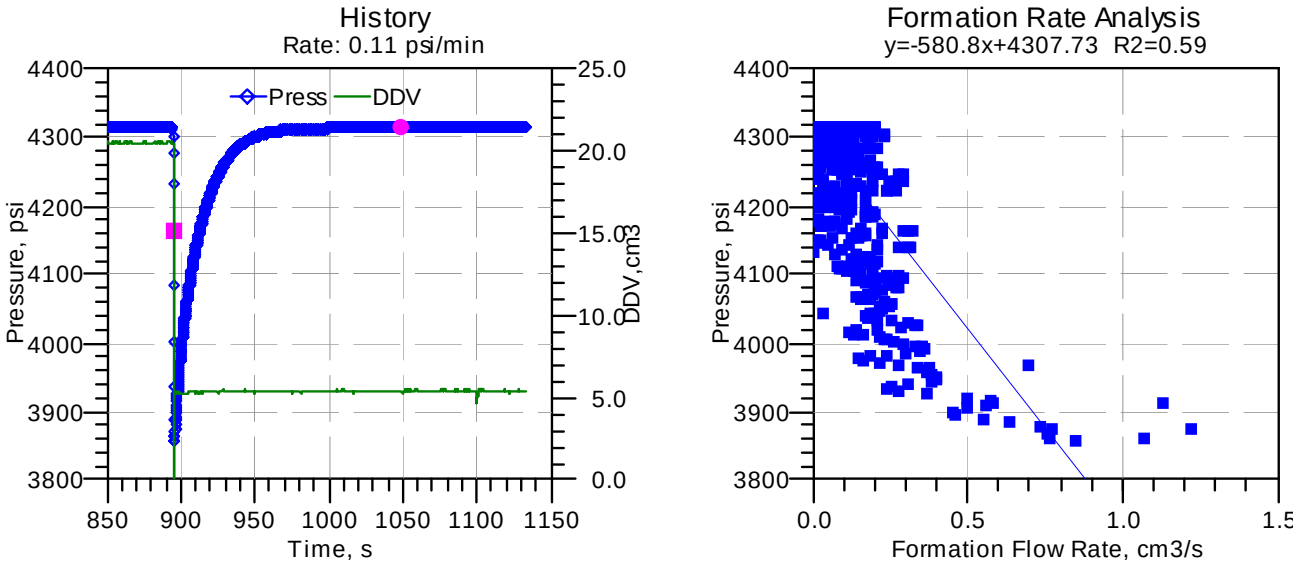
Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
36_3	3548.1	3101.5	4.7e-5	4229.6	7.6	11.2	4314.8

Figure 98 File no. i800g36_4: Depth 3548.1 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

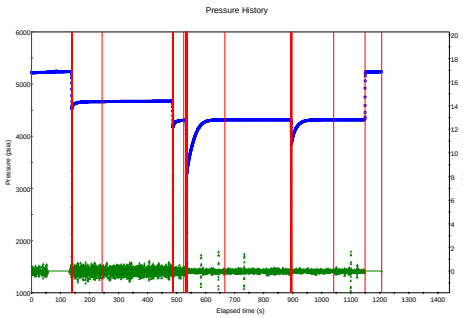
Wireline Formation Test Analyzer (WFTA^{SM})

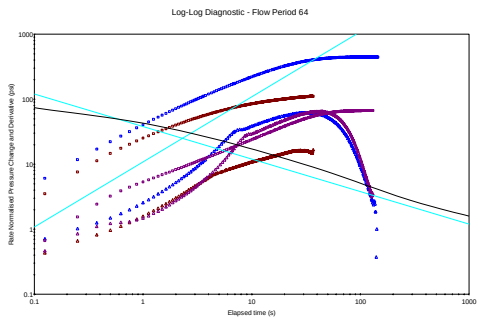


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
36_4	3548.1	3101.5	3.6e-5	4307.7	5.9	9.2	4314.6

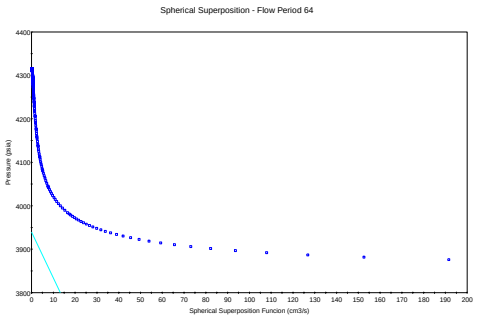
Figure 99 File no. i800g36: Depth 3548.1 m-MD

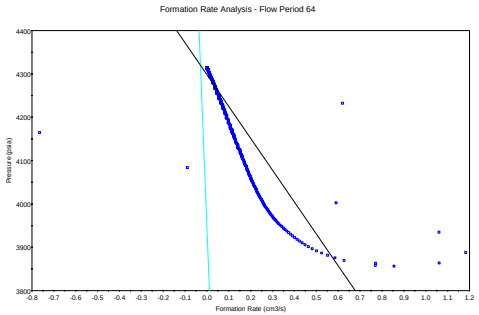


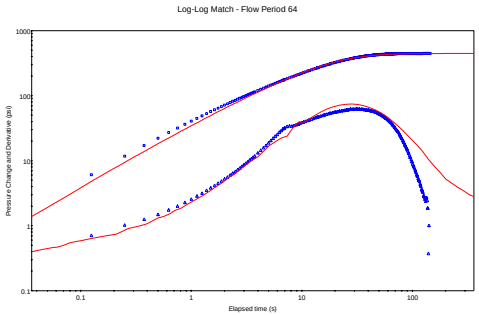


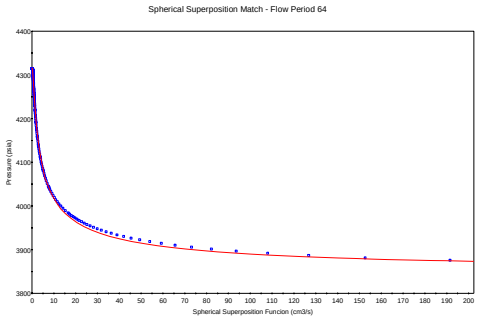
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4315.867	psia
pwf	3869.675	psia
k/u(xyz)	0.2995	mD/cp
k(xyz)	0.2995	mD
c(sys)	3.1523E-005	1/psi
S(p)	-0.66	
C	6.9399E-008	bbl/psi
ri	2	ft
p*(FRA)	4298.176	psia
k/u(FRA)	5.137	mD/cp
c(FRA)	3.6847E-005	1/psi









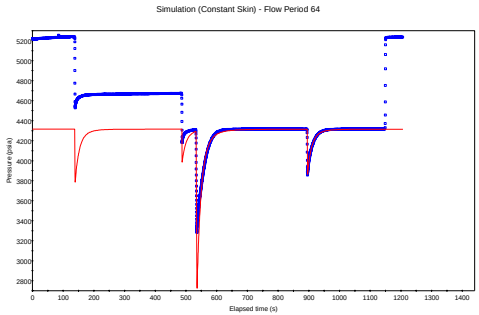
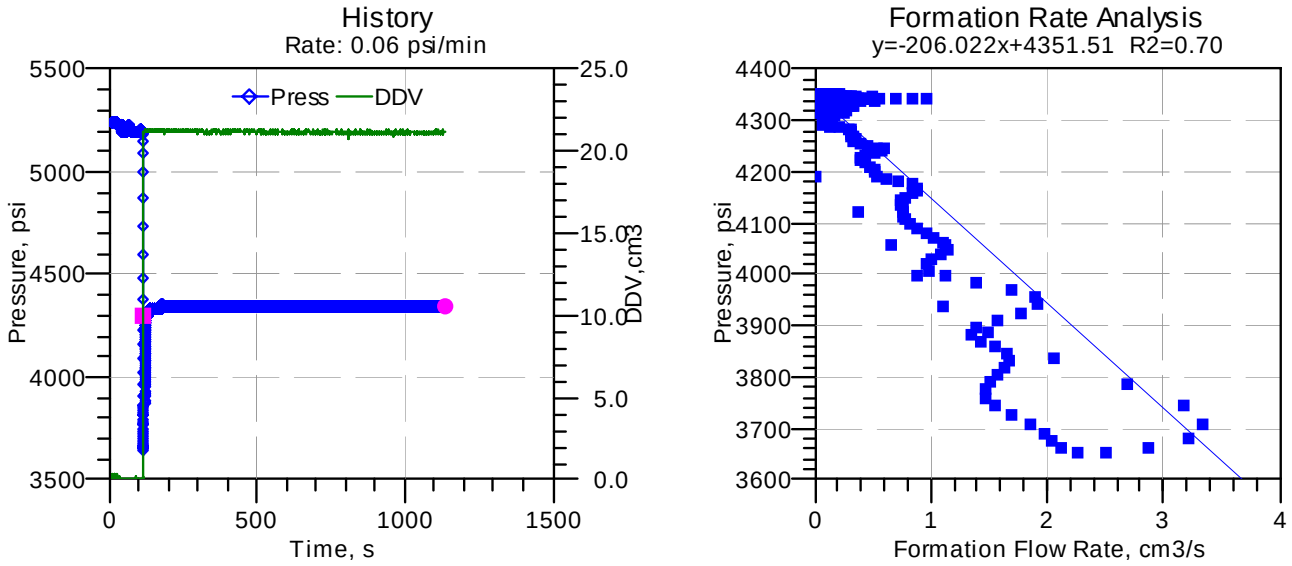


Figure 100 File no. i800g37_1: Depth 3560.9 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

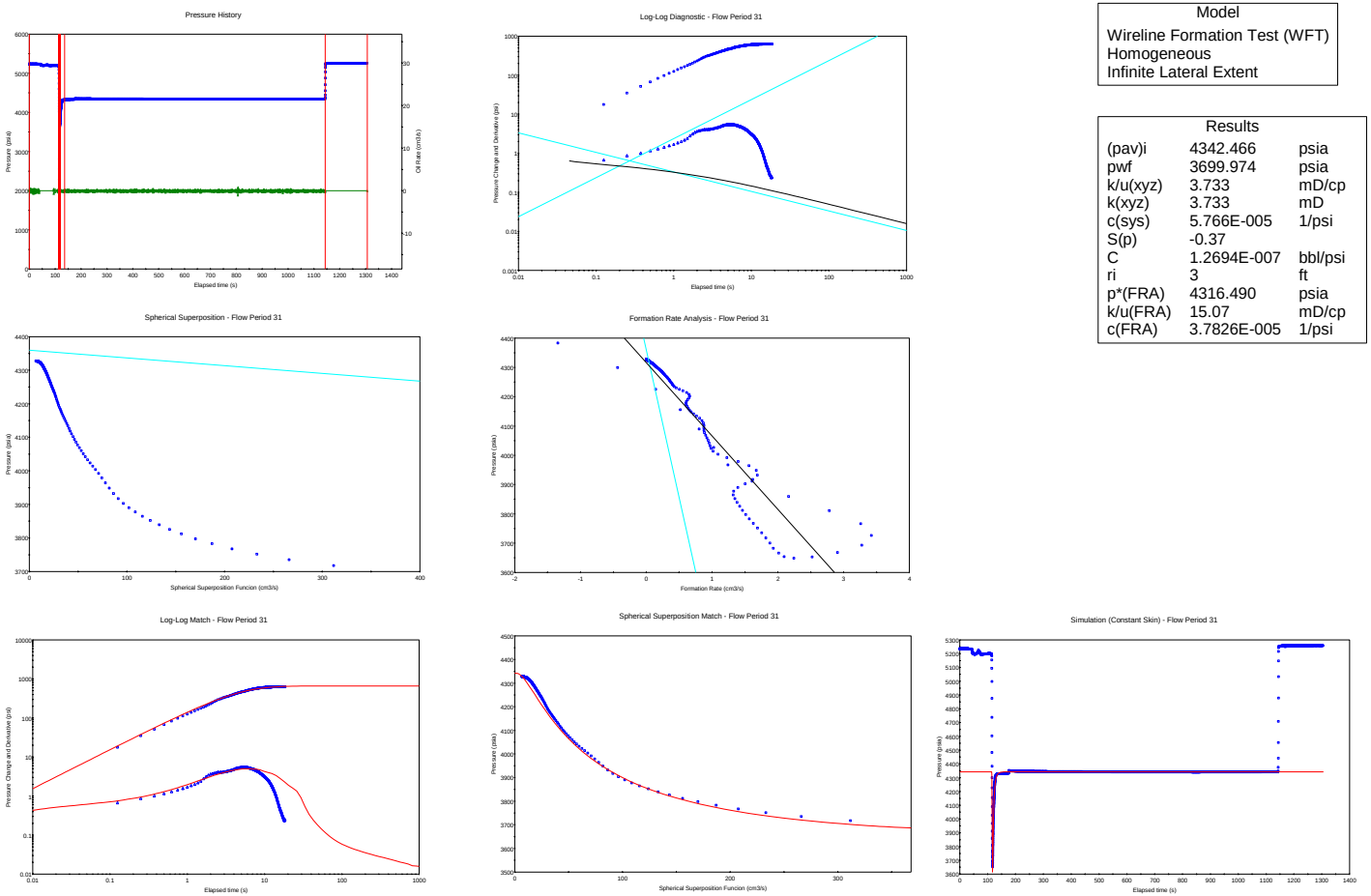
Wireline Formation Test Analyzer (WFTA^{SM})



Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
37_1	3560.9	3113.4	3.9e-5	4351.5	16.7	16.6	4342.4

Figure 101 File no. i800g37: Depth 3560.9 m-MD



Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

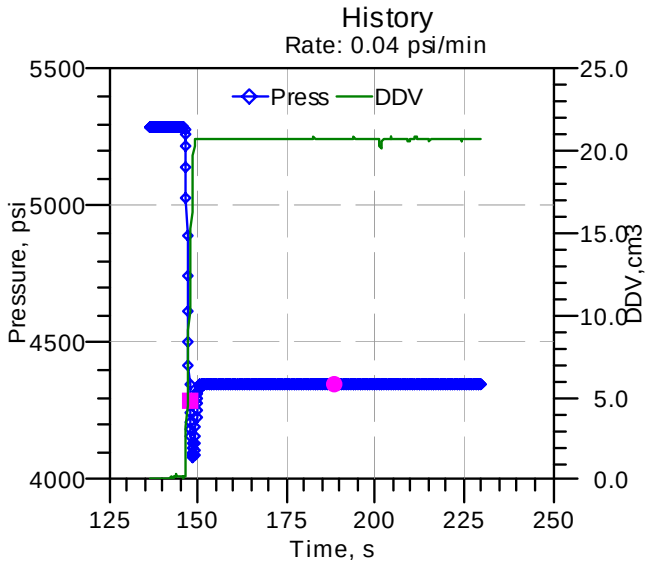
Results		
(pav)i	4342.466	psia
pwf	3699.974	psia
k/u(xyz)	3.733	mD/cp
k(xyz)	3.733	mD
c(sys)	5.766E-005	1/psi
S(p)	-0.37	
C	1.2694E-007	bbl/psi
ri	3	ft
p*(FRA)	4316.490	psia
k/u(FRA)	15.07	mD/cp
c(FRA)	3.7826E-005	1/psi

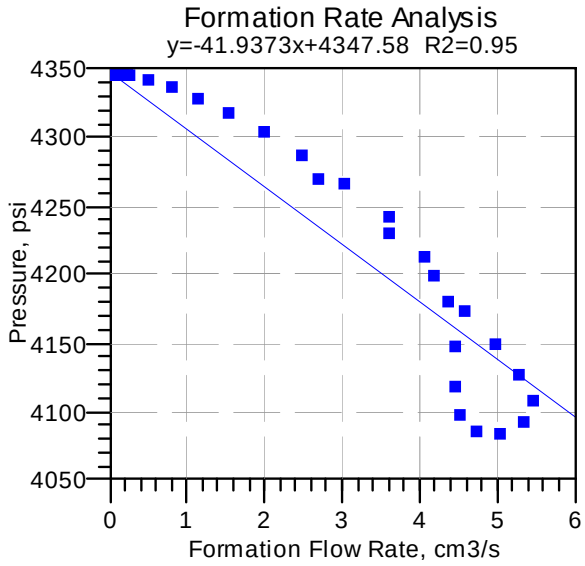
Baker Atlas GeoScience

Figure 102 File no. i800g38_1: Depth 3574.0 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

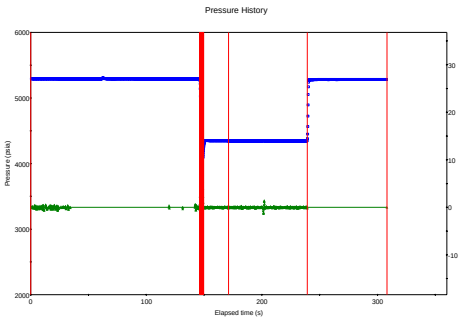


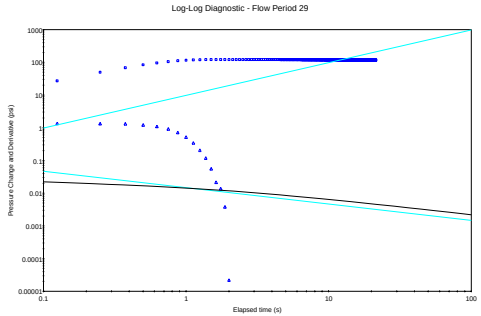


Pressure Test Results-NOT FRA Compliant

File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
38_1	3574.0	3125.6	4.6e-5	4347.6	82.1	71.5	4345.0

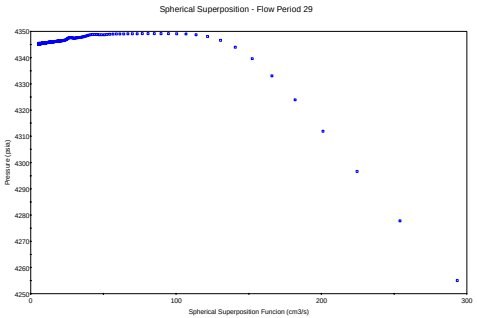
Figure 103 File no. i800g38: Depth 3574.0 m-MD

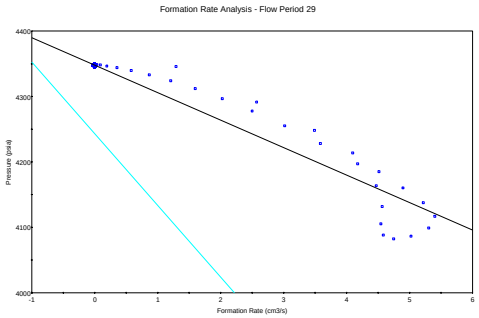


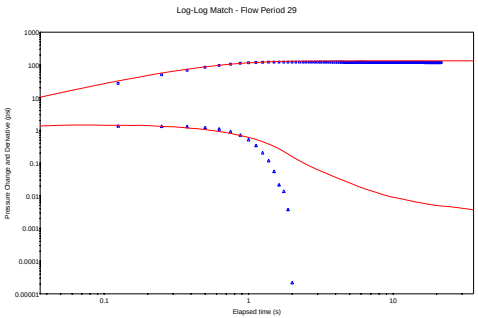


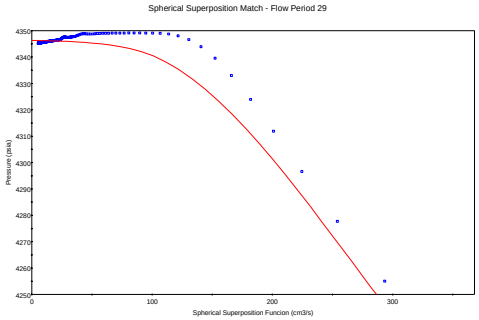
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

Results		
(pav)i	4346.308	psia
pwf	4227.981	psia
k/u(xyz)	34.43	mD/cp
k(xyz)	34.43	mD
c(sys)	1.633E-005	1/psi
S(p)	0.98	
C	3.5951E-008	bbl/psi
ri	10	ft
p*(FRA)	4347.743	psia
k/u(FRA)	89.84	mD/cp
c(FRA)	4.7365E-005	1/psi









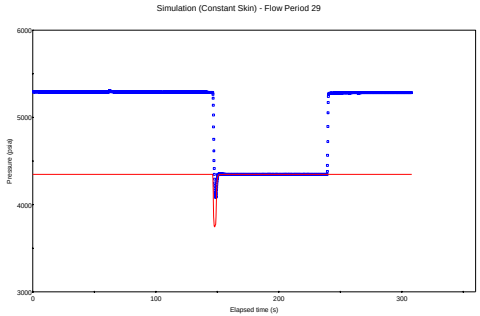
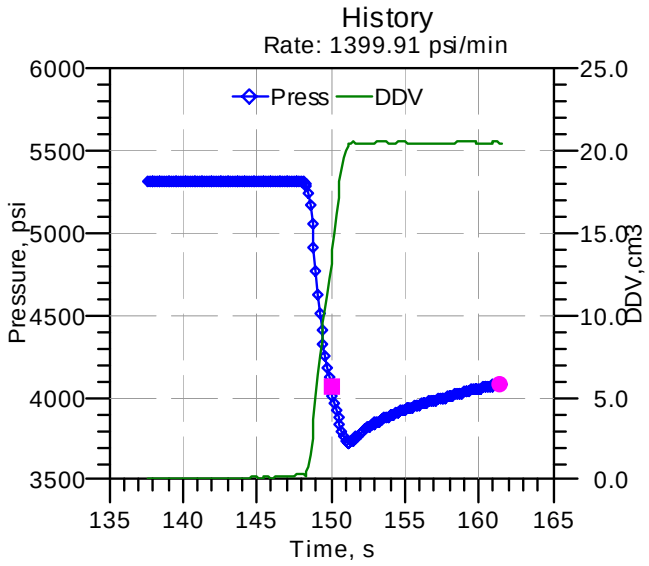
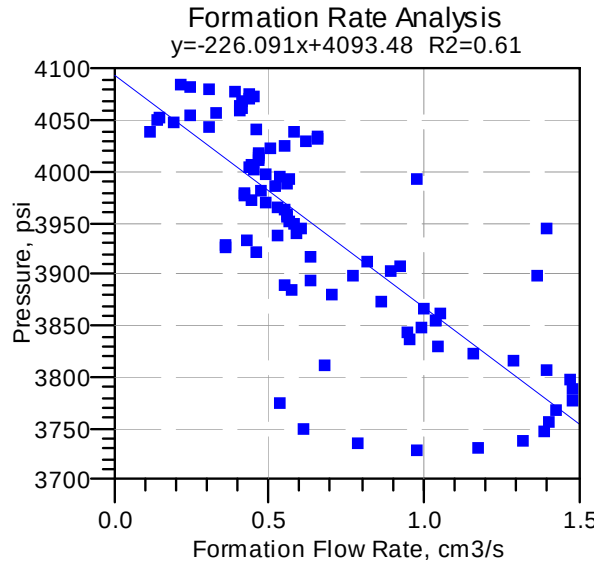


Figure 104 File no. i800g39_1: Depth 3622.8 m-MD

Company: BASS STRAIT OIL COMPANY LTD
Field: EXPLORATION
Well: ZANE GREY-1/ST1/ST2

Wireline Formation Test Analyzer (WFTA^{SM})

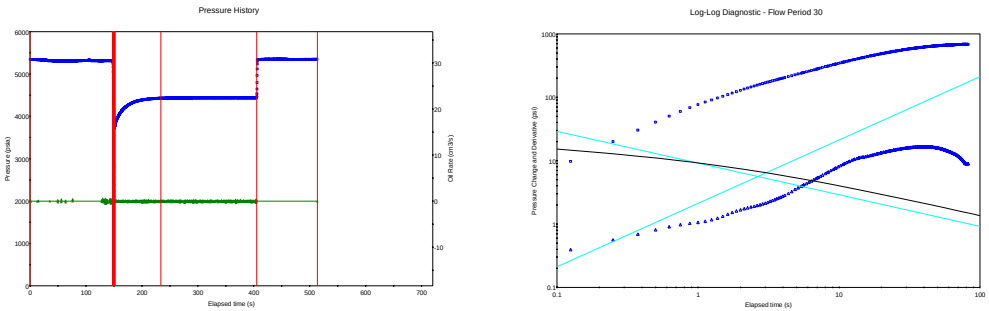




Pressure Test Results-NOT FRA Compliant

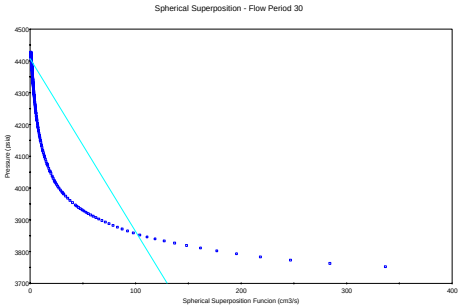
File	Depth		Flow Rate Analysis			Maximum	Final
Number	Measured	TVD	Ct	P*	Mobility	Rate	Buildup
i800g	(m)	(m)		(psi)	(mD/cP)	(mD/cP)	(psi)
39_1	3622.8	3170.9	5.4e-5	4093.5	15.2	14.4	4086.1

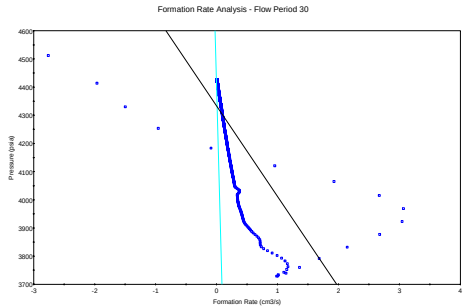
Figure 105 File no. i800g39: Depth 3622.8 m-MD

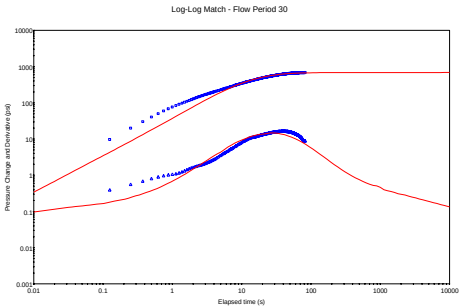


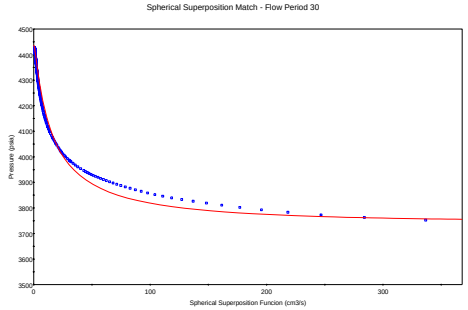
Model
Wireline Formation Test (WFT)
Homogeneous
Infinite Lateral Extent

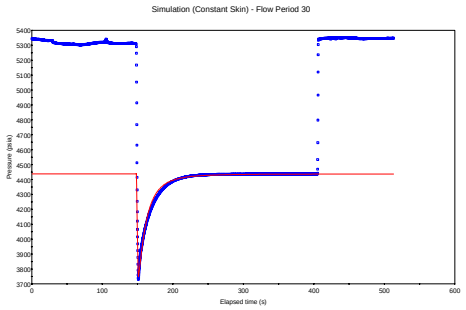
Results		
(pav)i	4437.604	psia
pwf	3742.515	psia
k/u(xyz)	0.4659	mD/cp
k(xyz)	0.4659	mD
c(sys)	7.5749E-005	1/psi
S(p)	-0.76	
C	1.6676E-007	bbl/psi
ri	2	ft
p*(FRA)	4333.521	psia
k/u(FRA)	11.74	mD/cp
c(FRA)	4.0606E-005	1/psi











7. Analysis Methods

7.1 Pressure Transient Analysis (PTA)

7.2 What is Pressure Transient?

In terms of interpreting and describing WFT pressure response, the initial pressure response measured by a wireline formation test is the hydrostatic pressure, as shown by the blue dots in Figure 106. As the tool is set to the formation, the packer begins to compress the mudcake causing a slight pressure rise, but the pressure subsequently drops as the piston within the WFT device moves to withdraw fluid from the formation. Pressure transient data is recorded during pressure tests with gauges located near the probe. If the piston movement can be measured accurately, the "formation rate" can be recorded, illustrated by the green curve in Figure 106. The "superposition method" can then be used to plot pressure drop and pressure derivatives versus time, which can be analysed using the PTA technique.

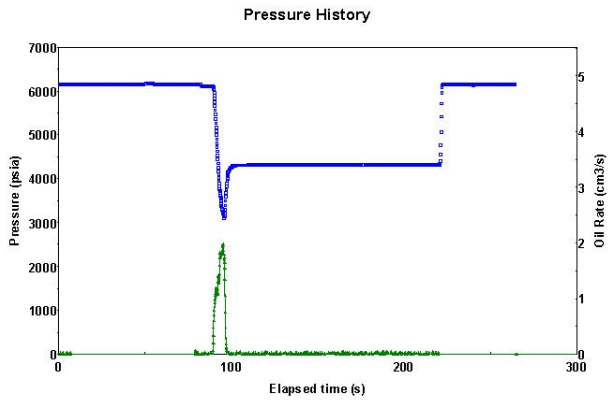


Figure 106 Typical Pressure Response of WFT using Single Probe

7.3 Is it Similar to Well Test Analysis?

Pressure Transient Analysis uses the same principle as advanced production well test analysis techniques. The near-wellbore, reservoir and boundary models are selected from the shape of pressure derivatives to match pressure data in log-log, Horner and simulation plots.

Compared to a Drill Stem Test (DST) and Production Test (PT), the WFT provides a very small-scale pressure test in terms of both the duration of the test and the volume of fluids produced to the well. Figure 107 illustrates a comparison of pressure derivative curves for WFT versus DST and PT. Even though scales of the radii of investigation of these three test techniques are different, the same advanced well test analysis principle can be used to analyse the pressure response. The pressure response curves can be divided into three periods: i.e. (1) "Early time" which indicates near wellbore behaviour, (2) "middle time" which reflects reservoir behaviour and (3) "late time" which reflects the influence of boundaries within the reservoir. The shape of the pressure derivative curves helps to diagnose which model is influencing a test and during advanced well test interpretation; early, middle and late time models are selected to match the pressure data.

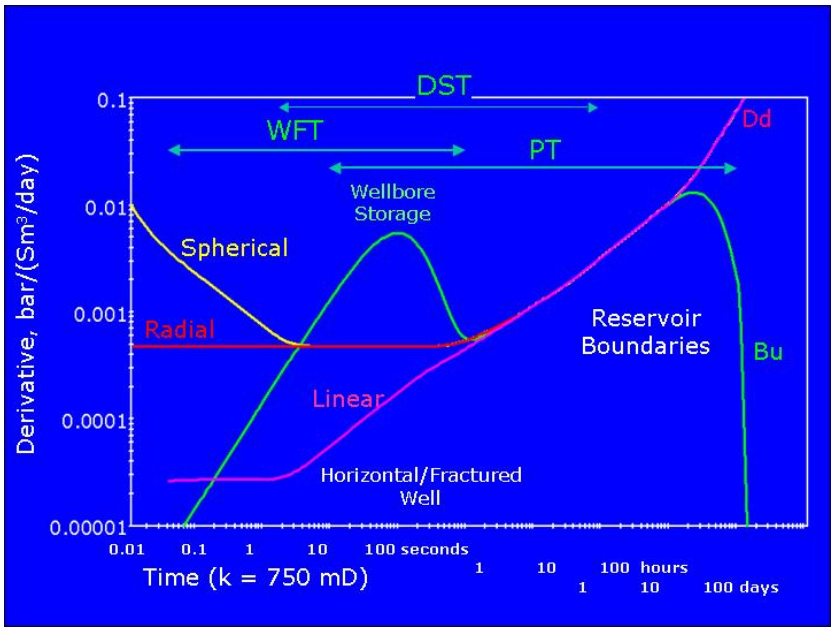


Figure 107 A Comparison of Pressure Response from Different Scales, i.e. Wireline Formation Test, Drill Stem Test, and Production Well Test (Whittle, 2002)

7.4 What Information do we obtain from Pressure Transient Analysis (PTA)?

Results obtained from pressure transient analysis depend on selected models. Formation pressure and fluid mobility are the typical result from all RCI analysis techniques (i.e. Interpret2001, WFTA, and RCI field plot). Tool storage and skin factor are additional information that could be obtained from pressure transient analysis techniques. Spherical permeability can be obtained if the spherical flow regime is seen in pressure derivatives. Vertical to horizontal permeability ratio, or top and bottom boundary distances can be calculated if the cylindrical flow develops in pressure derivatives and any of this information is known from other sources. Other boundary distances can also be estimated if the flow deviates from the radial flow.

7.5 How to Analyse Pressure Transient Data obtained from Wireline Formation Testers?

A spherical source solution is used to analyse wireline formation pressure data in the pressure transient analysis software, Interpret® 2003. Flow Rate analysis (FRA) technique is applied in one of diagnostic plots. The initial estimation of formation pressure, spherical permeability and tool storage are calculated using the FRA technique. Then the matching curves for log-log, Horner and simulation plots are generated using the initial estimated parameters from the FRA plot. The linear regression technique can be applied to obtain the best match with the pressure transient data.

Probe and reservoir parameters are required for pressure transient analyses. These parameters are:

1. Formation porosity
2. Probe inner diameter
3. Probe tool volume
4. Geometric factor
5. Fluid viscosity
6. Total compressibility

Wireline Formation Flow Models

The flow geometry of pressure transient data obtained using a WFT device is much more simplistic compared to data obtained during conventional well testing because of its smaller radius of investigation. In addition, pressure transient analysis of WFT data provides highly localized reservoir information, reflecting reservoir parameters close to the wellbore, which will be masked during conventional well testing. The near wellbore, reservoir and boundary models for WFT data are:

Tool Storage

During conventional well testing, pressures in the early time regime are affected by wellbore storage. Similarly, at WFT scale, pressure response in the early time domain is dominated by the tool storage effect, or fluid within the tool. Pressure derivative curves reflecting tool storage effect will show a "hump" in the early time domain, as illustrated in Figure 106.

Spherical Flow

The fluid in the formation around the wellbore moves into the WFT probe, which has a small radius. The flow-regime geometry from the formation into the WFT probe is spherical and characterized by a straight line pressure derivative curve having a negative half-unit slope in a log-log plot (Figure 108). The spherical flow regime is controlled by the spherical permeability, k_{xyz} and equations for spherical flow are illustrated in Equations 1 to 3. The spherical flow regime follows the tool storage effect and occurs prior to any reservoir boundary effects which occur in the late time domains.

Dimensionless Pressure Drop

$$p_D h_D = 1 - \frac{1}{\sqrt{\pi \frac{t_D}{r_{sD}^2}}} + S_p$$

Equation 1

Dimension Pressure Drop

$$\Delta p = \frac{qB\mu}{2a_1 k_{xyz} r_s}\left[1 - \sqrt{\frac{\phi \mu c_t r_s^2}{\pi a_2 k_{xyz}}}\frac{1}{\sqrt{\Delta t}} + S_p\right]$$

Equation 2

The derivative simplifies to:

$$p'_D h_D = \frac{1}{2\sqrt{\pi \frac{t_D}{r_{sD}^2}}}$$

Equation 3

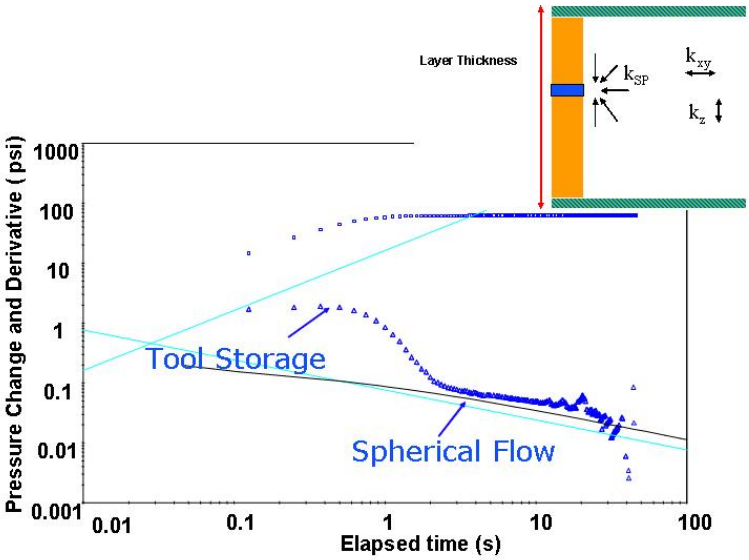


Figure 108 Log-log Plot, field Example 9. Spherical flow regime developed in middle time pressure derivatives

Cylindrical Flow (Radial Flow)

When fluid flows in the formation far from the probe; if the region sampled encounters an upper and lower layer boundary (e.g. a lithological or bed boundary, or a small shale bed or limestone within the sands sampled, which forms boundary for the flow), then the flow geometry changes from a spherical flow to a cylindrical or "radial" flow regime. Radial flow develops if the top and bottom boundaries of the reservoir are no-flow boundaries and these boundaries are close enough for the pressure transients to "reach" and be influenced by them during the test. An example of pressure derivatives indicating stabilization is provided in Figure 109.

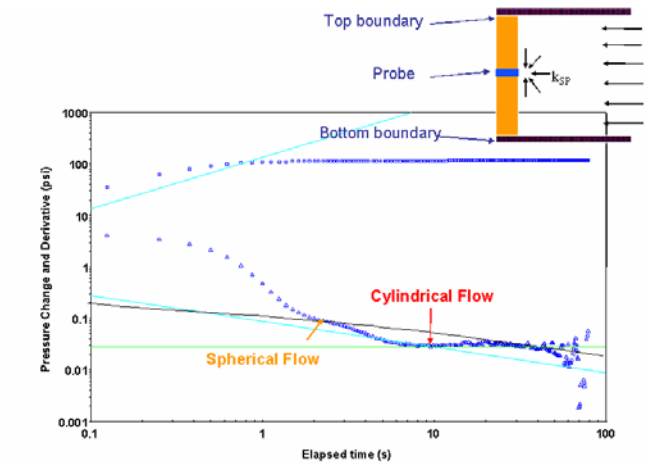


Figure 109 Log-log Plot, field Example 2. Cylindrical flow regime developed in late time.

The pressure response during radial flow depends only on the horizontal mobility thickness, ($k_{xy}h/\mu$), whilst the time to reach the boundaries depends on the vertical diffusivity ($k_z/\phi\mu\ c_t$)[21]. Pressure derivatives were expressed in dimentionless term:

$$p_D' = \frac{1}{2}$$ **Equation 4**

Pressure derivative was rewritten in dimentional form as[21]:

$$\Delta p' = \frac{qB\mu}{2a_1 k_{xy} h}$$ **Equation 5**

When a cylindrical flow model is diagnosed in pressure derivative curves, the vertical to horizontal permeability ratio can be calculated if the distances to the upper and lower layer boundary are known from an independent source e.g. a borehole image log or a core. The upper and lower layer boundary distances can be estimated relative to the probe location. In this example, the boundaries are sandstone-mudstone contacts. Using the analytical solution for a cylindrical flow model and boundary distances of 1.6 ft for both, top and bottom boundaries, a vertical to horizontal permeability ratio of 0.48 can be calculated. In the same way, if the vertical to horizontal permeability ratio is known, the boundary distances could be estimated.

From observation of various field data, the WFT tests which have repeated tests at the same depth show that the pressure derivative curve of the pre-test usually indicates a negative half slope, whereas the pressure derivative curve of the repeated test shows stabilization in the late time. This is because the flow in the first period is from the area nearby the probe and therefore, the flow geometry is a spherical flow model. On the other hand, the flow in the repeated test is from the area further away. The flow hits top and bottom boundary and therefore, the flow geometry changes from spherical flow to cylindrical flow models.

Cylindrical Flow with Extra Boundary

In addition to layer boundaries oriented "perpendicular" to the wellbore axis and probe orientation, and as a result of the small scale of the radius of investigation, extra boundaries (as shown on the top right of Figure 108), i.e. small shale body or fracture, which lie parallel but close to the wellbore, can also induce turbulence which is evident in pressure derivative curves. Figure 110 illustrates a field example for a test in which the pressure derivative deviates from the cylindrical flow stabilization. In this example, the spherical and cylindrical flow can be seen at the time before 1 second. Then the pressure derivative curve trends upward in the late time and then stabilizes at a value twice that of the first stabilization level, indicating the presence of a further no-flow boundary. Subsequently however, after circa 30 seconds, the pressure derivative deviates downward again, stabilizing at a level equivalent to the first stabilisation of cylindrical flow. The re-stabilisation trend in the late time after 30 seconds indicates that the wellbore parallel feature detected does not form a continuous no flow boundary. Fluids at distance in the formation can bypass this boundary to reach the probe in the late time. The results of advanced pressure transient analysis indicate that the wellbore perpendicular boundary is 0.82 ft away from the wellbore, and the radius of investigation[2] of this example pressure test was 10 ft.

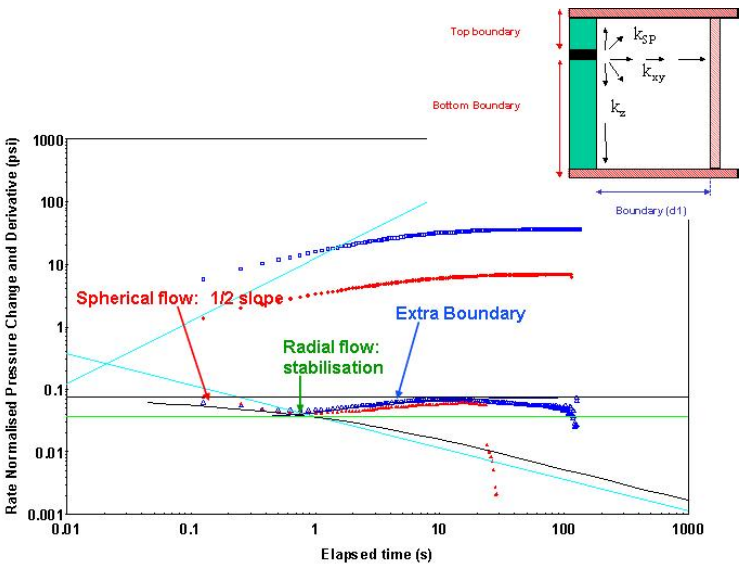


Figure 110 Log-log Plot, field Example 3. Cylindrical flow regime with extra boundary developed in late time

Fields examples for cylindrical and cylindrical flow with extra boundary show clearly that the use of PTA technique provides more details of reservoir heterogeneities at the sample scale of the wireline formation test tool. The layer boundaries and extra boundary information, e.g. distances from the wellbore, size of the extra boundary, can be input directly into a reservoir simulation model for more accurate simulation results.

8. Theory and Equations - Formation Rate Analysis (FRA) and Drawdown Mobility

8.1 Formation Rate Analysis (FRA)

The FRA theory is based on the material balance for the tool's flow-line volume. The key contribution of FRA is to use formation rate in the Darcy Equation instead of piston withdrawal rate. Formation rate is calculated by correcting the piston rate for tool storage effects. Representing the complex flow geometry of probe testing with a geometric factor makes the FRA technique more practical, from which we obtain p*, permeability, and fluid compressibility. The Darcy equation is expressed with a geometric factor for isothermal, steady-state flow of a liquid when inertial flow (Forchheimer) resistance is negligible,

$$q_f = \frac{k G_o r_i (p^* - p(t))}{\mu},$$

Equation 6

where q_f is the volumetric flow rate into the probe from the formation, p^* is the formation pressure, and $p(t)$ is the pressure in the probe. G_o is a geometric factor that accounts for the complex formation flow geometry and r_i is the probe radius.

When the variation in fluid density is small, the conservation of mass requires that the accumulation rate, q_{ac}, should be equal to the difference between formation rate, q_f, and the drawdown rate, q_{dd}. $q_{ac} = q_f - q_{dd}$. Using the definition of isothermal compressibility, the accumulation rate can be expressed as,

$$q_{ac} = C_t V_t \frac{dp(t)}{dt},$$

Equation 7

where V_t is the volume in the tool including probe, flow lines and drawdown chambers and the term $C_t V_t$ is called the compressive storage of the measuring system. After rearranging the material balance equation, we arrive at the following equation:

$$p(t) = p^* - \frac{\mu C_t V_t}{k G_o r_i}\frac{dp(t)}{dt} - \frac{\mu}{k G_o r_i} q_{dd}.$$

Equation 8

Since dp/dt and q_{dd} are the only non-constant variables on the right hand side of equation, the multi-linear regression technique can be used to simultaneously obtain two slopes and an intercept:

$$\frac{\mu C_t V_t}{k G_o r_i}, \quad \frac{\mu}{k G_o r_i}, \text{ and } P^*.$$

Equation 9

From the slope of q_{dd}, formation permeability is calculated when the fluid viscosity is known. The slope of the derivative term is to calculate the system compressibility.

The equation can be rearranged to,

$$p(t) = p^* - \left(\frac{\mu}{kG_o r_i}\right)\left(C_t V_t \frac{dp(t)}{dt} + q_{dd}\right).$$

Equation 10

Note that the terms within the last parentheses in the equation correspond to accumulation and drawdown rates, respectively. They act against each other during a drawdown period and together during a buildup period, but the combination, in essence, is the flow rate from the formation

$$q_f = \left(C_t V_t \frac{\partial P(t)}{\partial t} + q_{dd}\right).$$

Equation 11

A plot of *P(t)* vs. formation rate should approach a straight line with a negative slope and an intercept *P** at the *P(t)* axis. The absolute value of the slope, *m*, is

$$m = \frac{\mu}{kG_o r_i},$$

Equation 12

and permeability is calculated from

$$k = \frac{\mu}{G_o r_i m}.$$

Equation 13

In order to apply the FRA method, the drawdown rate, q_{dd}, should be a function of time not an average piston rate as in the conventional methods. RCI[SM] measures the drawdown volume as a function of time and therefore the drawdown rate at each moment can be calculated. When drawdown rates are not available as in the case of FMT data, only the buildup portion of the test can be considered because the FMT was not designed to measure the drawdown piston rate. In this case a value for compressibility of fluid must be assumed.

Apart from estimating permeability and formation pressure, FRA can be used as a simple graphical quality indicator.[4] Tests with poor graphical correlation (deviation from a straight line) indicate possible problem(s) during the test. Problems include inadequate drawdown rate, insufficient drawdown volume, plugging, tool problem, etc. Tests with poor graphical correlation often are not included in the interpretation if other supporting factors, such as falling in a gradient line, good correlation with nearby well, etc., are not provided.

8.2 Drawdown Mobility and Final Build-up Pressure calculated from RCI Field Plot

For a drawdown pressure test, the ECLIPS surface acquisition system produce a real time plot, as shown in Figure 111. The system automatically picks the hydrostatic pressure, the flowing pressure and the formation pressure. The system will also pick the start and the end point for the drawdown with corresponding time and the pressures.

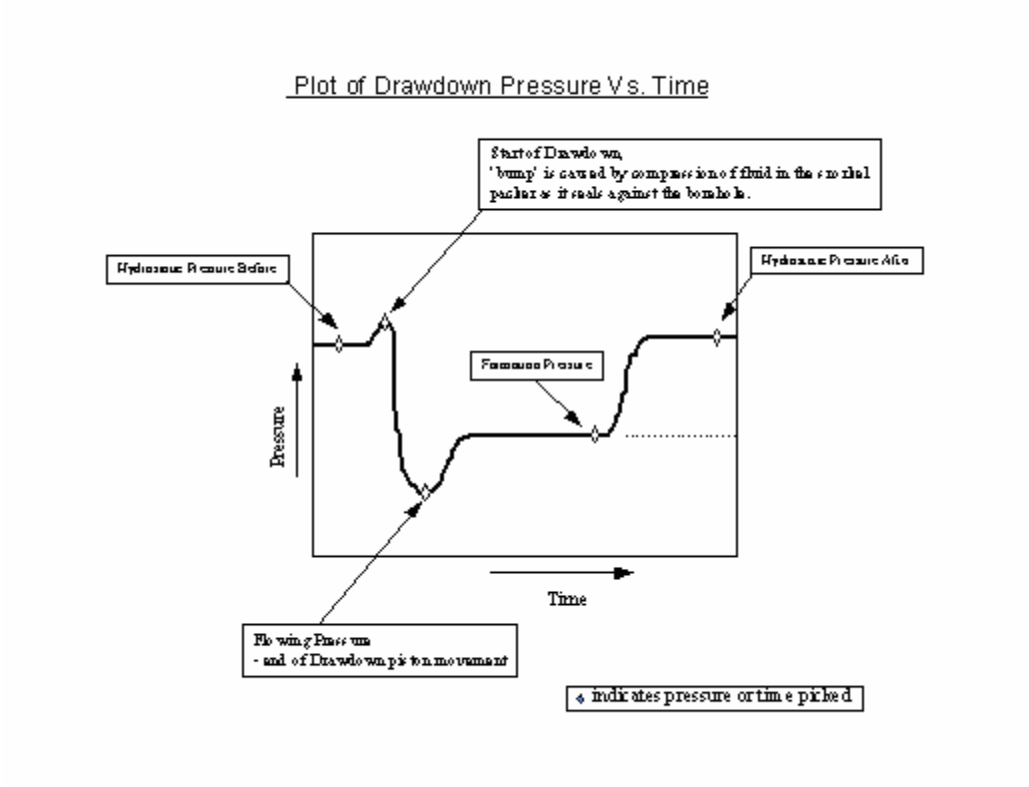


Figure 111 Plot of Drawdown Pressure versus Time

It is important to note that the drawdown permeability is derived from the build up portion of pressure curve. The minimum pressure, or flowing pressure is the result of the drawdown taking place.

Mobility Estimation in the RCI Field Plot:

1) Error in Flow Rate
The drawdown rate is the average rate, which is mostly smaller than the maximum formation rate. Because the maximum pressure difference (P_{fbu} - $P_{flowing}$) is used in the calculation, smaller rate means less mobility.

2) Error in the Equation - Flow Model
From '*Formation Multi-Tester (FMT) Principles, Theory, and Interpretation*'.
It states

$$\frac{k}{\mu} = 1842 \times C \times \frac{q}{d\,\Delta p} \quad , \qquad \textbf{Equation 14}$$

where C is the flow shape factor, q is the flow rate in cc/s, d is the probe diameter in inch, and Δp is the pressure drawdown (P_{fbu} - $P_{flowing}$) in psi.

where

$$Flowrate(cc/\sec) = \frac{drawdown \quad chamber \quad volume}{fill \quad time} \qquad \textbf{Equation 15}$$

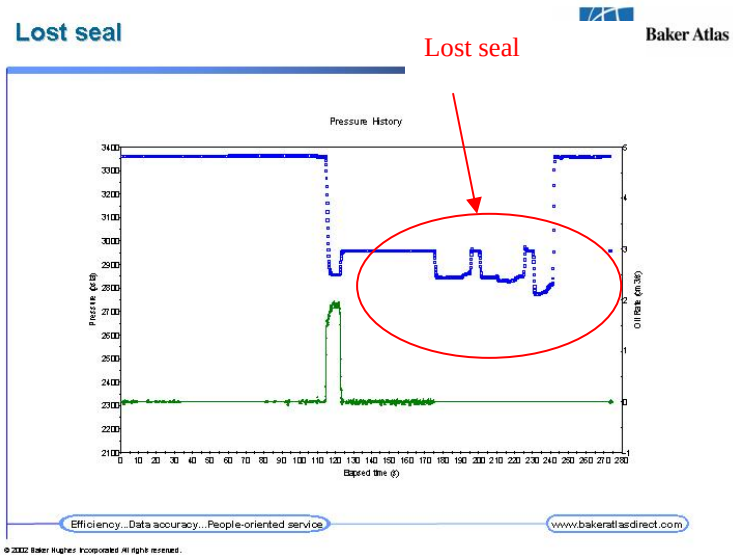
$$Drawdown \quad Pressure(\Delta p) = Sandface\,Pressure - Flowing \quad Pressure(psi) \qquad \textbf{Equation 16}$$

9. Examples of FRA Plots Indicating Types of Problems in RCI Pressure Tests

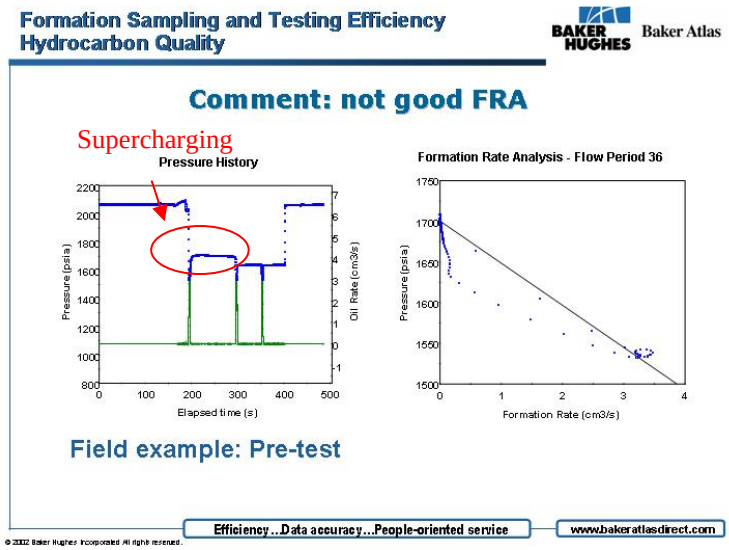
In real time, the pressure history (plot of pressure versus time) and FRA plots can be used to identify lost seal, super-charging effect, tight formation and dry test effects.

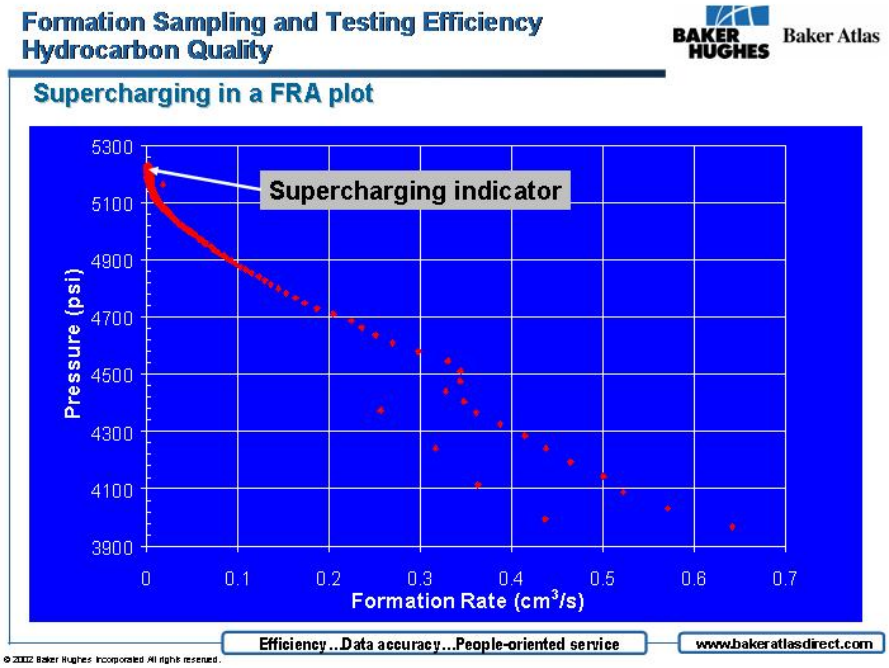
Examples of Tests with Non FRA compliance:

- **Lost Seal**

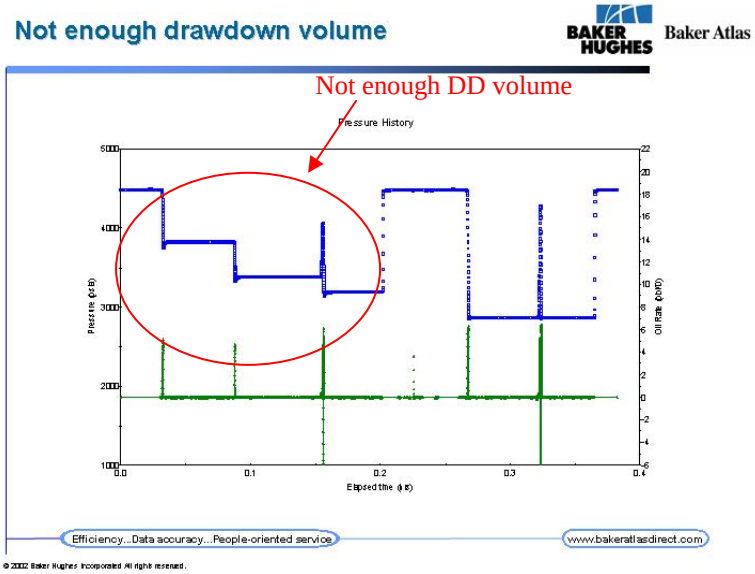


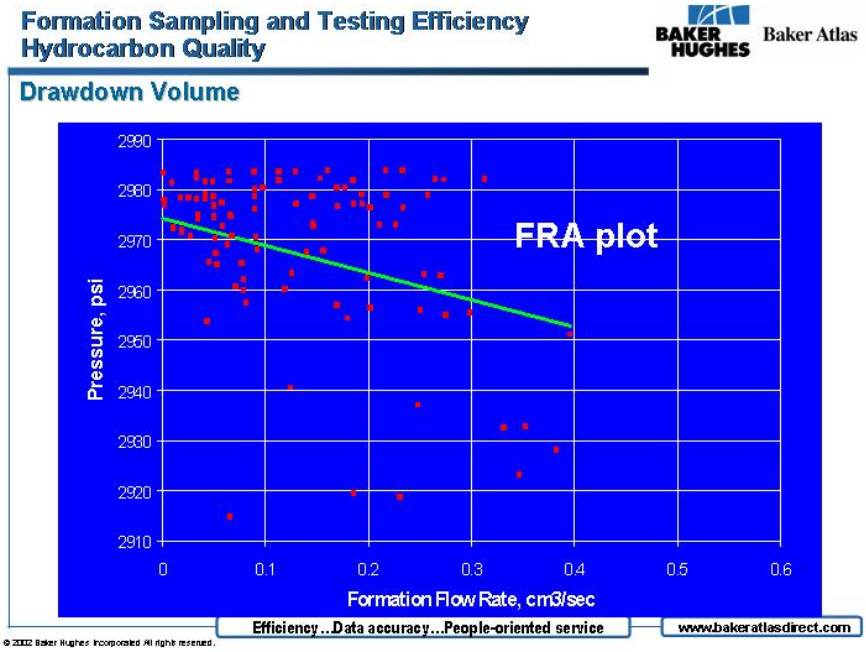
- **Supercharging**



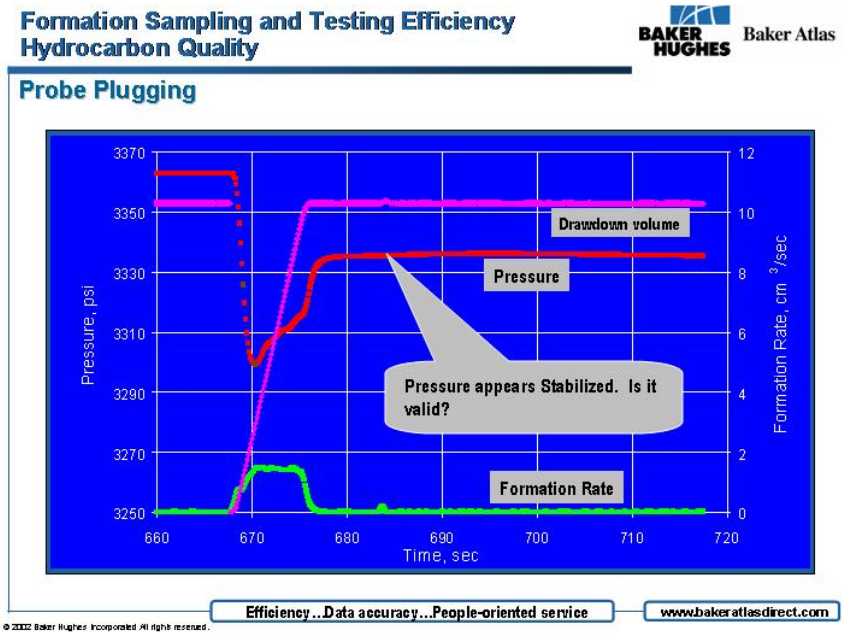


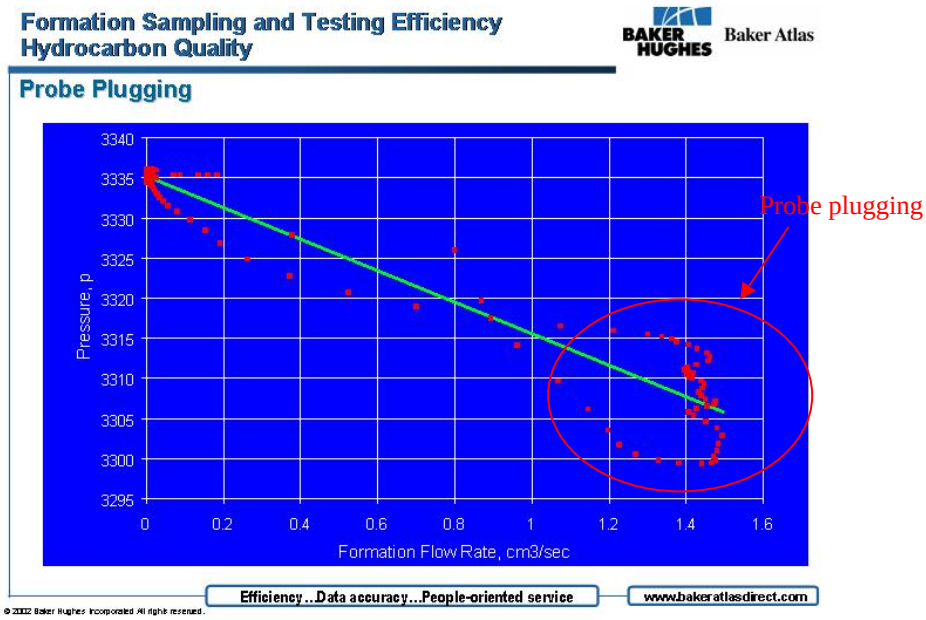
- **Not Enough Drawdown**



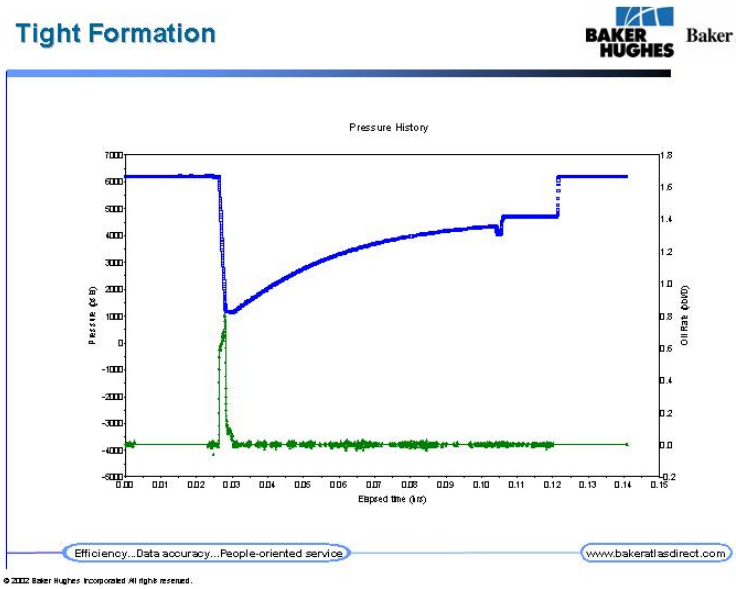


- **Probe Plugging**



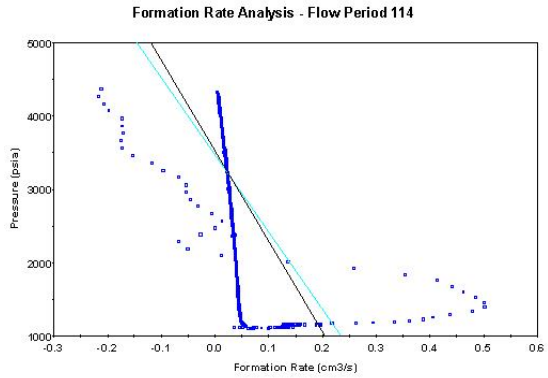


- **Tight Formation**



FRA plot for Tight Formation

Baker Atlas



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ENCLOSURES

BASS STRAIT OIL
Oil for Australians

ZANEGREY-1

COMPOSITE WELL LOG
(1:500 scale)

SURFACE LOCATION:	038deg 34' 31.640"S 143deg 58' 18.270"E	**PERMIT:**	VicPr42		
EASTING:	577 000.00 E	**MAP REFERENCE:**	SJ55 MELBOURNE Map Sheet (1:1,000,000); Australian Map Grid AMG	**REGION:**	GIPPSLAND BASIN
NORTHING:	5 729 956.420 S	**TOTAL DEPTH (Driller's):**	3675.0m MDRT		
UTM ZONE:	AGD 84	**TOTAL DEPTH (Logger's):**	3671.0m MDRT	**WELL STATUS:**	P&A as non-commercial Gas-Condensate Dis
SEISMIC LINE:	BSOC 2002 3D Survey; Inline 2095, CDP 1885	**PLUGGED BACK TO:**	108m		
		PERFORATIONS:	NIL		
ELEVATIONS:	+21.5 (m)	**DRILLING CONTRACTOR:**	Diamond Offshore General Company	**WELLSITE GEOLOGISTS:**	G.Gwaryh,Thangam©-MacFarlan
WATER DEPTH (MSL):	72.5 (m)	**RIG:**	MODU "Ocean Patriot"		
		WIRELINE LOGGING BY:	Baker Atlas	**LOG COMPILATION:**	R. Fisher
DATE COMMENCED	27th January 2005; 0500Hrs	**CEMENTING:**	Dowell Schlumberger	**DRAFTING:**	P. Charlesbois (Crocker Data Processing PtL)
DATE SPUDDED:	29th January 2005; 14:30Hrs	**MUD LOGGING BY:**	Sperry-Sun		
DATE AT TOTAL DEPTH:	10th March 2005; 17:00Hrs	**MWD LOGGING BY:**	Sperry-Sun		
DATE RIG RELEASED:	18th March 2005; 19:30Hrs				

CASING

SIZE	WEIGHT	INTERVAL
30"	310	107.5
20"	94	107.5 - 1
13 3/8"	68	1095.01
9 5/8"		2184.00

CEMENT

PLUG NUMBER	FROM (m)	TO (m)	CEMENT
1	100	305	
2	990	1095	
3	100	150	

HOLE SIZE & MUD SYSTEM

SIZE (inch)	FROM (m)	TO (m)	MUD SYSTEM
30"	107.5	120.5	
26"	120.5	1095	Seawater
12 1/4"	1095	2772	KCL/Mecap

LWD LOG DATA

RUN NUMBER	200	300	400	500	600
LOG TYPE/COMBINATION	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS
DATE	30-Jan-05	4-Feb-05	4-Feb-05	7-Feb-05	9-Feb-05
INTERVAL RECORDED	129.5 - 1095.0m	1095.0 - 1095.0m	1095.0 - 2103.0m	2103.0 - 2702.0m	2702.0 - 2772.5m

LITHOLOGY SYMBOLS

ROCK TYPE

- SANDSTONE (coarse)
- SANDSTONE (fine)
- CALCAREOUS SANDSTONE
- SILTSTONE
- CLAYSTONE
- SILTY SANDSTONE
- CLAYSTONE
- CALCAREOUS CLAYSTONE
- SHALE
- LIMESTONE
- CALCAREENITE
- CALCISILTITE
- CALCILUTITE
- DOLOMITE
- MARL
- TILLITE
- GREENSAND
- HALITE
- GYPSUM
- ANHYDRITE
- VOLCANICS
- IGNEOUS BASEMENT
- METAMORPHIC BASEMENT
- COAL
- ARGILLACEOUS CALCILUTITE

OTHER CONSTITUENTS

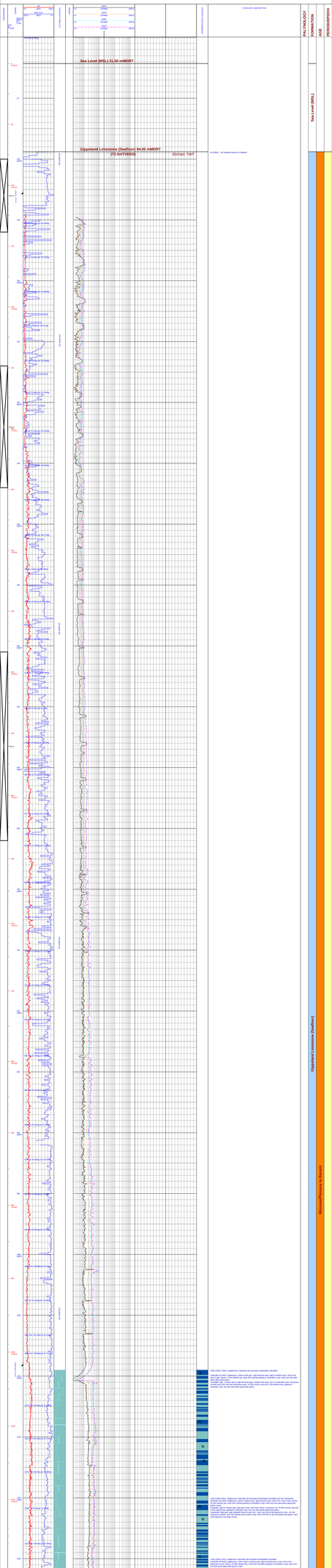
- ARGILLACEOUS
- GLAUCONITIC
- FELDSPATHIC
- MICACEOUS
- CARBONACEOUS
- PYRITE
- SILTY
- CALCAREOUS
- BIOERITIC
- CHERT
- SKELETAL FRAGMENTS
- MUSCEOUS
- CEMENT
- LITHICS

ENGINEERING SYMBOLS

- CASING SHUT
- PLUGGED INTERVAL
- DRILL STEM TEST
- PERFORATED INTERVAL
- CORE No. AND INTERVAL
- SIDEWALL CORE
- SIDEWALL CORE (Not recovered)
- Repeat Formation Test (RFT)
- RFT SAMPLE RECOVERED

SHOW LEGEND

- MODERATE TO STRONG OIL SHOW
- MODERATE TO STRONG GAS SHOW
- MINOR OIL SHOW
- MINOR GAS SHOW

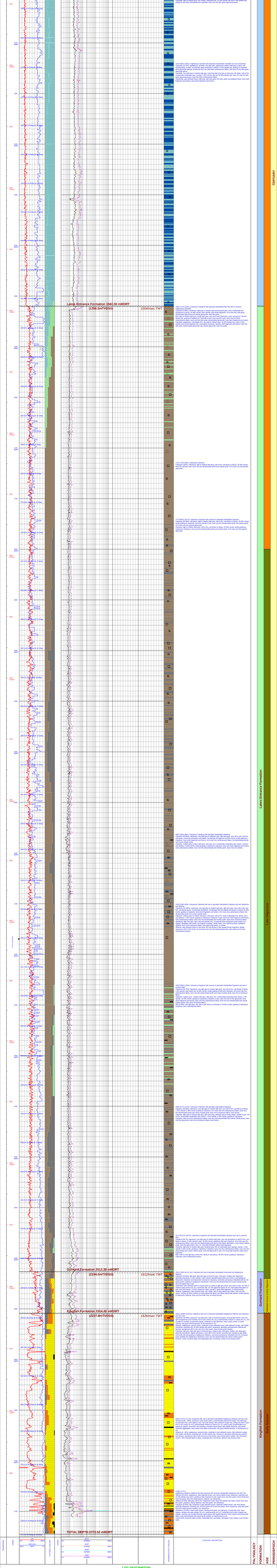


Lake Entrance Formation 1540.00 mMORT
(1396.5mTVDSS)
2054mscc 7/97

Gippsland Formation 2513.30 mMORT
(2194.0mTVDSS)
1622mscc 7/97

Kingfish Formation 2554.40 mMORT
(2227.8mTVDSS)
1626mscc 7/97

TOTAL DEPTH 2772.52 mMORT



0x2A0	Vertexbuf Factory Pos Lockless Opens
0x2A8	Vertexbuf Factory Pos Lockless Opens
0x2AF	Vertexbuf Factory Pos Lockless Opens
0x2B0	Shadow Cache Swap Pass Shift Server Processes Opens
0x2B8	Shadow Cache Swap Pass Shift Server Processes Opens
0x2BF	Shadow Cache Swap Pass Shift Server Processes Opens
0x2C0	Vertexbuf Shap Swamp Pass Shift Server Processes Opens
0x2C8	Vertexbuf Shap Swamp Pass Shift Server Processes Opens

ZANEGREY-1/ST1/ST2

COMPOSITE WELL LOG
(1:500 scale)

BASS STRAIT Oil — Oil for Australians

SURFACE LOCATION:	038deg 34' 31.640"S 147deg 59' 16.270"E	PERMIT:	Vic/P42		
		MAP REFERENCE:	SJ55 MELBOURNE Map Sheet (1:1,000,000); Graticular Block: 2208		
EASTING:	586 049.890 E			REGION:	GIPPSLAND BASIN
NORTHING:	5 729 856.420 S	TOTAL DEPTH (Driller's):	3675.00m MDRT		
UTM ZONE:	AGD 84	TOTAL DEPTH (Logger's):	3671.00m MDRT	WELL STATUS:	P&A as non-commercial Gas-Condensate Discovery
SEISMIC LINE:	BSOC 2002 3D Survey; Inline 2095; CDSP 1885				
		PLUGGED BACK TD:	100m		
		PERFORATIONS:	NIL		
ELEVATIONS:	+21.5 (m)	DRILLING CONTRACTOR:	Diamond Offshore General Company	WELLSITE GEOLOGISTS:	G.Geary/A.Thangam/D.MacFarlan
WATER DEPTH (MSL):	72.5 (m)	RIG:	MODU "Ocean Patriot"		
		WIRELINE LOGGING BY:	Baker Atlas	LOG COMPILATION:	R. Fisher
DATE COMMENCED	27th January 2005; 0500Hrs	CEMENTING:	Dowell Schlumberger	DRAFTING:	P. Charlebois (Crocker Data Processing P/L)
DATE SPUDDED:	29th January 2005; 14:30Hrs	MUD LOGGING BY:	Sperry-Sun		
DATE AT TOTAL DEPTH:	10th March 2005; 17:00Hrs	MWD LOGGING BY:	Sperry-Sun		
DATE RIG RELEASED:	18th March 2005; 19:30Hrs				

CASING

SIZE	WEIGHT	INTERVAL
(inch)	(lb/ft)	(m)
30"	553	127.75
13 3/8"	68	1090.61
9 5/8"		2184.00

CEMENT

PLUG NUMBER	FROM (m)	TO (m)	CEMENT
1	660	505	
2	370	270	
3	160	100	

HOLE SIZE

SIZE	INTERVAL	COMMENTS
(inch)	(m)	
36"	94-129.5	
16"	129.5-1095	
12 1/4"	1095-2772	TD of ZaneGrey-1
8 1/2"	2184-3107	TD of ZaneGrey-1/ST-1
8 1/2"	2988-3675	TD of ZaneGrey-1/ST-2

LWD LOG DATA

RUN NUMBER	200	300	400	500	600	700
LOG TYPE/COMBINATION	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS
DATE	30-Jan-05	4-Feb-05	4-Feb-05	7-Feb-05	9-Feb-05	21-Feb-05
INTERVAL RECORDED	129.5 - 1095.0m	1095.0 - 1095.0m	1095.0 - 2103.0m	2103.0 - 2702.0m	2702.0 - 2772.5m	2190.0 - 3107.0m

RUN NUMBER	800	900	1000	1100	1200
LOG TYPE/COMBINATION	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS	DIR-DGR-EWR_P4-PM-DDS
DATE	27-Feb-05	28-Feb-05	3-Mar-05	4-Mar-05	5-Mar-05
INTERVAL RECORDED	3107.0 - 3107.0m	2970.0 - 3031.0m	3031.0 - 3070.0m	3070.0 - 3092.0m	3092.0 - 3675.0m

WIRELINE LOG DATA

RUN #	1	2
LOGGING TOOL	DLL-MLL-MAC-ORIT-ZDL-CNL-DSL-TTRM	RCI-GR
DATE	11-Mar-05	12-Mar-05
START RIG UP	08:00 hrs 11/03/2005	02:41 hrs 12/03/2005
TIME RIH START	10:10 hrs 11/03/2005	05:15 hrs 12/03/2005
TIME ON BTM	15:38 hrs 11/03/2005	n/a
LOG SPEED (min/m)	n/a	n/a
TIME ON SURFACE	00:45 hrs 12/03/2005	12:42 hrs 14/03/2005
FINISH RIG DOWN	2:41 hrs 12/03/2005	13:00 hrs 14/03/2005
LOG HOURS	18 hrs 41 mins	67 hrs 19 mins
LOGGER'S TD (m)	3671m	n/a
LOGGER'S CSG SHOE (m)	3184m	n/a
LOGGED (m) FROM	3179.6m	3179.6m
LOGGED (m) TO	3674m	3622m
LOGGED (m) INTERVAL	1490m	442.4m
MAX. TEMP (degC)/DEPTH (mTVDRT)	121.7degC @ 3216.1m	135.3degC @ 3170.9m
TIME SINCE CIRC. STOP	16 hrs 38 mins	72 hrs

PRESSURE DATA SUMMARY

SUITE	RUN	PRESSURES	SAMPLES	TOTAL
1	2	32	1	33
TOTAL		32	1	33

LITHOLOGY SYMBOLS

ROCK TYPE

SANDSTONE (coarse); SANDSTONE (fine); CALCAREOUS SANDSTONE; SILTSTONE; SILTY SANDSTONE; CLAYSTONE; CALCAREOUS CLAYSTONE; SHALE; LIMESTONE; CALCARENITE; CALCISILTITE; CALCILUTITE; DOLOMITE; MARL; TILLITE; GREENSAND; HALITE; GYPSUM; ANHYDRITE; VOLCANICS; IGNEOUS BASEMENT; METAMORPHIC BASEMENT; COAL; ARGILLACEOUS CALCILUTITE

OTHER CONSTITUENTS

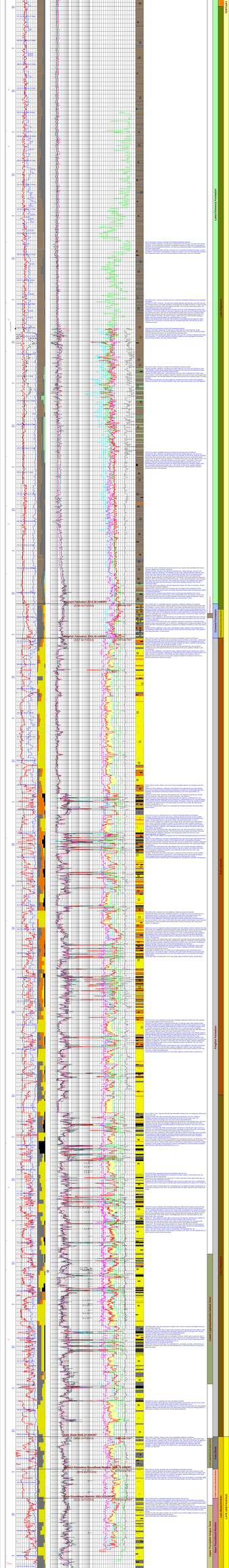
ARGILLACEOUS; GLAUCONITIC; FELDSPATHIC; MICACEOUS; CARBONACEOUS; PYRITE; SILTY; CALCAREOUS; SIDERITIC; CHERT; SKELETAL FRAGMENTS; SILICEOUS; CEMENT; LITHICS

ENGINEERING SYMBOLS

CASING SEAT; PLUGGED INTERVAL; DRILL STEM TEST; PERFORATED INTERVAL; CORE No. AND INTERVAL; SIDEWALL CORE; SIDEWALL CORE (Not recovered); Repeat Formation Test (RFT); RFT SAMPLE RECOVERED

SHOW LEGEND

MODERATE TO STRONG OIL SHOW; MODERATE TO STRONG GAS SHOW; MINOR OIL SHOW; MINOR GAS SHOW

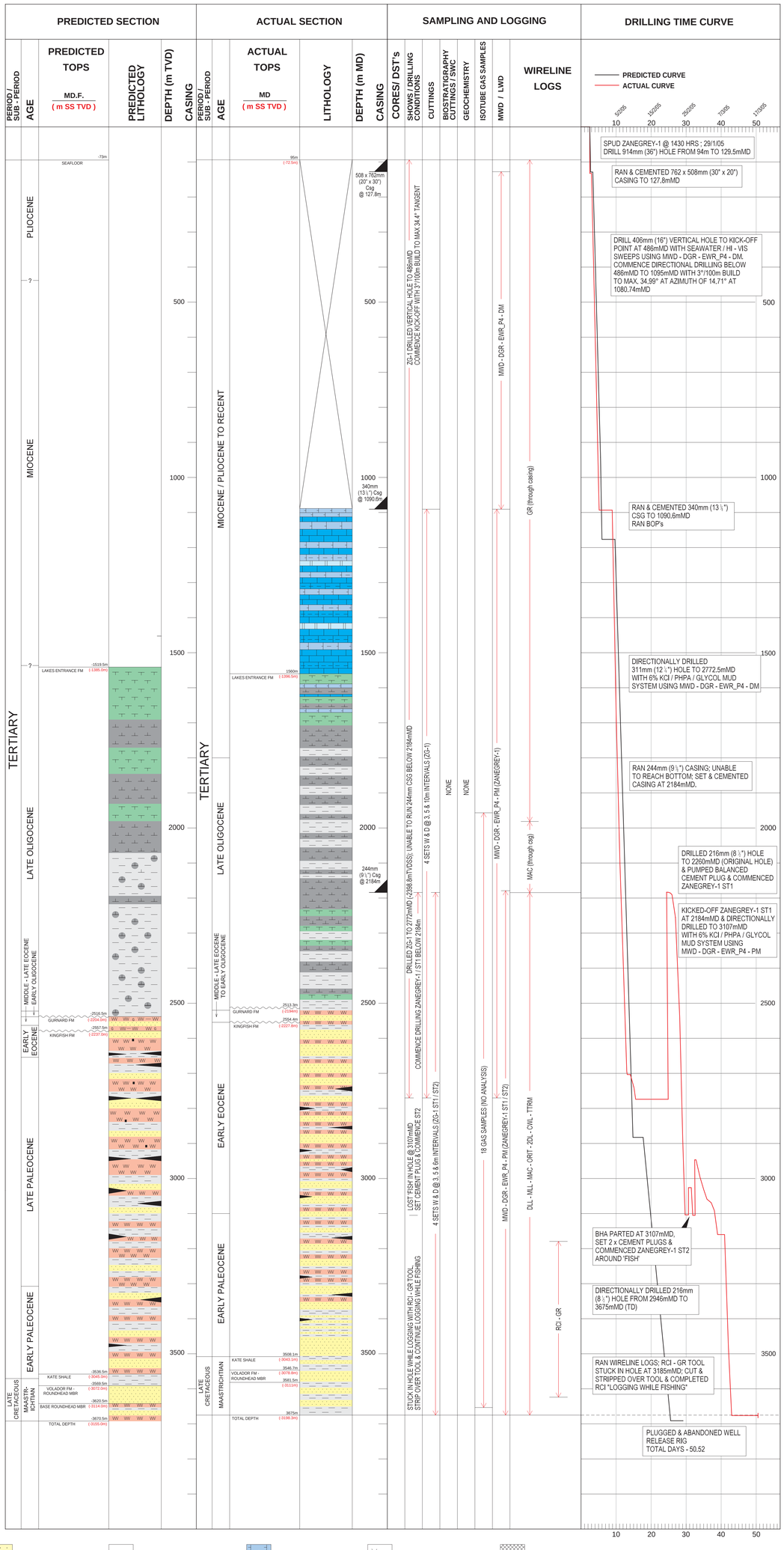

Lower Eocene Formation
Upper Eocene
Middle Eocene
Upper Cretaceous
Lower Cretaceous
Upper Jurassic
Middle Jurassic
Lower Jurassic
Upper Triassic
Middle Triassic
Lower Triassic
Upper Permian
Middle Permian
Lower Permian
Upper Carboniferous
Middle Carboniferous
Lower Carboniferous
Upper Devonian
Middle Devonian
Lower Devonian
Upper Silurian
Middle Silurian
Lower Silurian
Upper Ordovician
Middle Ordovician
Lower Ordovician
Upper Cambrian
Middle Cambrian
Lower Cambrian
Upper Proterozoic
Middle Proterozoic
Lower Proterozoic
Upper Archean
Middle Archean
Lower Archean

BASS STRAIT Oil
Oil for Australians

ZANEGREY-1 / ST1 / ST2

WELL PROGRESS CHART

SEISMIC LINE :	BSOC 2002 3D Survey INLINE 2095; CDP 1885
LATITUDE :	38° 34' 31.64" S
LONGITUDE :	147° 59' 16.27" E
UTM ZONE :	Zone 55 S : AGD 84
EASTING :	586,049.89 mE
NORTHING :	5,729,856.42 mN

PERMIT :	VIC / P42
OPERATOR :	BASS STRAIT OIL COMPANY LTD
SPUD :	29th JANUARY 2005; 14:30 HRS
TD REACHED :	10th MARCH 2005; 17:00 HRS
RIG RELEASED :	18th MARCH 2005; 19:20 HRS

RIG :	"OCEAN PATRIOT"
D.F. :	+21.5m
WATER DEPTH :	72.5m (MSL)
T.D. :	3675mMD (-3198.3mTVDSS)
STATUS :	P & A NON-COMMERCIAL GAS CONDENSATE DISCOVERY