# SANTOS – NEXUS – TAP

## COMPILED FOR

## SANTOS LIMITED

***(A.B.N. 80 007 550 923)***

# GALLOWAY 1

# INTERPRETED DATA REPORT

**PREPARED BY:**
**R. Subramanian**
**(Consultant)**
**May 2007**

# GALLOWAY 1

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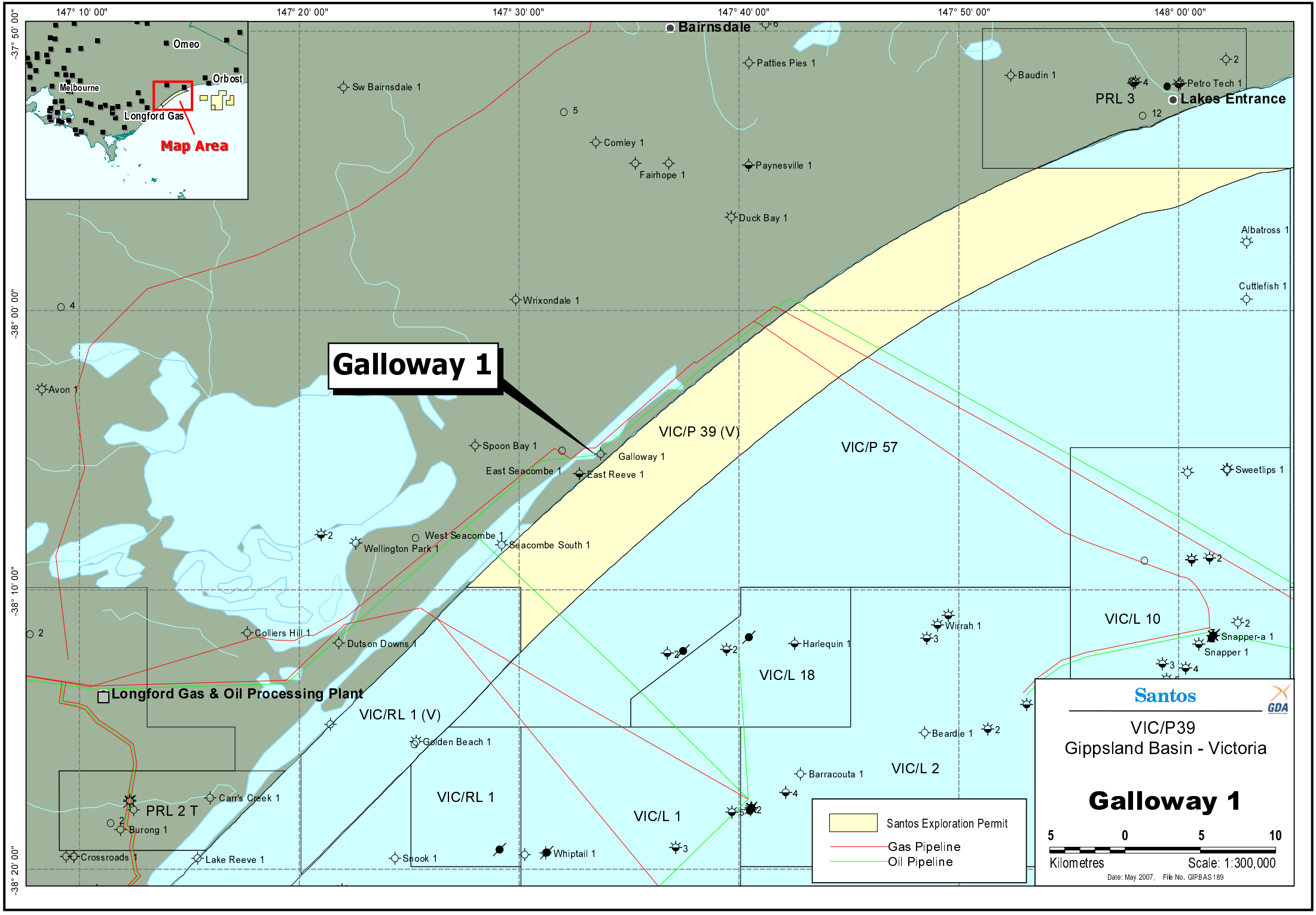
# LOCATION MAP


147° 10' 00"
147° 20' 00"
147° 30' 00"
147° 40' 00"
147° 50' 00"
148° 00' 00"
-37° 50' 00"
-38° 00' 00"
-38° 10' 00"
-38° 20' 00"
Omeo
Orbost
Melbourne
Longford Gas
Map Area
Bairnsdale
Patties Pies 1
Sw Bairnsdale 1
Baudin 1
Petro Tech 1
PRL 3
Lakes Entrance
Comley 1
Fairhope 1
Paynesville 1
Duck Bay 1
Albatross 1
Cuttlefish 1
Wrixondale 1
Galloway 1
Avon 1
VIC/P 39 (V)
VIC/P 57
Spoon Bay 1
Galloway 1
East Seacombe 1
East Reeve 1
Sweetlips 1
West Seacombe 1
Wellington Park 1
Seacombe South 1
Colliers Hill 1
Dutson Downs 1
Harlequin 1
Wirrah 1
VIC/L 10
Snapper-a 1
Snapper 1
VIC/L 18
Longford Gas & Oil Processing Plant
VIC/RL 1 (V)
Golden Beach 1
Beardie 1
Barracouta 1
VIC/L 2
PRL 2 T
Carr's Creek 1
Burong 1
VIC/RL 1
VIC/L 1
Crossroads 1
Lake Reeve 1
Snook 1
Whiptail 1
Santos Exploration Permit
Gas Pipeline
Oil Pipeline
Santos
GDA
VIC/P39
Gippsland Basin - Victoria
Galloway 1
5 0 5 10
Kilometres
Scale: 1:300,000
Date: May 2007, File No. GIPBAS189

# WELL CARD

| | | | | | |
|---|---|---|---|---|---|
| **WELL:** GALLOWAY 1 | **WELL CATEGORY:** EXPLORATION<br>**WELL INTENT:** OIL | **SPUD:** 04:30 29/07/06 **TD REACHED:** 15:30 20/08/06 | | | |
| | | **RIG RELEASED:** 14:30 24/08/06 **CMPLT:** P&A | | |
| **SURFACE: LAT:** 38º 05' 08.78" S **LONG:** 147º 33' 44.10" E **(GDA94)** (549307mE 5784520mN) | | **RIG:** Ensign 32 | | | |
| | | **STATUS:** PLUGGED & ABANDONED | | | |
| **TARGET: LAT:** 38º 05' 31.88" S **LONG:** 147º 34' 38.81" E **(GDA94)** (550635mE 5783799mN) | | **REMARKS:**<br>TARGET SANDS WERE WET.<br>NO HYDROCARBONS ENCOUNTERED. | | | |
| **SEISMIC STATION:** Line GNX05_03, SP 1690 | | | | | |
| **ELEVATION GND:** 2.70 m **RT:** 8.58 m | | | | | |
| **PERMIT / LICENSE:** VIC / P39(V) | | | | | |
| **TD:** 2315 m (Logger Extrap.), 2315 m (Driller) | | **HOLE SIZE** | **CSG SIZE** | **SHOE DEPTH** | **TYPE** |
| **PBTD:** Well Plugged & Abandoned | | 26" H/O | 20" | 60 m | |
| **TYPE STRUCTURE:** ANTICLINE | | 17.5" | 13.375" | 317 m | 54.5# J55 BTC |
| **TYPE COMPLETION:** Nil | | 12.25" | 9.625" | 1598 m | 47# N80 BTC L80 |
| **ZONE(S):** - | | 8.5" | NIL | NIL | |

| AGE | FORMATION OR ZONE TOPS | DEPTH (m) | | THICKNESS TVD (m) | HIGH (H) LOW (L) |
|---|---|---|---|---|---|
| | | MD (Lgr) | TVD SS | | |
| LOWER PLIOCENE | JEMMY'S POINT | 5.9 | +2.7 | 137.1 | |
| UPPER MIOCENE | TAMBO RIVER | 143.0 | -134.4 | 91.6 | 30.6 m H |
| MIOCENE | GIPPSLAND LIMESTONE | 235.0 | -226.0 | 730.6 | 5.9 m L |
| OLIGOCENE | LAKES ENTRANCE FORMATION | 1880.1 | -956.5 | 197.0 | 3.6 m H |
| EOCENE | LATROBE GROUP | 2110.4 | -1153.5 | 202.6+ | N.P. |
| EOCENE | GURNARD FORMATION | 2110.4 | -1153.5 | (13.5) | N.P. |
| EOCENE | LATROBE COARSE CLASTICS | 2124.4 | -1167.0 | (71.0) | 12.2 m L |
| EOCENE | LATROBE N. ASPERUS | 2196.7 | -1238.0 | (118.1+) | 17.8 m L |
| | TOTAL DEPTH | 2315.0 | -1356.1 | | 18.0 m L |

N.P. = Not Prognosed.

| LOG INTERPRETATION (Interval Averages) | | | | | PERFORATIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FORMATION | INTERVAL (m) | NET PAY (m) | Ø % | Sw % | FORMATION | | INTERVAL (m) | | |
| Latrobe N Asperus | 2279 - 2289 | 0.5 | 24.2 | 59.7 | Well Plugged & Abandoned | | | | |
| | | | | | CORES CUT | | | | |
| | | | | | FORM | NO. | INTERVAL (m) | CUT | REC |
| | | | | | | | No Cores Cut | | |

| TYPE OF LOG | SUITE / RUN | FROM (m) | TO (m) | REPEAT SECTION | TIME SINCE LAST CIRCULATION | BHT |
|---|---|---|---|---|---|---|
| **MWD: (12.25" phase in 2 runs)**<br>GR-Dir | 1-2 | 320 | 1606 | | N/A | - |
| **MWD: (8.5" phase in 4 runs)**<br>GR-Dir-Resistivity-Density-Neutron | 3-6 | 1606 | 2315 | | N/A | 73°C |
| **MWD:**<br>GEOTAP Pressure Survey | 7 | 2126 | 2282 | | N/A | 61°C |

| DRILL STEM TESTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO. | INTERVAL (m) | FORMATION | FLOW (mins) | SHUT IN (mins) | BOTTOM GAUGE IP / FP (psia) | SIP (psia) | MAX SURF PRESS (psia) | FLUID TO SURF (mins) | TC / BC | REMARKS |
| | No DST's | | | | | | | | | |

**SUMMARY**

Location
Galloway 1 is a Gippsland Basin oil exploration wildcat well in the offshore VIC/P39(V) Licence, Victoria. The well is located onshore approximately 45 km east of Sale, 40 km north-east of the Longford oil & gas processing facilities and 13.5 km north-west of the Seahorse Oil Field. The nearest wells are East Reeve 1 (2.8 km W) and East Seacombe 1 (4.0 km WNW).

Objectives
The primary target of the Galloway 1 well was the Eocene Latrobe Group Coarse Clastics and the secondary target was in the mid N. asperus sands which are interbedded with shale and coals. The Latrobe anticlinal play is well established in the Gippsland Basin with the Latrobe Group reservoirs hosting significant volumes of hydrocarbon reserves. The proposed top reservoir location is ~1.2km from the Victorian coastline with a target depth of ~ -1155mSS. The onshore well was drilled as an extended reach well targeting the crest of the offshore anticlinal structure.

Results of Drilling
Prior to Ensign-32, a Drilltec rig was used to drill the pre-conductor surface hole to 100m. A 20" conductor was run in hole but was unable to pass 60m where the conductor was eventually cemented. Ensign Rig-32 was then mobilised onto the lease and Galloway 1 was spudded at 04:30 hrs on 29/07/06. Bit 1, a 17.5" TCI bit was used to open the 9.625" pilot hole from 65m to 100m and to drill the 17.5" surface hole from 100m to 120m. The drillstring was pulled to surface and a directional BHA was run in hole to drill from 120m to 320m and the inclination was built to 24° at a rate of 4.5°/30m. A string of 13.375" surface casing (54.5 ppf J-55, BTC) was run and cemented with the shoe set at 317m. The BOPs were installed & pressure tested and a 12.25" directional assembly consisting of a motor and MWD (GR & surveys) was run in hole with Bit 3 (TCI). After drilling out the cement, casing shoe track and 3m of new hole to 323m, a Leak-off test was conducted yielding an EMW of 20.0 ppg. Drilling of the 12.25" directional hole continued with surveys to 636m, building inclination to 72° as per the directional plan. The drill string was pulled to surface and Bit 4 (PDC) was run in hole and used to drill the 12.25" tangent section from 636m to 1606m where a wiper trip was performed prior to running a string of 9.625" casing which was cemented with the shoe at 1602m (D). Two bit runs (Bit 5 & Bit 6) were required to drill out the 9.625" casing shoe which was located at 1598m (L) with MWD logs. A Leak-off Test was performed and fetched an EMW=16.7 ppg. A PDC Bit 7 was run in hole with a Geopilot directional assembly and TRIPLE COMBO MWD (Gamma Ray, Resistivity, Neutron Porosity, Density and Surveys) and used to drill from 1606m to 1660m where the Top Drive required repairs. The drillstring was pulled to surface and MWD memory data was downloaded. Following Top Drive repairs, drilling of the 8.5" directional hole continued from 1660m to 1681m where a balled PDC bit was changed for a Mill Tooth rock bit. Drilling continued from 1681m to 1833m where the Top Drive again required repairs. Drilling continued to 2074m where the bit was pulled back into the casing shoe to further repair the Top Drive. Following repairs, drilling continued from 1833m to a total depth of 2315m which was reached at 15:30 hrs on 20/08/06. The bit was pulled to surface and the directional tools and MWD were laid out. A Geotap Pressure tool was run in hole to acquire pressures.

While drilling Galloway 1, MWD surveys were taken at 30m intervals to ensure that the wellpath was as per the planned trajectory designed to hit the target at LAT: 38º 05' 31.88" S, LONG: 147º 34' 38.81" E (GDA94) (540635mE 5783799mN). In the build section below the 13.375" casing shoe, the wellpath had digressed from the plan and was about 10m deeper than planned. However in the tangent section from 636m, the wellpath was steered back on the planned trajectory by the 9.625" casing point. At total depth, it is estimated that the TVDSS is -1356mSS and the well is 1545m from the well center in a 118°T direction. The well was within 13m of the target co-ordinates.

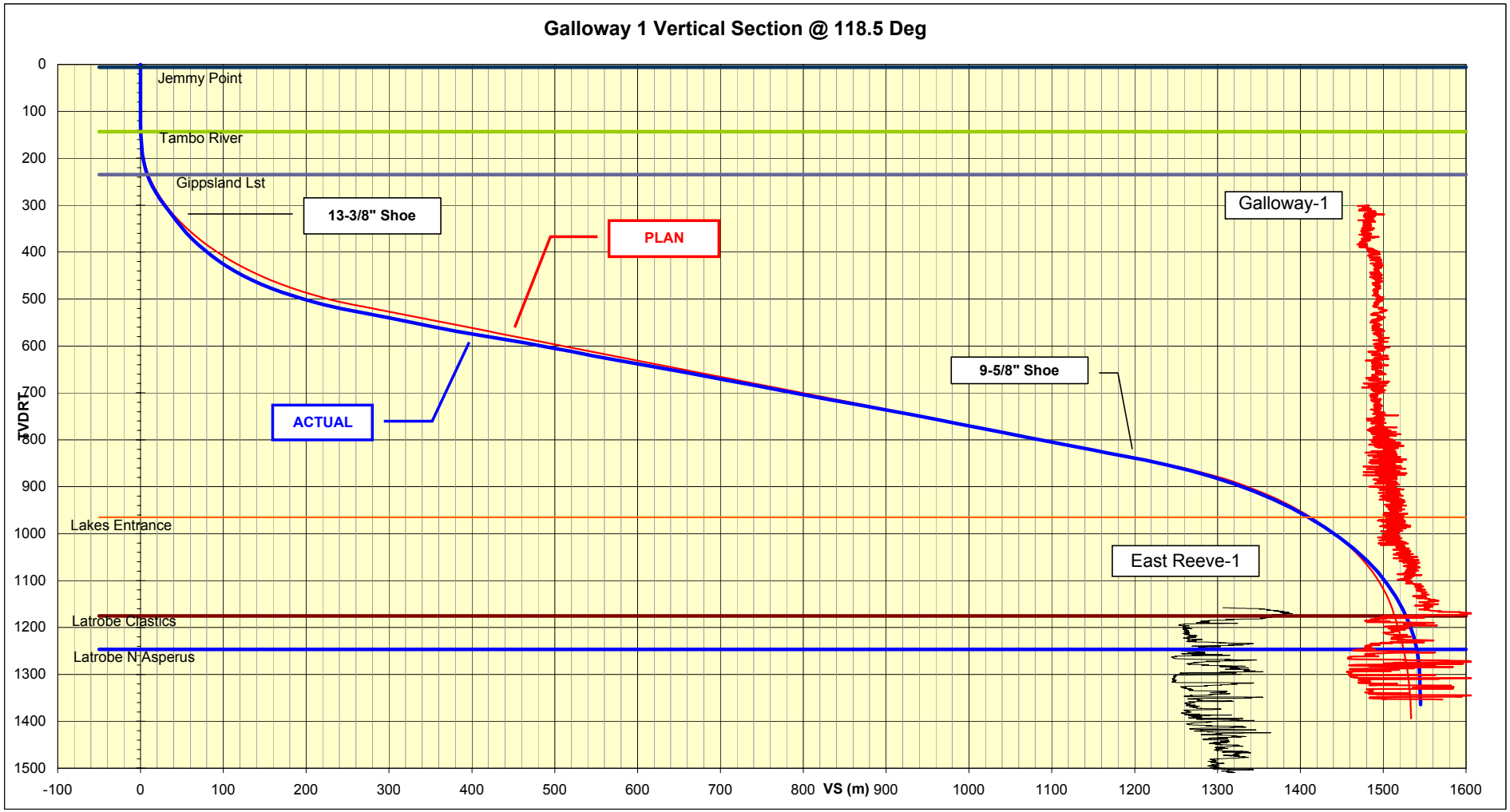
Formation tops were generally lower to prognosis as can be seen in the table above. The primary target Latrobe Coarse Clastics and the secondary target Latrobe N Asperus were penetrated 12.2m and 17.8m low to prognosis. No oil fluorescence or significant gas readings were observed in Galloway 1. Log analysis indicated no pay in the Latrobe Coarse Clastics. However, 0.5m Net Pay in the Sand "5" in the Latrobe N Asperus were indicated in the interval 2279-2289m. The GEOTAP Pressure Survey results established that the fluid gradient was 0.44 which is a water gradient. Further drilling was abandoned.

A Santos in-house post-well study to understand why Galloway 1 failed to intersect movable hydrocarbons concluded that the primary reason for the lack of hydrocarbons was an ineffective hydrocarbon source pod and migration from the adjacent Seahorse-Wirrah trough. It was likely that the mapped hydrocarbon source intervals were not buried to sufficient depth to enter the hydrocarbon generation window in this trough. The result also implies that the Galloway structure does not lie on a hydrocarbon migration pathway from the proven hydrocarbon source kitchen in the Central Deep Trough of the Gippsland Basin. Good quality reservoirs in the Latrobe Group were present along with Lakes Entrance marls and Gippsland Limestones of sufficient thickness and competency to seal the structure. The structure at the Top Latrobe horizon remains to exhibit structural closure in time and depth.

Status
Galloway 1 was plugged and abandoned with five cement plugs as follows. Plug 1: 2315m-2196m, Plug 2: 2196-2078m, Plug 3: 1894-1833m, Plug 4: 1627-1432m and Plug 5: 72-51m. Ensign Rig 32 was released at 14:30 hrs on 24/08/06.

**AUTHOR:** R Subramanian | **DATE:** May 2007

# WELL PATH SCHEMATIC


Galloway 1 Vertical Section @ 118.5 Deg
TVDRT
VS (m)
Jemmy Point
Tambo River
Gippsland Lst
13-3/8" Shoe
PLAN
ACTUAL
9-5/8" Shoe
Galloway-1
East Reeve-1
Lakes Entrance
Latrobe Clastics
Latrobe N Asperus
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
-100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

# 1. GEOLOGY

## 1.1 INTRODUCTION

Galloway 1 is proposed as a Gippsland Basin oil exploration wildcat well in the offshore VIC/P39(V) License, Victoria. The proposed well location is onshore approximately 45 km east of Sale, 40 km north-east of the Longford oil & gas processing facilities and 13.5 km north-west of the Seahorse Oil Field. The nearest wells are East Reeve 1 (2.8 km W) and East Seacombe 1 (4.0 km WNW). The proposed top reservoir location is approximately 1.2km from the Victorian coastline with a target depth of approximately -1155mSS. The well will be drilled as an extended reach well from onshore targeting the crest of the offshore anticlinal structure.

The primary target of the Galloway 1 well is the Eocene Latrobe Group coarse clastics and a secondary target in the mid N. asperus sands which are interbedded with shales and coals. The Latrobe anticlinal play is well established in the Gippsland Basin with the Latrobe Group reservoirs hosting significant volumes of hydrocarbon reserves.

The prospect is mapped at the top Latrobe horizon on the 2005 offshore 2D seismic data. The Galloway prospect is mapped as an elongate (roughly E-W trending) anticlinal structure a in both two-way-time and depth. The TWT map exhibits a structural closure 9.6km$^2$ and a depth closure of between 2.7 to 3.6 km$^2$ (depending on the velocity model used). The anticlinal structure is offshore, although a small possible extension of the structure can be mapped in the adjacent onshore area. East Reeve 1 defines the down-dip limit of the structure.

The critical risk to the Galloway prospect is hydrocarbon charge. Hydrocarbons cannot charge the Galloway structure using the common model of a source kitchen in the central area of the basin. Rather an alternate model has been derived to explain oil charge into the Seahorse, West Seahorse and Wirrah Oil fields and inboard to the Galloway structure. Expulsion is proposed from a potential small source kitchen in the trough north of the Seahorse, West Seahorse & Wirrah Fields. The Latrobe Group and Golden Beach Formation within this trough are interpreted to be within the present day oil generation window with expulsion from coals within these formations. Hydrocarbon migration can then be modelled to charge the existing oil fields and the structures at Galloway & Angus.

If successful the well will be cased and suspended. It has been acknowledged that any discovered oil may be biodegraded and/or water-washed. Formation testing, either via a cased hole test or wireline sampling (MDT), is required to confirm the quality of any discovered oil.

The key objectives of the Galloway 1 well are to:

- Discover a new hydrocarbon resource within the primary Latrobe coarse clastics reservoir, and
- Prove up a commercial volume of hydrocarbons.

The critical risks to success at Galloway 1 are:

- Oil source rock generative history, and
- Potential oil alteration by bio-organisms.

Success at Galloway 1 will significantly downgrade the hydrocarbon charge risk at the nearby Angus prospect, located some 6.5 km south west of Galloway.

## 1.2 DRILLING RATIONALE (after Well Proposal)

The Galloway Prospect is interpreted as a top Latrobe anticlinal structure located in the offshore Gippsland Basin. The Galloway 1 well is targeting an oil play with source from a potential source kitchen in the trough north of the Seahorse and Wirrah Fields. Reservoirs are provided by the Latrobe coarse clastics and mid N. asperus sands with Lakes Entrance marls and calcareous limestones providing top seal. Key risks identified include hydrocarbon charge into the prospect and possible biodegradation of any hydrocarbons encountered.

Galloway 1 is proposed as an oil exploration well in VIC/P39(V). VIC/P39(V) occupies the 3-mile coastal strip adjacent to the 90 mile beach in offshore Gippsland Basin.

The VIC/P39(V) block occupies the northern terrace of the Gippsland Basin, north-east of the large Barracouta and Snapper gas fields and Wirrah, Seahorse and West Seahorse oil fields. The network of oil and gas pipelines, oil and gas platforms and processing facilities are almost exclusively owned by the Gippsland Basin Joint Venture (ExxonMobil & BHP-Billiton). Only the Patricia-Baleen Field and Orbost gas processing facility (operated by Santos), and the Basker-Manta-Gummy Field (operated by Anzon Australia) produce hydrocarbons outside the Gippsland Basin JV. To date, approximately 4 BBO and 9 TCF of gas have been discovered in the basin.

The dominant hydrocarbon system in the Gippsland Basin is the Top Latrobe anticlinal trap which hosts accumulations at Barracouta, Snapper, Seahorse, Wirrah and Kingfish. Latrobe reservoirs, ranging from barrier/shoreface sands to stacked fluvial-deltaic sands, are sealed by Lakes Entrance calcareous mudstones and marls. Gentle NW-SE compression in the mid Miocene formed most of the anticlinal traps in the basin, which trend NE-SW. Late Miocene to present day hydrocarbon generation occurred with deposition and loading of the Gippsland Limestone with migration into the existing traps. The Galloway Prospect is an extension of this play into the north-western corner of the basin, requiring long distance migration or generation and expulsion from older Golden Beach source intervals.

Galloway 1 is an updip appraisal of East Reeve 1 which detected very minor oil slicks while flowing clear formation waters on test. Two zones flowed approximately 1000 bwpd with the resistivity of the formation waters around 1.5 ohms at 75°F. Current interpretation shows East Reeve 1 to be outside of structural closure. Several other onshore wells have been drilled in the area, however none have encountered hydrocarbons. These wells have predominantly drilled in the pre-1980s period, with poor seismic resolution possibly resulting in invalid tests.

The proposed Galloway 1 well will be drilled as an extended reach well from onshore targeting the offshore anticlinal structure. The lateral reach of the well is approximately 1500m to intersect the target at approximately -1155m TVDSS. The horizontal and angle-build sections are predominantly in the competent Gippsland Limestone. The well bore returns to approximately 11° inclination as to increase confidence of intersecting the target and not over/under-shooting the structure.

An alternate model for oil expulsion is proposed to be the source of hydrocarbons for the Galloway Prospect. Migration studies have shown that if the alternate source kitchen is generating and expelling hydrocarbons the Galloway structure can be charged.

At West Seahorse 1 (60 °C) and Wirrah 1 (65 °C) oils have been water-washed and biodegraded. Water-washing is likely to be due to the proximity of fresh water aquifer recharge while biodegradation is a function of cooler temperatures (less than 65 °C). Potential for biodegradation and water-washing within the Galloway 1 reservoirs is acknowledged since temperatures are predicted to be between 60-65 °C and the well is interpreted to be more proximal to freshwater aquifer recharge. It is proposed to obtain a fluid samples and reservoir pressures by MDT pressure testing and formation sampling. If unable to obtain MDT data a cased hole test (with down-hole gauges) is proposed to confirm oil quality in the case of a successful oil discovery.

In this proposal probabilistic resource estimates and risking are provided for the primary Latrobe coarse clastics reservoir only.

**Technical Risk Assessment:**

| **Primary** | | ***Latrobe Coarse*** |
|---|---|---|
| Play: | *Ppl* | 1.00 |
| Closure: | *Pcl* | 0.80 |
| Reservoir: | *Prs* | 0.90 |
| Seal: | *Psl* | 0.70 |
| Charge: | *Pch* | 0.40 |

**Play (Ppl = 1.0)**

The Latrobe anticlinal play is a proven and prolific play in the Gippsland Basin, with all valid structural closures/traps containing hydrocarbons. The Barracouta, Snapper & Golden Beach gas fields and Wirrah, Seahorse & West Seahorse oil fields are examples of this play in the immediate vicinity.

The Galloway prospect is a test of the play to exist inboard of the Rosedale fault system. Galloway lies up-dip and north-east of the Seahorse and West Seahorse oil fields.

As Galloway tests an established productive play in the Gippsland Basin, the probability of success for the play is 100%.

**Closure (Pcl = 0.80)**

The Galloway Prospect is mapped at the top Latrobe horizon, a consistent and conformable high amplitude event on the 2005 2D gnx05 seismic data, up-dip of East Reeve 1. A two-way-time closure of 9.6 $km^2$ is well defined, however depth closures can vary due to the regional velocity gradient in the area. The velocities are generally lower in the onshore (NW), and higher in the offshore (SE). Although there is certainty in the velocity trend derived from well based velocity data, there is uncertainty to the precise velocities for depth conversion. However with the simplest, more conservative velocity model the anticlinal structure is robust.

Structural closure is generated by the mid Miocene compressional event which initiated anticlinal trap formation for most of the fields in the basin.

At mid N. asperus level and deeper the structure is faulted on the northern flank in response to the mild Miocene compression. The faulting is perceived to have an impact on seal risk, as discussed later.

At Galloway 1 closure risk is perceived to be low with a probability of closure of 80%.

**Reservoir (Prs = 0.90)**

Primary reservoir target is the Latrobe coarse clastic shore-face sands. Underlying this are the mid N. asperus interbedded coals, shales and sands which are proposed as a secondary target.

The coarse clastic sands have been intersected at East Reeve 1 (gross thickness 66m, net sand 35m thickness), some 3km south west. These sands are also intersected onshore at East Seacombe 1, Spoon Bay 1 and Seacombe South 1. At Spoon Bay 1 the coarse clastic sand attains net thickness of approximately 90m over a 150m gross interval. The primary reservoir is also intersected at Golden Beach 1A where course clastics interval reaches 62m thickness; the interval interpreted to be almost 100% net to gross with 19.5m of net gas pay interpreted. A DST over a ~2m interval produced gas to surface at a rate of 4.5 MMscf/d.

Outboard of East Reeve 1 the top Latrobe unconformity truncates the coarse clastic sand. The regional schematic illustrates the truncation of the Latrobe section from East Seacombe 1 to West Seahorse 1. In both the Seahorse and West Seahorse fields the Latrobe coarse clastic sands are completely absent and oil is reservoired within mid N. asperus sands.

At Galloway 1 reservoir risk is perceived to be very low with a probability of intersecting reservoir of 90%.

**Charge (Pch = 0.40)**

Hydrocarbon charge is perceived to be the critical risk in the petroleum system of the Galloway Prospect.

The conventional model for hydrocarbon source relies on generation and expulsion from the Latrobe Group within the central deep area of the basin. Migration from this kitchen fills all accumulations outboard of the Snapper-Barracouta structural highs, whilst the structure inboard remain are shadowed from migration, including the Seahorse, West Seahorse & Wirrah.

Charge is therefore reliant on an alternate model for oil expulsion. A proposed source of hydrocarbons for the Galloway Prospect is a possible small source kitchen in the syncline on the northern side of the Seahorse, West Seahorse & Wirrah Fields. Within this depression the lowermost Latrobe Group and Golden Beach Formation sediments which are interpreted to be within the present day early oil generation window (Vr 0.5 - 0.7). The source facies are interpreted as type 3 oil-prone coals and carbonaceous shales with hydrocarbon generation between the Miocene and present day with deposition of the Gippsland Limestone overburden.

A hydrocarbon buoyancy model was constructed to model the likely migration pathways from the proposed source kitchen. Based on the regional top Latrobe depth interpretation, the forward model demonstrates migration from this potential source kitchen into the north-western closures at Galloway & Angus. The model also demonstrates charge from the same small possible source kitchen into the proven oil accumulations at Wirrah, Seahorse and West Seahorse. The model offers a possible explanation to the unsuccessful test at Spoon Bay since it lies in a migration shadow zone.

Charge risk is also attributed to potential water-washing and biodegradation. At West Seahorse 1 (60 °C) and Wirrah 1 (65 °C) oils have been water-washed. Water-washing is likely to be due to the proximity of fresh water aquifer recharge while biodegradation is a function of cooler temperatures (less than 65 °C). Potential for biodegradation and water-washing within the Galloway 1 reservoirs is expected since temperatures are predicted to be between 60-65 °C and the well is interpreted to be more proximal to freshwater aquifer recharge.

With Galloway addressing an alternate plausible oil source kitchen with potential for significant water-washing and biodegradation of oil, the probability of intersecting movable hydrocarbons is perceived to be 40%.

**Seal (Psl = 0.70)**

The overlying Lakes Entrance Formation forms the top seal to the Latrobe reservoirs in the Gippsland Basin. This top seal is a proven top seal comprised of calcareous mudstone and marl. The unit provides seal to the majority of the traps in the Gippsland Basin.

The Lakes Entrance sealing facies have been intersected nearby at East Reeve 1 and East Seacombe 1 with thicknesses of 193m and 259m respectively. Lithological interpretation from the East Reeve 1 mudlog is interpreted as fissile fossiliferous shale to calcareous shale. Down-dip at West Seahorse 1 Lakes Entrance calcareous mudstone thickness 109m.

Seal is also likely to be provided, in part, by the Gippsland Limestone which lies conformably on the Lake Entrance Formation and attains thicknesses in excess of 600m onshore to over 1000m thickness offshore. The lithology of the lower to middle Miocene Gippsland Limestone is fossiliferous limestone, marly limestone and marl.

Possible fault juxtaposition and low chance of clay smear provides justification for increased seal risk. Compressional faulting is observed at deeper levels and these faults possibly propagate into the shallower horizons. Faults are poorly resolved on the 2D seismic. Since the reservoir is dominantly sand prone, chance of fault seal by clay smear is low. Therefore, if faulted, the reservoir is unlikely to be adequately sealed and leakage may occur. Seal risk is considered to be low to moderate with a probability of seal of 70%.

## 1.3 WELL LOCATION

Galloway 1 is a Gippsland Basin oil exploration wildcat well in the offshore VIC/P39(V) Licence, Victoria. The well is located onshore approximately 45 km east of Sale, 40 km north-east of the Longford oil & gas processing facilities and 13.5 km north-west of the Seahorse Oil Field. The nearest wells are East Reeve 1 (2.8 km W) and East Seacombe 1 (4.0 km WNW).

| | | | |
|---|---|---|---|
| Block / License: | VIC/P 39 (V) Victoria | | |
| Surveyed Location: | Surface: | Latitude: | 38º 05' 08.78" South (GDA94) |
| | | Longitude: | 147º 33' 44.10" East (GDA 94) |
| | | Easting: | 549 307 m (MGA 94) |
| | | Northing: | 5 784 520 m (MGA 94) |
| | Objective: | Easting: | 550 651 m (MGA 94) |
| | | Northing: | 5 783 795 m (MGA 94) |
| | TD: | Easting: | 550 669 m (MGA 94) |
| | | Northing: | 5 783 791 m (MGA 94) |
| Surveyed Elevation: | Ground Level: | 2.7 m | |
| | Rotary Table: | 8.6 m | |
| | (Australian Height Datum) | | |
| Seismic Location: | Shotpoint 1690, Line GNX05_03 | | |

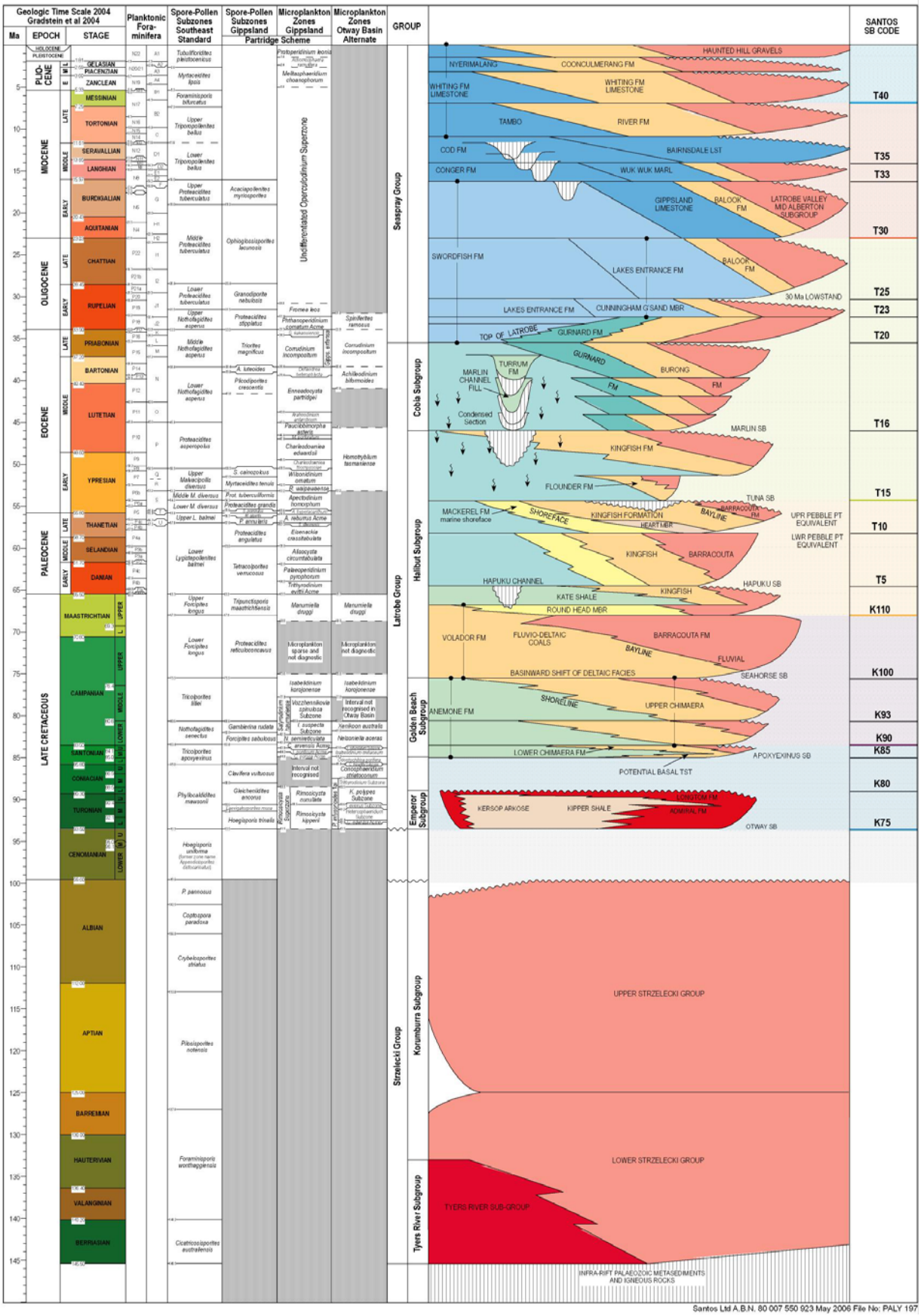
# 2. RESULTS OF DRILLING

## 2.1 STRATIGRAPHY & GEOPHYSICAL PROGNOSIS

### TABLE 1: SUMMARY OF STRATIGRAPHY

| GROUP | AGE | FORMATION OR ZONE TOPS | DEPTH (m) | | THICKNESS (m) |
|---|---|---|---|---|---|
| | | | MDRT | SUBSEA | |
| SEASPRAY GROUP | LOWER PLIOCENE | JEMMY'S POINT FM. | 5.9 | +2.7 | 137.1 |
| | UPPER MIOCENE | TAMBO RIVER FM. | 143.0 | -134.4 | 91.6 |
| | MIOCENE | GIPPSLAND LIMESTONE | 235.0 | -226.0 | 730.6 |
| | OLIGOCENE | LAKES ENTRANCE FM. | 1880.1 | -956.5 | 197.0 |
| LATROBE GROUP | EOCENE | GURNARD FM. | 2110.4 | -1153.5 | 13.5 |
| | EOCENE | LATROBE COARSE CLASTICS | 2124.4 | -1167.0 | 71.0 |
| | EOCENE | LATROBE N. ASPERUS | 2196.7 | -1238.0 | 118.1+ |
| | | TOTAL DEPTH | 2315.0 | -1356.1 | |

# Sequence Boundary Nomenclature - Gippsland Basin




Santos Ltd A.B.N. 80 007 550 923 May 2006 File No: PALY 197

The following is a brief summary of the stratigraphy intersected in Galloway 1. Detailed lithological descriptions are in the Basic Data Report for Galloway 1.

Drilling was terminated after penetrating 118.1m TVD of the **Latrobe Group N.asperus (Mid Eocene)**. The predominantly fluvial and deltaic clastic section is comprised of sandstone interbedded with coal, siltstone and claystone. The sandstones are generally light grey; clear to occasionally translucent, fine to coarse grained with moderately strong siliceous and calcareous cement, with trace to moderate light grey argillaceous matrix. The coals are very dark brown with a dull to sub-vitreous lustre, very argillaceous and grading to carbonaceous siltstone. Siltstones brown grey in colour, trace to minor calcareous and arenaceous, slightly micro-micaceous. The claystones are light to medium green grey, light to medium brown grey, trace glauconite, trace off white lithic fragments, firm to hard in part, subblocky to subfissile.

**The Latrobe Group Course Clastics (Late Eocene)** was the primary objective of Galloway 1. As named the sequence primarily consist of course grained clastics with minor interbeds of claystone. The sequence was likely deposited as beach sands associated with the marine transgression at the basin margin. The sands are predominantly medium to very course grained, clear to translucent, light grey in part, trace moderately strong siliceous cement, minor off white argillaceous matrix, trace pyrite, trace glauconite grains, trace fossil fragments, common loose clear quartz grains, moderately hard to hard to occasional hard aggregates, poor visual porosity in aggregates, fair to generally good inferred porosity. The claystones are light to medium grey, brown grey, minor light to medium brown, trace pyrite, firm to moderately hard, occasional hard, subblocky.

The continuation of the Late Eocene-Early Oligocene transgression resulted in the deposition of the shallow water glauconitic sands, silts and clays of the **Gurnard Formation (Late Eocene-Early Oligocene)**. At the Galloway 1 location the Gurnard Formation is represented by a relatively thin (14m TVD) section of interbedded calcareous and glauconitic claystone and siltstone.

The **Lakes Entrance Formation** (Early-Late Oligocene) and Gippsland Limestone (Miocene) conformably overly the Gurnard Formation, The Lakes Entrance Fm comprises fine grained calcareous shales and marls, while the Gippsland Limestone grades from Calcilutites and Marl in the lower section to Calcarenite and massive Limestone at the top.

The **Tambo River Formation (Late Miocene)** was deposited in a shallow marine environment, and comprises Coquina interbedded with marl and sandstone. The coquina is off white, pale yellow, pale brown, cream, abundant fossil fragments, locally loosely cemented with calcite, occasional fossil casts with Calcareous Claystone, common fragments of bi-valves, brachiopods, echinoid spines, sponges, bryozoa, Turritella fragments.

The **Jemmy's Point Formation (Lower Pliocene)** represents a marginal marine sequence comprising poorly sorted fine to course fossiliferous sands.

For further details concerning the lithology of formations encountered in Galloway 1, refer to Appendix I (a) of this report.

**Geophysical Prognosis**

The Galloway structure has been mapped using the interpretation from the 2005 gnx05 2D seismic survey. Line spacing is approximately 250m with the line direction being NE-SW, i.e. paralleling the coast. This 05 data is of high quality with a strong top Latrobe coal marker defining a near top reservoir horizon. This contrasts with the poor quality of the onshore gb82a data. A lack of data at the transition or beach zone which precludes a definitive tie between the various surveys and adds risk to the mapping of the western side of the Galloway structure. Depth conversion is difficult with poor well control and no seismic gather data to constrain velocity maps. Two velocity grids were derived; a simple average velocity interpretation by Santos.

As outlined in Table 2 below, prognosed formation tops were encountered relatively close to prognosis. The interval velocities appear to be slightly faster than expected, pushing the entire section marginally lower.

**TABLE 2: SUMMARY OF FORMATION TOPS AND THICKNESS**

| FORMATION | DEPTH (MDRT) | DEPTH (m Subsea) | DIFF PROG (m H/L) | TVD THICK (m) |
|---|---|---|---|---|
| JEMMY'S POINT | 5.9 | +2.7 | N.P. | 137.1 |
| TAMBO RIVER | 143.0 | -134.4 | 5.9 m L | 91.6 |
| GIPPSLAND LIMESTONE | 235.0 | -226.0 | 3.6 m H | 730.6 |
| LAKES ENTRANCE FM. | 1880.1 | -956.5 | N.P. | 197.0 |
| LATROBE GROUP | 2110.4 | -1153.5 | N.P. | 202.6+ |
| GURNARD FORMATION | 2110.4 | -1153.5 | 12.2 m L | (13.5) |
| LATROBE COARSE CLASTICS | 2124.4 | -1167.0 | 17.8 m L | (71.0) |
| LATROBE N. ASPERUS | 2196.7 | -1238.0 | 18.0 m L | (118.1+) |

N.P. = Not Prognosed.

## 2.2 HYDROCARBON AND PAY SUMMARY

Galloway 1 was designed as an oil exploration well targeting the coarse clastics of the Latrobe Group with a secondary objective of the interbedded sands of the Latrobe N. Asperus section.

During drilling operations, ditch gas levels and chromatographic analysis were carried out using a Geoservices Total Gas Analyser and an F.I.D. (flame ionisation detector) Gas Chromatograph. Total gas was monitored in gas units (1 unit = 200ppm methane equivalent in air) and the Chromatograph was calibrated to measure ppm (parts per million) concentrations of the alkane gases methane, ethane, propane and butane. All gas values in this report are expressed in gas units and where pertinent gas composition is expressed as a percentage ratio of the component alkane gases methane (C1) through butane (C4) (e.g. 80/10/7/3 denotes a composition of 80% methane, 10% ethane, 7% propane and 3% butane). Ditch cuttings were tested for hydrocarbon fluorescence by using an ultraviolet fluoroscope.

**TABLE 3: HYDROCARBON SHOW DESCRIPTIONS**

| | HYDROCARBON SHOW SUMMARY | |
|---|---|---|
| **INTERVAL** | **LITHOLOGY & FLUORESCENCE** | **GAS** |
| | NO SIGNIFICANT GAS SHOWS OR FLUORESCENCE WERE OBSERVED DURING THE DRILLING OF GALLOWAY 1. | |

**Pay Summary**

Galloway 1 was proposed oil sands within the Latrobe Group. Hydrocarbon charge was identified as the critical risk for the well.

The Latrobe Coarse Clastics primary target was intersected 17.8m low to prognosis, and no significant gas shows or fluorescence were recorded through this section.

The fluid gradient calculated from the formation pressure survey concluded that the Formation is water bearing, with water gradient of about 0.43 psi/ft. However, log analysis indicated there is about 35% of residual hydrocarbon over the potential sands. This may suggested that the Galloway structure is within the hydrocarbon migration path or it may have a different value of Rw due to a different environment deposition as there is no gas show or fluorescence detected over the bottom two sands. Minimal net pay (0.5m) was interpreted in Galloway 1 well. Formation pressure survey concluded that it is water bearing.

## 2.3 SUMMARY

Galloway 1 is a Gippsland Basin oil exploration wildcat well in the offshore VIC/P39(V) Licence, Victoria. The well is located onshore approximately 45 km east of Sale, 40 km north-east of the Longford oil & gas processing facilities and 13.5 km north-west of the Seahorse Oil Field. The nearest wells are East Reeve 1 (2.8 km W) and East Seacombe 1 (4.0 km WNW).

The primary target of the Galloway 1 well was the Eocene Latrobe Group Coarse Clastics and the secondary target was in the mid N. asperus sands which are interbedded with shale and coals. The Latrobe anticlinal play is well established in the Gippsland Basin with the Latrobe Group reservoirs hosting significant volumes of hydrocarbon reserves. The proposed top reservoir location is ~1.2km from the Victorian coastline with a target depth of ~ -1155mSS. The onshore well was drilled as an extended reach well targeting the crest of the offshore anticlinal structure.

Prior to Ensign-32, a Drilltec rig was used to drill the pre-conductor surface hole to 100m. A 20" conductor was run in hole but was unable to pass 60m where the conductor was eventually cemented. Ensign Rig-32 was then mobilised onto the lease and Galloway 1 was spudded at 04:30 hrs on 29/07/06. Bit 1, a 17.5" TCI bit was used to open the 9.625" pilot hole from 65m to 100m and to drill the 17.5" surface hole from 100m to 120m. The drillstring was pulled to surface and a directional BHA was run in hole to drill from 120m to 320m and the inclination was built to 24° at a rate of 4.5°/30m. A string of 13.375" surface casing (54.5 ppf J-55, BTC) was run and cemented with the shoe set at 317m. The BOPs were installed & pressure tested and a 12.25" directional assembly consisting of a motor and MWD (GR & surveys) was run in hole with Bit 3 (TCI). After drilling out the cement, casing shoe track and 3m of new hole to 323m, a Leak-off test was conducted yielding an EMW of 20.0 ppg. Drilling of the 12.25" directional hole continued with surveys to 636m, building inclination to 72° as per the directional plan. The drill string was pulled to surface and Bit 4 (PDC) was run in hole and used to drill the 12.25" tangent section from 636m to 1606m where a wiper trip was performed prior to running a string of 9.625" casing which was cemented with the shoe at 1602m (D). Two bit runs (Bit 5 & Bit 6) were required to drill out the 9.625" casing shoe which was located at 1598m (L) with MWD logs. A Leak-off Test was performed and fetched an EMW=16.7 ppg.

A PDC Bit 7 was run in hole with a Geopilot directional assembly and TRIPLE COMBO MWD (Gamma Ray, Resistivity, Neutron Porosity, Density and Surveys) and used to drill from 1606m to 1660m where the Top Drive required repairs. The drillstring was pulled to surface and MWD memory data was downloaded. Following Top Drive repairs, drilling of the 8.5" directional hole continued from 1660m to 1681m where a balled PDC bit was changed for a Mill Tooth rock bit. Drilling continued from 1681m to 1833m where the Top Drive again required repairs. Drilling continued to 2074m where the bit was pulled back into the casing shoe to further repair the Top Drive. Following repairs, drilling continued from 1833m to a total depth of 2315m which was reached at 15:30 hrs on 20/08/06. The bit was pulled to surface and the directional tools and MWD were laid out. A Geotap Pressure tool was run in hole to acquire pressures.

While drilling Galloway 1, MWD surveys were taken at 30m intervals to ensure that the wellpath was as per the planned trajectory designed to hit the target at LAT: 38º 05' 31.88" S, LONG: 147º 34' 38.81" E (GDA94) (540635mE 5783799mN). In the build section below the 13.375" casing shoe, the wellpath had digressed from the plan and was about 10m deeper than planned. However in the tangent section from 636m, the wellpath was steered back on the planned trajectory by the 9.625" casing point. At total depth, it is estimated that the TVDSS is -1356mSS and the well is 1545m from the well center in a 118°T direction. The well was within 13m of the target co-ordinates.

Formation tops were generally lower to prognosis as can be seen in the table above. The primary target Latrobe Coarse Clastics and the secondary target Latrobe N Asperus were penetrated 12.2m and 17.8m low to prognosis. No oil fluorescence or significant gas readings were observed in Galloway-1. Log analysis indicated no pay in the Latrobe Coarse Clastics. However, 0.5m Net Pay in the Sand "5" in the Latrobe N Asperus were indicated in the interval 2279-2289m. The GEOTAP Pressure Survey results established that the fluid gradient was 0.44 which is a water gradient. Further drilling was abandoned.

A Santos in-house post-well study to understand why Galloway 1 failed to intersect movable hydrocarbons concluded that the primary reason for the lack of hydrocarbons was an ineffective hydrocarbon source pod and migration from the adjacent Seahorse-Wirrah trough. It was likely that the mapped hydrocarbon source intervals were not buried to sufficient depth to enter the hydrocarbon generation window in this trough. The result also implies that the Galloway structure does not lie on a hydrocarbon migration pathway from the proven hydrocarbon source kitchen in the Central Deep Trough of the Gippsland Basin. Good quality reservoirs in the Latrobe Group were present along with Lakes Entrance marls and Gippsland Limestones of sufficient thickness and competency to seal the structure. The structure at the Top Latrobe horizon remains to exhibit structural closure in time and depth.

Galloway 1 was plugged and abandoned with five cement plugs as follows. Plug 1: 2315m-2196m, Plug 2: 2196-2078m, Plug 3: 1894-1833m, Plug 4: 1627-1432m and Plug 5: 72-51m. Ensign Rig 32 was released at 14:30 hrs on 24/08/06.

# 3. REFERENCES


| | |
|---|---|
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| SUBRAMANIAN, R., 2007 | GALLOWAY-1 BASIC DATA REPORT, PREPARED FOR SANTOS LIMITED, (UNPUBLISHED). |
| McPHAIL, A., 2007 | GALLOWAY-1 POST WELL ANALYSIS, (UNPUBLISHED), (VIA EMAIL). |
| McPHAIL, A., 2007 | POWERPOINT PRESENTATION NOTES VIC/P39(V) Permit VIC/P39(V) Permit Technical Committee Meeting (UNPUBLISHED), |

# APPENDIX I : LOG ANALYSIS

The Log Analysis Report is presented overleaf.

# GALLOWAY 1

# PETROPHYSICAL ANALYSIS

**By**

**Siew Looi**

Santos

**September 2006**

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## 1. Summary

Galloway 1 was spudded on 29th July 2006. Gas shows and florescence were encountered during drilling, and log anomaly was also detected from LWD. Formation pressures survey was conducted over the potential sands and concluded that it was water bearing with water gradient of 0.43 psi/ft. Log evaluation shown that it was about 35% of residue hydrocarbon over the potential sands. Consequently Galloway 1 was plugged and abandoned.

The pay summary using *Vcl <50%, $\phi_t$>10%, Swt<60%* and *Vcl <50%, $\phi_t$>10%* and *Swt<70%* are tabulated in Table 1 and 2 below:-

**Table 1 - Net pay cut-off: - *Vcl<50%, $\phi_t$>10% & Swt<60%.***

| FORMATION | | SAND | | | | | | | PAY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Øt>10% | | | | | | | Øt>10%, Swt<60%, Vcl<50% | | | | | | |
| SAND NAME | Sand Interval m | Net Sand m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD | Net Pay m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD |
| *Latrobe Coarse Clastics* | | | | | | | | | | | | | | | |
| SAND 1 | 2124-2196 | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Sub-Total/Average*** | | **69.5** | **30.2** | **97.8** | **23.8** | **96.8** | **16.4** | **233** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| *Latrobe N Aspetrus* | | | | | | | | | | | | | | | |
| SAND 2 | 2204-2210 | 6.2 | 28.9 | 99.6 | 26.4 | 99.3 | 6.4 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 3 | 2225-2228 | 2.8 | 26.6 | 100 | 15.1 | 100 | 29.3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 4 | 2261-2271.5 | 10.5 | 29.1 | 68.2 | 27.3 | 65.2 | 4.7 | 376 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 5 | 2277-2289 | 10.9 | 25.1 | 75.2 | 19.7 | 72.8 | 13.8 | 109 | 0.5 | 24.8 | 59.7 | 24.2 | 58.6 | 1.7 | 136 |
| ***Sub-Total/Average*** | | **30.4** | **27.4** | **80.1** | **23.3** | **77.5** | **10.6** | **216.9** | **0.5** | **24.8** | **59.7** | **24.2** | **58.6** | **1.7** | **136.0** |
| ***Total/Average*** | | **99.9** | **29.3** | **92.8** | **23.6** | **91.0** | **14.6** | **228.1** | **0.5** | **24.8** | **59.7** | **24.2** | **58.6** | **1.7** | **136.0** |

**Table 2 - Net pay cut-off: - *Vcl<50%, $\phi_t$>10% & Swt<70%.***

| FORMATION | | SAND | | | | | | | PAY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Øt>10% | | | | | | | Øt>10%, Swt<60%, Vcl<50% | | | | | | |
| SAND NAME | Sand Interval m | Net Sand m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD | Net Pay m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD |
| *Latrobe Coarse Clastics* | | | | | | | | | | | | | | | |
| SAND 1 | 2124-2196 | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Sub-Total/Average*** | | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Latrobe N Aspetrus* | | | | | | | | | | | | | | | |
| SAND 2 | 2204-2210 | 6.2 | 28.9 | 99.6 | 26.4 | 99.3 | 6.4 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 3 | 2225-2228 | 2.8 | 26.6 | 100 | 15.1 | 100 | 29.3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 4 | 2261-2271.5 | 10.5 | 29.1 | 68.2 | 27.3 | 65.2 | 4.7 | 376 | 8.8 | 29.2 | 66.3 | 27.3 | 62.9 | 4.9 | 390 |
| SAND 5 | 2277-2289 | 10.9 | 25.1 | 75.2 | 19.7 | 72.8 | 13.8 | 109 | 7 | 26.9 | 64.3 | 25 | 61.5 | 4.7 | 147 |
| ***Sub-Total/Average*** | | **30.4** | **27.4** | **80.1** | **23.3** | **77.5** | **10.6** | **216.9** | **15.8** | **28.2** | **65.5** | **26.3** | **62.3** | **4.8** | **282.3** |
| ***Total/Average*** | | **99.9** | **29.3** | **92.8** | **23.6** | **91.0** | **14.6** | **228.1** | **15.8** | **28.2** | **65.5** | **26.3** | **62.3** | **4.8** | **282.3** |

## 2. Introduction

Galloway 1 is located in VIC/P39(V) block, which is approximately 45km east of Sale, 40km northeast of the Longford oil & gas processing facilities and 13.5km northwest of the Seahorse Oil Field. The primary target of the Galloway 1 well is the Eocene Group coarse clastics and a secondary target in the mid N. Asperus sands which are interbedded with shales and coals.

## 3. Available Data

### 3.1. Logging While Drilling

| | | | |
|---|---|---|---|
| Run 1 | 12 ¼ in. | GR-Resistivity | 320m – 1606m |
| Run 2 | 8 ½ in. | GR-Resitivity-Neutron-Density | 1606m – 2315m |
| Run 3 | 8 ½ in | GEOTAP | |

### 3.2. Wireline Logging

No wireline logging.

**Mud Parameters**

| | |
|---|---|
| Mud Type | KCl Polymer/Glycol |
| KCl Content | 6% |
| Mud Density | 10.43 lb/g |
| Rm | 0.13 ohmm @ 27.8$^{o}$C |
| Rmf | 0.1 ohmm @ 25.6$^{o}$C |
| Rmc | 0.27 ohmm @ 25.6$^{o}$C |
| MRT | 79°C |

### 3.3. Core Data

No conventional core.

### 3.4. Well Production Test

No DST.

## 4. Interpretation

### 4.1. Log Processing and Remarks

- Over all the data was of good quality.
- Formation water resistivity of 2.5 ohmm @ 75$^{0}$F was obtained using Pickett plot.
- All logs are depth shifted prior to evaluation.
- All logs were borehole environmentally corrected.
- The water saturation (Sw) was calculated using Dual Water Saturation Equation.
- Permeability was calculated using Coates' Free Water Method

## 4.2. Interpretation Procedures and Parameters

The GEOLOG Multimin Probabilistic method was used. This method focuses wireline logging tools response to the environment being logged. Response equations for predicting each measurement in the logging suite are posed in terms of summing all the volumes of minerals and fluids that influenced each sensor. These volumes were adjusted to give the optimum or most probable match of the measured and predicted readings across the suite of measurements being modelled. From this most likely solution, the volumes of minerals were derived, as were the fluid volumes and hence, porosity and fluid saturations of the modelled formation.

In general, the tool response equation can be defined as:

$$tool = (toola.xwa)(vxwa) + (toola.xga)(vxga) + (toola.xoi)(vxoi) + \sum_{i=1}^{nm}(toola.i)(v.i) + \sum_{i=1}^{nclays}((toola_{cl}.i)(1-\phi_{cl}.i) + (toola.xbw)(\phi_{cl}.i)(v_{cl}.i))$$

Where

| | | |
|---|---|---|
| *tool* | = | Input log such as $\rho_b$, $\phi_N$, *DT* and etc. |
| *toola.xwa* | = | The response parameter for flushed fluid |
| *vxwa* | = | Volume of flushed fluid |
| *toola.xga* | = | The response parameter for gas |
| *vxga* | = | Volume of gas |
| *toola.xoi* | = | The response parameter for oil |
| *vxoi* | = | Volume of oil |
| *nm* | = | Number of formation minerals, excluding clay |
| *toola.i* | = | The response parameter for mineral *i* |
| *v.i* | = | The volume of mineral *i* |
| *nclays* | = | The number of clays in the formation |
| $toola_{cl}.i$ | = | The dry clay response parameter for clay *i* |
| $\phi_{cl}.i$ | = | Clay *i* porosity |
| *tools.xbw* | = | The response parameter for bound water |
| $v_{cl}.i$ | = | The volume of clay *i* |

### 4.2.1. Water Saturation

The water saturation was derived using the Dual Water Saturation Equation as defined below:

$$C_t = \frac{1}{a}\phi_t^m S_{wt}^n \left[\left(\frac{S_{wt} - S_{wb}}{S_{wt}}\right)C_w + C_{bw}\frac{S_{wb}}{S_{wt}}\right]$$

Therefore, the effective porosity $\phi_e$ is

$$\phi_e = \phi_t(1 - S_{wb})$$

And effective water saturation $S_{we}$ is

$$S_{we} = \frac{S_{wt} - S_{wb}}{1 - S_{wb}}$$

Where

$S_{wb}$ = Clay bound water saturation
$c_w$ = Formation water conductivity
$c_{bw}$ = Clay bound water conductivity

### 4.2.2. Permeability

### (a) Coates Free Fluid Index:

The permeability *(k)* equation is defined as:-

$$k = \left[ c\phi_e^2 \left( \frac{\phi_t - bfv}{bfv} \right) \right]^x$$

*Where*

$\phi_e$ = Effective porosity
$\phi_t$ = Total porosity
$c$ = Coates constant
$x$ = Power coefficient
$bfv$ = Bound fluid volume

And $bfv$ is defined as,

$$bfv = \max(volume\_of\_boundwater, 0.06)$$

Relative permeability is derived using the relationships proposed by Park Jones (and other). The equations are:

$$k_{rw} = \left( \frac{S_{wt} - bfv}{1 - bfv} \right)^3$$

And

$$k_{ro} = \frac{(1 - S_{wt})^{2.1}}{(1 - bfv)^2}$$

Where $k_{rw}$ and $k_{ro}$ are the relative permeability to water and oil, and $bfv$ in this case is equal to $S_{wi}$, the irreducible water saturation.

### 4.2.3. *Rw* determination

The Archie equation can be rearranged and stated as a log-log linear equation as follows:-

$$\log(R_t) = -m\log(\phi_t) + \log(aR_w)$$

*and*

$$\log(R_{xo}) = -m\log(\phi_t) + \log(aR_{mf})$$

Assuming *a* equals to1, *n* equals to 2, and *m* equals to 2 over the water bearing sand from 2180m – 2210m. $R_w$ was calculated to be 2.5 ohmm at 75°F or 1.225 ohmm at formation temperature (refer to Figure 1 below).

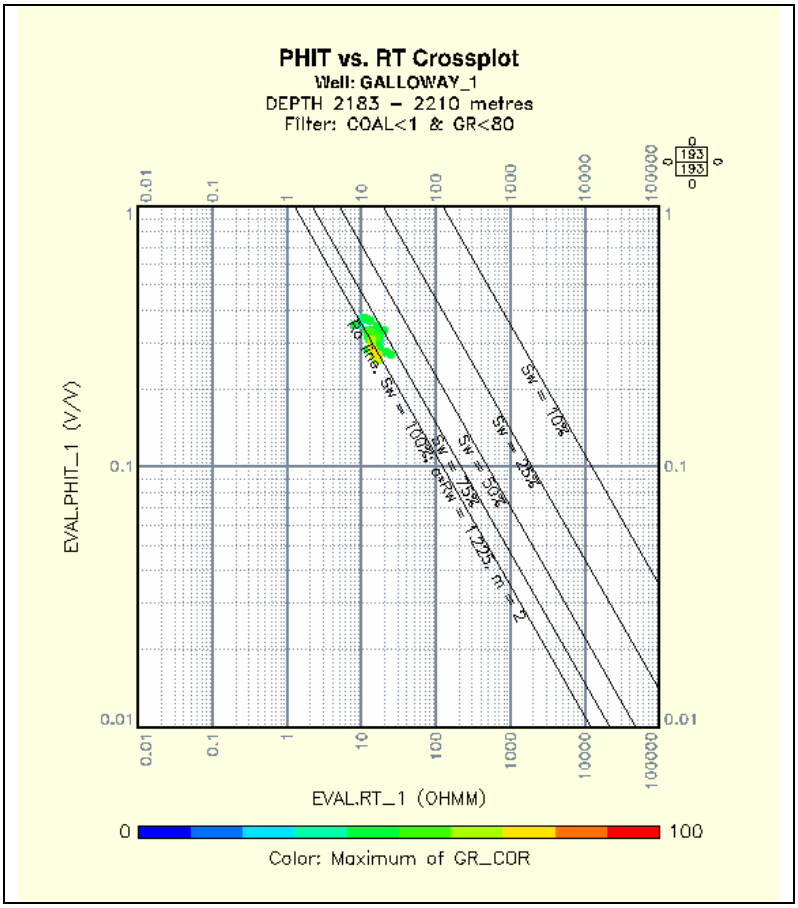



**Figure 1 – Pickett Plot for Rw of water bearing sands for Galloway 1**

### 4.2.4. Multimin Model

The parameters used in the model for Henry 1ST1 are summarised in Table 2 below:-

**Table 3 - Input parameters used to model the Galloway 1 well**

| Mineral | $\rho_b$ (g/cc) | $\phi_N$ (v/v) | GR (Gapi) | DT(us/ft) | U (B/cc) | CEC(m/g) |
|---|---|---|---|---|---|---|
| **Quartz** | *2.645* | *-0.05* | *6* | *50.4* | *4.78* | - |
| **Calcite** | *2.71* | *0* | *15* | *47.79* | *13.77* | - |
| **Pyrite** | *4.987* | *0.388* | *5* | *37.61* | *82.22* | |
| **Coal** | *1.225* | *0.7* | *10* | *130* | *0.22* | - |
| **Illite** | *2.78* | *0.3* | *265* | *110* | *11.73* | *0.25* |
| **Kaolinite** | *2.62* | *0.451* | *110* | *80* | *4.50* | *0.1* |
| **Glauconite** | *2.94* | *0.388* | *150* | *100* | *17.42* | *0.2* |
| ***Rw = 2.5 ohmm @75$^0$F, a = 1.0, m = 2.0 ,n = 2.0*** | | | | | | |

### 4.2.5. Net Pay

A net pay cut-off of *Vcl <50%, $\phi_t$>10%* and *Swt<60%* was used. The results are summarised in Table 4 below:-

**Table 4 - Net pay cut-off: - *Vcl<50%, $\phi_t$>10% & Swt<60%***

| FORMATION | | SAND | | | | | | | PAY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Øt>10% | | | | | | | Øt>10%, Swt<60%, Vcl<50% | | | | | | |
| SAND NAME | Sand Interval m | Net Sand m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD | Net Pay m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD |
| *Latrobe Coarse Clastics* | | | | | | | | | | | | | | | |
| SAND 1 | 2124-2196 | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Sub-Total/Average*** | | **69.5** | **30.2** | **97.8** | **23.8** | **96.8** | **16.4** | **233** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| *Latrobe N Aspetrus* | | | | | | | | | | | | | | | |
| SAND 2 | 2204-2210 | 6.2 | 28.9 | 99.6 | 26.4 | 99.3 | 6.4 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 3 | 2225-2228 | 2.8 | 26.6 | 100 | 15.1 | 100 | 29.3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 4 | 2261-2271.5 | 10.5 | 29.1 | 68.2 | 27.3 | 65.2 | 4.7 | 376 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 5 | 2277-2289 | 10.9 | 25.1 | 75.2 | 19.7 | 72.8 | 13.8 | 109 | 0.5 | 24.8 | 59.7 | 24.2 | 58.6 | 1.7 | 136 |
| ***Sub-Total/Average*** | | **30.4** | **27.4** | **80.1** | **23.3** | **77.5** | **10.6** | **216.9** | **0.5** | **24.8** | **59.7** | **24.2** | **58.6** | **1.7** | **136.0** |
| ***Total/Average*** | | **99.9** | **29.3** | **92.8** | **23.6** | **91.0** | **14.6** | **228.1** | **0.5** | **24.8** | **59.7** | **24.2** | **58.6** | **1.7** | **136.0** |

For comparison a net pay with cut-off of *Swt<70%* was included in Table 5 below: -

**Table 5 - Net pay cut-off: - *Vcl<50%, $\phi_t$>10% & Swt<70%***

| FORMATION | | SAND | | | | | | | PAY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Øt>10% | | | | | | | Øt>10%, Swt<60%, Vcl<50% | | | | | | |
| SAND NAME | Sand Interval m | Net Sand m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD | Net Pay m | Avg Øt % | Avg Swt % | Avg Øe % | Avg Swe % | Avg Vcl % | Avg k mD |
| *Latrobe Coarse Clastics* | | | | | | | | | | | | | | | |
| SAND 1 | 2124-2196 | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Sub-Total/Average*** | | 69.5 | 30.2 | 97.8 | 23.8 | 96.8 | 16.4 | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Latrobe N Aspetrus* | | | | | | | | | | | | | | | |
| SAND 2 | 2204-2210 | 6.2 | 28.9 | 99.6 | 26.4 | 99.3 | 6.4 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 3 | 2225-2228 | 2.8 | 26.6 | 100 | 15.1 | 100 | 29.3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAND 4 | 2261-2271.5 | 10.5 | 29.1 | 68.2 | 27.3 | 65.2 | 4.7 | 376 | 8.8 | 29.2 | 66.3 | 27.3 | 62.9 | 4.9 | 390 |
| SAND 5 | 2277-2289 | 10.9 | 25.1 | 75.2 | 19.7 | 72.8 | 13.8 | 109 | 7 | 26.9 | 64.3 | 25 | 61.5 | 4.7 | 147 |
| ***Sub-Total/Average*** | | **30.4** | **27.4** | **80.1** | **23.3** | **77.5** | **10.6** | **216.9** | **15.8** | **28.2** | **65.5** | **26.3** | **62.3** | **4.8** | **282.3** |
| ***Total/Average*** | | **99.9** | **29.3** | **92.8** | **23.6** | **91.0** | **14.6** | **228.1** | **15.8** | **28.2** | **65.5** | **26.3** | **62.3** | **4.8** | **282.3** |

As it can be noticed with cut-off of $S_{wt}$<70%, resulted in about 35% of hydrocarbon saturation over the potential sands (Sand 4 and 5). However, the pressure survey indicated that it was water bearing with water gradient of 0.43 psi/ft.

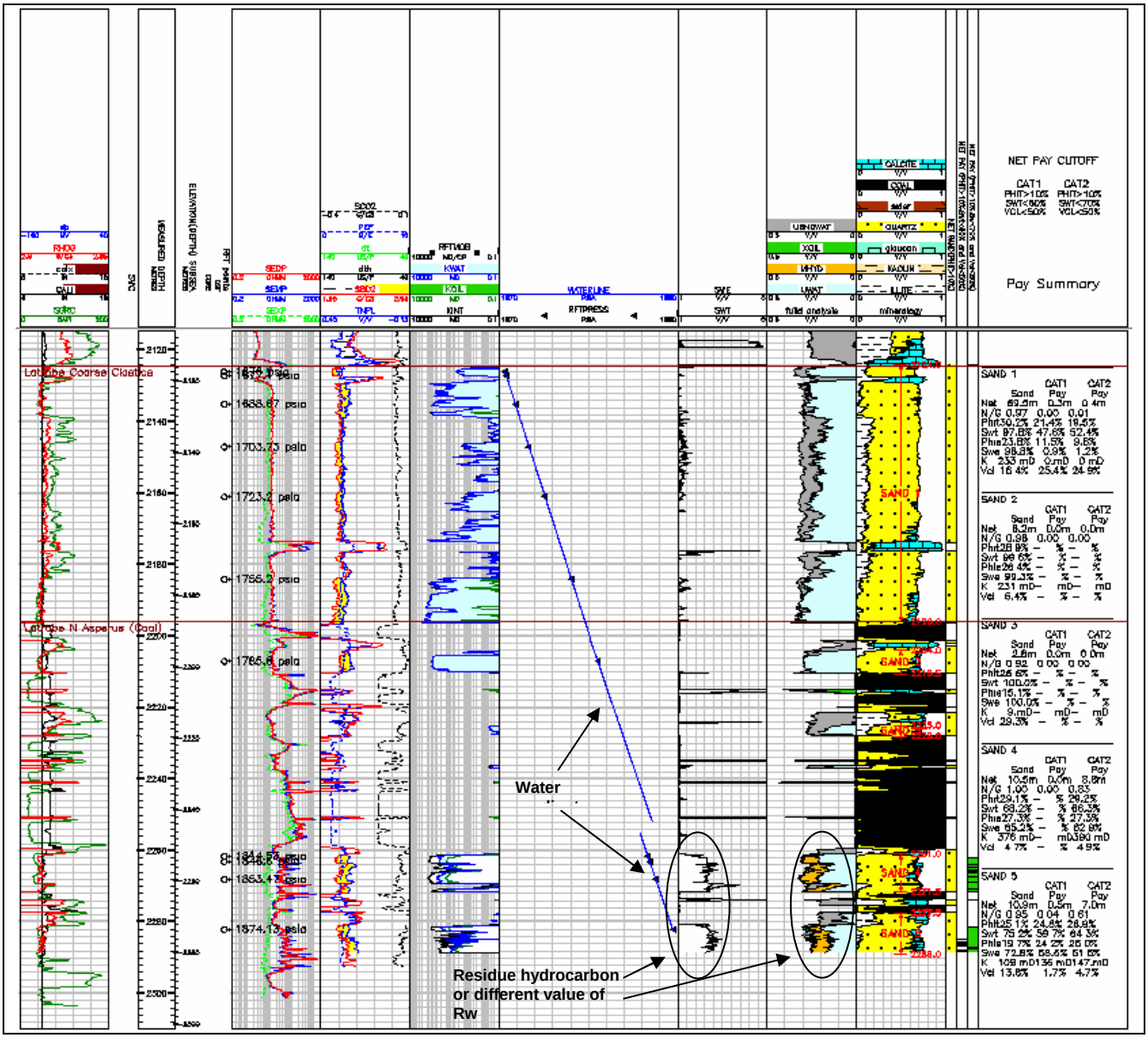



**Figure 2 - Galloway 1 composite logs**

## 5. Discussion of Result

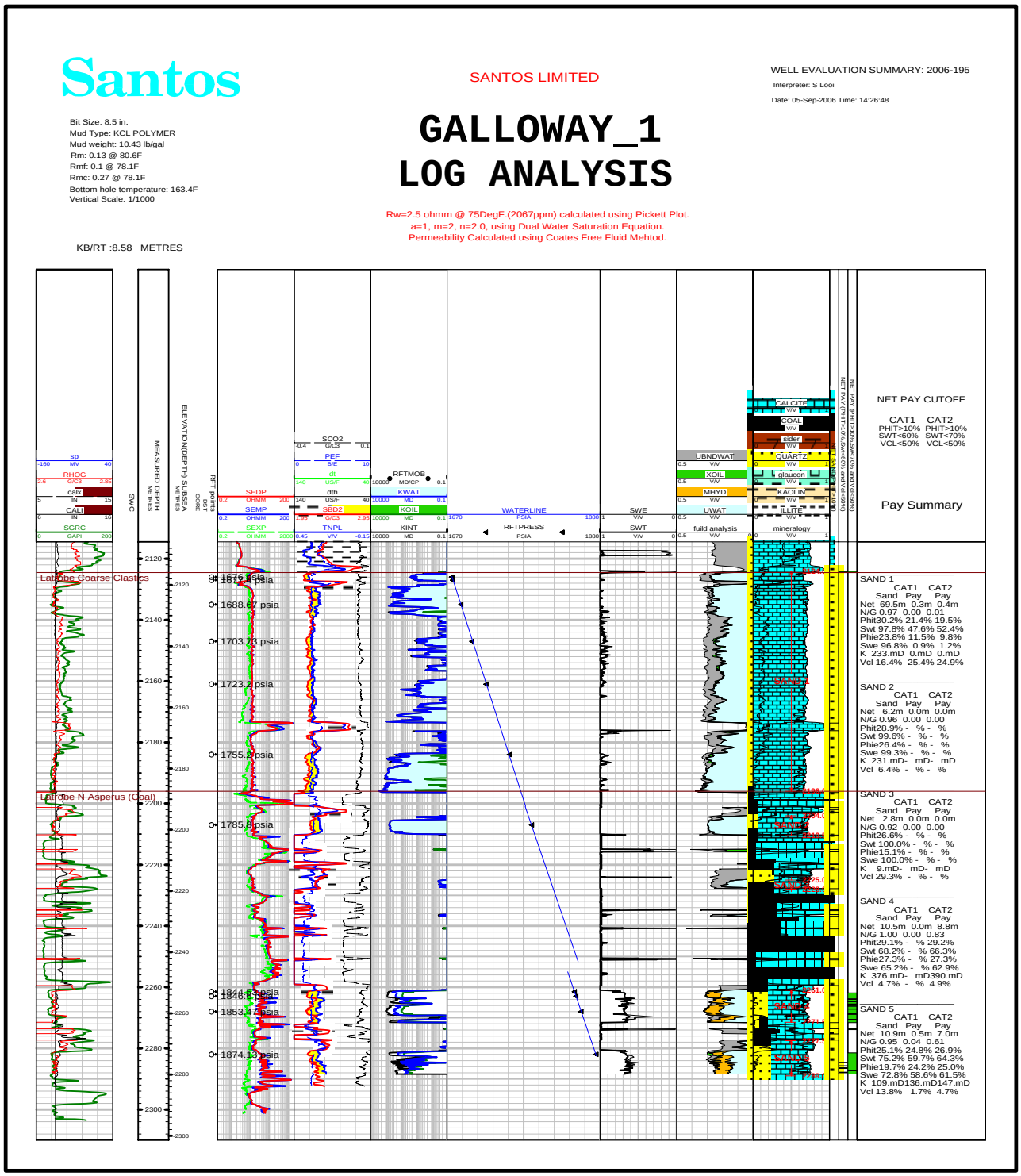
- Formation water resistivity (Rw) of 2.5 ohmm at 75$^{o}$F (2067ppm) was used in the well evaluation. This value was obtained using Pickett plot over the water bearing sands.

- The fluid gradient calculated from the formation pressure survey concluded that the Formation is water bearing, with water gradient of about 0.43 psi/ft. (refer to Figure 2 above). However, log analysis indicated there is about 35% of residue of hydrocarbon over the potential sands. This may suggested that the Galloway structure is within the hydrocarbon migration path or it may have a different value of Rw due to a different environment deposition as there is no gas show or fluorescence detected over the bottom two sands (sand 4 and 5).

## 6. Conclusions

No hydrocarbon producible pay was interpreted in Galloway 1 well. Formation pressure survey concluded that it is water bearing. Hence Galloway 1 was subsequently plugged and abandoned.

Attached is the well evaluation summary (WES) plot for Galloway 1



# 7. Appendix

## 7.1 Multimin Report

```
************************************
*                                  *
*          MULTIMIN REPORT         *
*                                  *
*    Project : TRY2                *
*    User id : loosi               *
*    Date    : 05-Sep-2006 14:38:11 *
*                                  *
************************************
```

MULTIMIN REPORT for well GALLOWAY_1 interval START PORCESSING (1600.00 - 1879.90 metres) Project TRY2
Reported by loosi on 05-Sep-2006 at 14:38
Analysed by loosi on 31-Aug-2006 at 11:08

MODELS:

| Type | Name | Cond# | Cutoff | Expression |
|---|---|---|---|---|
| Primary | GALLOWAY1CLCLOIL | 4.248 | 10.0 | |
| Secondary | GALLOWAY1COAL | 6.086 | 10.0 | coal |

FORMATION FLUID PARAMETERS:
Fluid properties option = DEPTH
Oil Gravity Degrees API = 30.00 dapi Gas specific gravity = 0.650
Rws = 2.5000 @ 75.00 degF Cwbs = - @ - degF Rmfs = 1.6000 @ 75.00 degF

BOREHOLE PARAMETERS:
Mud base = WATER Mud density = 10.430 lb/g KCl concentration of mud = 0.00 %
SHT = - BHT = 73.00 degC
Rms = 2.1300 @ 75.00 degF Rmcs = 3.200 @ 75.00 degF Total depth = - metres

Average temperature of 141.88 degF by TLI/BLI method.
Average pressure of 3093.06 psi by MUD_DENS method.

MULTIMIN REPORT for well GALLOWAY_1 interval START PORCESSING (1600.00 - 1879.90 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.2617 | 0.3020 | 0.0884 | 0.0515 | 0.0465 | 0.1100 | 0.0677 | 0.0570 | 0.1357 |

EQUATION RESPONSES:

| Log | Method | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.710 | 2.776 | 0.709 | 0.987 | 0.987 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.000 | 0.300 | 1.010 | 0.986 | 0.986 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 13.77 | 11.73 | 0.10 | 0.41 | 0.41 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 15.0 | 265.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0256I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.92 | 0.73 |
| CT | Dual-water nonlinear | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0320I | 0.00 | 0.00 | 0.00 | 0.00 | 5.70 | 1.14 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | |

| CONSTRAINTS: | Value | Type | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.183 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.574 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.990 | 0.000 | 0.000 |

MULTIMIN REPORT for well GALLOWAY_1 interval START PORCESSING (1600.00 - 1879.90 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL (continued):

PROPERTIES AND BOUNDS:

| | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.710 | 2.776 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.000 | 0.250 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval START PORCESSING (1600.00 - 1879.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.7358 | 0.1625 | 0.2076 | 2.2948 | 1.6695 | 0.0615 | 0.1409 | 1.6640 | 0.0761 | 0.1792 |

EQUATION RESPONSES:

| Log | Method | Uncertainty | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.776 | 2.635 | 1.225 | 0.709 | 0.987 | 0.987 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.300 | 0.451 | 0.700 | 1.010 | 0.986 | 0.986 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 11.73 | 4.50 | 0.22 | 0.10 | 0.41 | 0.41 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 265.0 | 110.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0256I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.92 | 0.73 |
| CT | Dual-water nonlinear | | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0320I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.70 | 1.14 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | | |

MULTIMIN REPORT for well GALLOWAY_1 interval START PORCESSING (1600.00 - 1879.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL (continued):

CONSTRAINTS:

| | Value | Type | Uncertainty | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.183 | 0.069 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.574 | 0.218 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | Tool | 0.0100 | 0.000 | 3.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <USER CONSTR2> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 |

PROPERTIES AND BOUNDS:

| | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.776 | 2.635 | 1.225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.250 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 1.000 | 0.001 | 0.500 | 0.001 | 0.001 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LAKE ENTRANCE FORMATION (1880.00 - 2124.40 metres) Project TRY2

Reported by loosi on 05-Sep-2006 at 14:38
Analysed by loosi on 31-Aug-2006 at 11:08

MODELS:

| Type | Name | Cond# | Cutoff | Expression |
|---|---|---|---|---|
| Primary | GALLOWAY1CLCLOIL | 4.247 | 10.0 | |
| Secondary | GALLOWAY1COAL | 6.117 | 10.0 | coal |

FORMATION FLUID PARAMETERS:

Fluid properties option = DEPTH
Oil Gravity Degrees API = 30.00 dapi Gas specific gravity = 0.650
Rws = 2.5000 @ 75.00 degF Cwbs = - @ - degF Rmfs = 1.6000 @ 75.00 degF

BOREHOLE PARAMETERS:

Mud base = WATER Mud density = 10.430 lb/g KCl concentration of mud = 0.00 %
SHT = - BHT = 73.00 degC
Rms = 2.1300 @ 75.00 degF Rmcs = 3.200 @ 75.00 degF Total depth = - metres

Average temperature of 151.96 degF by TLI/BLI method.
Average pressure of 3559.32 psi by MUD_DENS method.

MULTIMIN REPORT for well GALLOWAY_1 interval LAKE ENTRANCE FORMATION (1880.00 - 2124.40 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.2607 | 0.3010 | 0.0893 | 0.0529 | 0.0473 | 0.1130 | 0.0705 | 0.0581 | 0.1401 |

EQUATION RESPONSES:

| Log | Method | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.710 | 2.776 | 0.692 | 0.985 | 0.985 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.000 | 0.300 | 1.004 | 0.984 | 0.984 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 13.77 | 11.73 | 0.10 | 0.41 | 0.41 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 15.0 | 265.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0264I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.31 | 0.78 |
| CT | Dual-water nonlinear | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0331I | 0.00 | 0.00 | 0.00 | 0.00 | 6.21 | 1.21 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | |

| CONSTRAINTS: | Value | Type | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.183 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.574 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.990 | 0.000 | 0.000 |

MULTIMIN REPORT for well GALLOWAY_1 interval LAKE ENTRANCE FORMATION (1880.00 - 2124.40 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL (continued):

PROPERTIES AND BOUNDS:

| | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.710 | 2.776 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.000 | 0.250 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LAKE ENTRANCE FORMATION (1880.00 - 2124.40 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.7361 | 0.1594 | 0.1618 | 2.3947 | 1.7257 | 0.0619 | 0.1431 | 1.7202 | 0.0766 | 0.1831 |

EQUATION RESPONSES:

| Log | Method | Uncertainty | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.776 | 2.635 | 1.225 | 0.692 | 0.985 | 0.985 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.300 | 0.451 | 0.700 | 1.004 | 0.984 | 0.984 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 11.73 | 4.50 | 0.22 | 0.10 | 0.41 | 0.41 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 265.0 | 110.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0264I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.31 | 0.78 |
| CT | Dual-water nonlinear | | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0331I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.21 | 1.21 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | | |

MULTIMIN REPORT for well GALLOWAY_1 interval LAKE ENTRANCE FORMATION (1880.00 - 2124.40 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL (continued):

CONSTRAINTS:

| | Value | Type | Uncertainty | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.183 | 0.069 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.574 | 0.218 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | Tool | 0.0100 | 0.000 | 3.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <USER CONSTR2> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 |

PROPERTIES AND BOUNDS:

| | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.776 | 2.635 | 1.225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.250 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 1.000 | 0.001 | 0.500 | 0.001 | 0.001 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE COARSE CLASTICS (2124.50 - 2259.90 metres) Project TRY2

Reported by loosi on 05-Sep-2006 at 14:38
Analysed by loosi on 31-Aug-2006 at 11:08

MODELS:

| Type | Name | Cond# | Cutoff | Expression |
|---|---|---|---|---|
| Primary | GALLOWAY1CLCLOIL | 4.237 | 10.0 | |
| Secondary | GALLOWAY1COAL | 6.142 | 10.0 | coal |

FORMATION FLUID PARAMETERS:

Fluid properties option = DEPTH
Oil Gravity Degrees API = 30.00 dapi Gas specific gravity = 0.650
Rws = 2.5000 @ 75.00 degF Cwbs = 0.500 @ 75.00 degF Rmfs = 1.6000 @ 75.00 degF

BOREHOLE PARAMETERS:

Mud base = WATER Mud density = 10.430 lb/g KCl concentration of mud = 0.00 %
SHT = - BHT = 73.00 degC
Rms = 2.1300 @ 75.00 degF Rmcs = 3.200 @ 75.00 degF Total depth = - metres

Average temperature of 159.26 degF by TLI/BLI method.
Average pressure of 3897.07 psi by MUD_DENS method.

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE COARSE CLASTICS (2124.50 - 2259.90 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.2703 | 0.3115 | 0.0785 | 0.0319 | 0.0419 | 0.0553 | 0.0326 | 0.0516 | 0.0680 |

EQUATION RESPONSES:

| Log | Method | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.710 | 2.776 | 0.680 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.000 | 0.300 | 1.000 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 13.77 | 11.73 | 0.10 | 0.40 | 0.40 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 15.0 | 265.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0270I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.14 | 0.81 |
| CT | Dual-water nonlinear | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0338I | 0.00 | 0.00 | 0.00 | 0.00 | 1.41 | 1.27 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | |

| CONSTRAINTS: | Value | Type | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.183 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.574 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.990 | 0.000 | 0.000 |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE COARSE CLASTICS (2124.50 - 2259.90 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLCLOIL (continued):

PROPERTIES AND BOUNDS:

| | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.710 | 2.776 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.000 | 0.250 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE COARSE CLASTICS (2124.50 - 2259.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | | | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | | | 0.7382 | 0.1709 | 0.1629 | 2.4812 | 1.7909 | 0.0622 | 0.0722 | 1.7882 | 0.0770 | 0.0959 |
| EQUATION RESPONSES: | | | | | | | | | | | | |
| Log | Method | Uncertainty | | | | | | | | | | |
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.776 | 2.635 | 1.225 | 0.680 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.300 | 0.451 | 0.700 | 1.000 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 11.73 | 4.50 | 0.22 | 0.10 | 0.40 | 0.40 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 265.0 | 110.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0270I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.14 | 0.81 |
| CT | Dual-water nonlinear | | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0338I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.41 | 1.27 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | | |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE COARSE CLASTICS (2124.50 - 2259.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL (continued):

CONSTRAINTS:

| | Value | Type | Uncertainty | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.183 | 0.069 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.574 | 0.218 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | Tool | 0.0100 | 0.000 | 3.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <USER CONSTR2> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 |

PROPERTIES AND BOUNDS:

| | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.776 | 2.635 | 1.225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.250 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 1.000 | 0.001 | 0.500 | 0.001 | 0.001 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE N ASPERUS (COAL) (2260.00 - 2309.90 metres) Project TRY2

Reported by loosi on 05-Sep-2006 at 14:38
Analysed by loosi on 31-Aug-2006 at 11:08

MODELS:

| Type | Name | Cond# | Cutoff | Expression |
|---|---|---|---|---|
| Primary | GALLOWAY1CLC2 | 4.237 | 10.0 | |
| Secondary | GALLOWAY1COAL | 6.153 | 10.0 | coal |

FORMATION FLUID PARAMETERS:

Fluid properties option = DEPTH
Oil Gravity Degrees API = 30.00 dapi  Gas specific gravity = 0.650
Rws = 2.5000 @ 75.00 degF  Cwbs = 0.500 @ 75.00 degF  Rmfs = 1.6000 @ 75.00 degF

BOREHOLE PARAMETERS:

Mud base = WATER  Mud density = 10.430 lb/g  KCl concentration of mud = 0.00 %
SHT = -  BHT = 73.00 degC
Rms = 2.1300 @ 75.00 degF  Rmcs = 3.200 @ 75.00 degF  Total depth = - metres

Average temperature of 162.82 degF by TLI/BLI method.
Average pressure of 4061.86 psi by MUD_DENS method.

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE N ASPERUS (COAL) (2260.00 - 2309.90 metres) Project TRY2

PRIMARY MODEL GALLOWAY1CLC2:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | 0.2703 | 0.3116 | 0.0784 | 0.0318 | 0.0420 | 0.0555 | 0.0326 | 0.0517 | 0.0682 |

EQUATION RESPONSES:

| | Log | Method | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Formation density [G/C3] | RHO_COR | Linear | 0.0264 | 2.645 | 2.710 | 2.776 | 0.675 | 0.981 | 0.981 | 0.000 | 0.000 | 0.000 |
| Neutron [V/V] | TNPH_COR | Linear | 0.0140 | -0.050 | 0.000 | 0.300 | 0.998 | 0.981 | 0.981 | 0.000 | 0.000 | 0.000 |
| Photoelectric absorption [B/C3] | U | Linear | 3.0000 | 4.78 | 13.77 | 11.73 | 0.10 | 0.40 | 0.40 | 0.00 | 0.00 | 0.00 |
| Total gamma [GAPI] | GR_COR | Linear | 30.0000 | 30.0 | 15.0 | 265.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Unflushed conductivity [MH/M] | CT | Dual-water nonlinear | 0.0273I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.16 | 0.83 |
| Flushed conductivity [MH/M] | CXO | Dual-water nonlinear | 0.0342I | 0.00 | 0.00 | 0.00 | 0.00 | 1.45 | 1.30 | 0.00 | 0.00 | 0.00 |

| CONSTRAINTS: | Value | Type | Uncertainty | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.183 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.574 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.100 | >= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 |

PRIMARY MODEL GALLOWAY1CLC2 (continued):

PROPERTIES AND BOUNDS:

| | QUARTZ | CALCITE | ILLITE | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.710 | 2.776 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.000 | 0.250 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE N ASPERUS (COAL) (2260.00 - 2309.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL:
Cementation factor m = 2.000 Saturation exponent n = 2.000 Linear dual-water w = 2.00
Expansion of clay bound water is enabled.

| Component | | | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Error of prediction | | | 0.7382 | 0.1723 | 0.1609 | 2.5183 | 1.8120 | 0.0623 | 0.0723 | 1.8094 | 0.0772 | 0.0961 |
| EQUATION RESPONSES: | | | | | | | | | | | | |
| Log | Method | Uncertainty | | | | | | | | | | |
| Formation density [G/C3] | | 0.0264 | 2.645 | 2.776 | 2.635 | 1.225 | 0.675 | 0.981 | 0.981 | 0.000 | 0.000 | 0.000 |
| RHO_COR | Linear | | | | | | | | | | | |
| Neutron [V/V] | | 0.0140 | -0.050 | 0.300 | 0.451 | 0.700 | 0.998 | 0.981 | 0.981 | 0.000 | 0.000 | 0.000 |
| TNPH_COR | Linear | | | | | | | | | | | |
| Photoelectric absorption [B/C3] | | 3.0000 | 4.78 | 11.73 | 4.50 | 0.22 | 0.10 | 0.40 | 0.40 | 0.00 | 0.00 | 0.00 |
| U | Linear | | | | | | | | | | | |
| Total gamma [GAPI] | | 30.0000 | 30.0 | 265.0 | 110.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GR_COR | Linear | | | | | | | | | | | |
| Unflushed conductivity [MH/M] | | 0.0273I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.16 | 0.83 |
| CT | Dual-water nonlinear | | | | | | | | | | | |
| Flushed conductivity [MH/M] | | 0.0342I | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.45 | 1.30 | 0.00 | 0.00 | 0.00 |
| CXO | Dual-water nonlinear | | | | | | | | | | | |

MULTIMIN REPORT for well GALLOWAY_1 interval LATROBE N ASPERUS (COAL) (2260.00 - 2309.90 metres) Project TRY2

SECONDARY MODEL GALLOWAY1COAL (continued):

CONSTRAINTS:

| | Value | Type | Uncertainty | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <PROG UNITY> | 1.000 | Tool | 0.0100 | 1.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 |
| <PROG POROSITY> | 0.000 | Tool | 0.0100 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | -1.000 | -1.000 | -1.000 |
| <PROG X BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.183 | 0.069 | 0.000 | 0.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <PROG U BNDWAT> | 0.000 | Tool | 0.0100 | 0.000 | 0.574 | 0.218 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -1.000 | 0.000 |
| <PROG WATER MUD> | 0.000 | <= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 0.000 | -1.000 | -1.000 |
| <USER CONSTR1> | 0.000 | Tool | 0.0100 | 0.000 | 3.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| <USER CONSTR2> | 0.000 | >= | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 |

PROPERTIES AND BOUNDS:

| | QUARTZ | ILLITE | KAOLIN | SPCMIN1 | XOIL | XBNDWAT | XFREWAT | UOIL | UBNDWAT | UFREWAT |
|---|---|---|---|---|---|---|---|---|---|---|
| Mineral grain density | 2.650 | 2.776 | 2.635 | 1.225 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral cation exchange capacity | 0.000 | 0.250 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lower Bound | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Upper Bound | 1.000 | 1.000 | 1.000 | 1.000 | 0.001 | 0.500 | 0.001 | 0.001 | 0.500 | 0.500 |

```
************************************
*                                  *
*          MULTIMIN REPORT         *
*                                  *
*       *** End of Report ***      *
*                                  *
*    Project : TRY2                *
*    User id : loosi               *
*    Date    : 05-Sep-2006 14:38:12 *
*    Pages   :  20                 *
*                                  *
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# APPENDIX II: HYDROCARBON SHOW REPORT

No significant fluorescence was observed in Galloway 1.
The reports overleaf are presented for completeness.

SANTOS LIMITED

# OIL SHOW EVALUATION REPORT

WELL: GALLOWAY-1 GEOLOGIST: R. Subramanian

INTERVAL 2129-2133m DATE:

FORMATION Latrobe Coarse Clastics

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C1 ppm | **7.5k** | 10k | 20k | 30k | 40k | 50k | 100k | 150k | 200k | >250k |
| C2+ ppm | **500** | 750 | 1k | 2k | 3k | 4k | 5.5k | 7.5k | 10k | >15k |
| Porosity Ø | tight | | | poor | | **fair** | | **good** | | |
| % with fluorescence | **Trace** | **5** | 20 | 30 | 40 | 50 | 60 | 70 | 80 | >90 |
| Fluorescence appearance | trace | | spotted | | | streaked | | **patchy** | | solid |
| Brightness of fluorescence | v. dull | | **dull** | | Dim | | | Mod bright | v. bright | glowing |
| Type of cut | trace | **v. slow crush cut** | crush cut | instant crush cut | v. slow streaming cut | slow stream | moderate streaming | streaming | fast streaming | instant |
| Residue on spot plate | trace | heavy trace | v. thin ring | thin ring | **thick ring** | v. thick ring | thin film | thin film | thick film | solid |
| Show rating | **trace** | | poor | | Fair | | good | | | |
| Comments: | Trace to 5 % dull brown yellow patchy fluorescence, trace yellow crush cut, thick ring residue.. | | | | | | | | | |

SANTOS LIMITED

# OIL SHOW EVALUATION REPORT

WELL: GALLOWAY-1 GEOLOGIST: R. Subramanian

INTERVAL 2133-2139m DATE:

FORMATION Latrobe Coarse Clastics

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C1 ppm | **7.5k** | 10k | 20k | 30k | 40k | 50k | 100k | 150k | 200k | >250k |
| C2+ ppm | **500** | 750 | 1k | 2k | 3k | 4k | 5.5k | 7.5k | 10k | >15k |
| Porosity Ø | tight | | | poor | | **fair** | | **good** | | |
| % with fluorescence | **Rare** | **Trace** | 20 | 30 | 40 | 50 | 60 | 70 | 80 | >90 |
| Fluorescence appearance | trace | | spotted | | | streaked | | **patchy** | | solid |
| Brightness of fluorescence | v. dull | | **dull** | | Dim | | | Mod bright | v. bright | glowing |
| Type of cut | trace | **v. slow crush cut** | crush cut | instant crush cut | v. slow streaming cut | slow stream | moderate streaming | streaming | fast streaming | instant |
| Residue on spot plate | trace | heavy trace | v. thin ring | thin ring | **thick ring** | v. thick ring | thin film | thin film | thick film | solid |
| Show rating | **trace** | | poor | | Fair | | good | | | |
| Comments: | Rare to trace dull brown yellow patchy fluorescence, trace yellow crush cut, thick ring residue.. | | | | | | | | | |

SANTOS LIMITED

# OIL SHOW EVALUATION REPORT

WELL: GALLOWAY-1 GEOLOGIST: R. Subramanian

INTERVAL 2148-2151m DATE:

FORMATION Latrobe Coarse Clastics

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C1 ppm | **7.5k** | 10k | 20k | 30k | 40k | 50k | 100k | 150k | 200k | >250k |
| C2+ ppm | **500** | 750 | 1k | 2k | 3k | 4k | 5.5k | 7.5k | 10k | >15k |
| Porosity Ø | tight | | | poor | | fair | | **good** | | |
| % with fluorescence | **Trace** | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | >90 |
| Fluorescence appearance | trace | | spotted | | | streaked | | **patchy** | | solid |
| Brightness of fluorescence | v. dull | | **dull** | | Dim | | | Mod bright | v. bright | glowing |
| Type of cut | trace | **v. slow crush cut** | crush cut | instant crush cut | v. slow streaming cut | slow stream | moderate streaming | streaming | fast streaming | instant |
| Residue on spot plate | trace | heavy trace | v. thin ring | thin ring | thick ring | v. thick ring | thin film | thin film | **thick film** | solid |
| Show rating | **trace** | | poor | | Fair | | good | | | |
| Comments: | Trace dull yellow patchy fluorescence, trace yellow crush cut, thick film residue.. | | | | | | | | | |

# APPENDIX III : GEOTHERMAL GRADIENT

Wireline Logs were not run in Galloway 1.

No Temperature Data was available and the Geothermal Gradient was not calculated.

# APPENDIX IV : PRODUCTION TEST REPORT

Production Tests were not run in Galloway 1.

# APPENDIX V : PALYNOLOGY REPORT

No Palynology Studies were conducted in Galloway 1.

# APPENDIX VI : WATER ANALYSIS REPORTS

No Water Analysis was carried out in Galloway 1.

# ENCLOSURE I: COMPOSITE LOG

# ENCLOSURE II: MUDLOG

# ENCLOSURE III: STRUCTURE MAP

# ENCLOSURE IV: STRATIGRAPHIC CROSS SECTION

# ENCLOSURE V: LOG INTERPRETATION PLOT