# Well Completion Report for Flounder - A11 A

Volume 2.

W1231.

**Esso Australia Ltd.**

915467 002



# WELL COMPLETION REPORT

# FLOUNDER A11A (Tukari 1)

VOLUME 2

INTERPRETATIVE DATA

**VIC/L5**

GIPPSLAND BASIN, VICTORIA

ESSO AUSTRALIA LTD

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December 1998

915467 003

# WELL COMPLETION REPORT

## *VOLUME 2: INTERPRETATIVE DATA*

**CONTENTS**



**FIGURES**



**APPENDICES**



**ENCLOSURES**



**ATTACHMENTS**

## 1. SUMMARY OF WELL RESULTS

The Tukari-1 exploration well spudded on 3rd June 1998 and was drilled as a deviated well utilising the Flounder A-11 conductor.

The Top of Latrobe Group was intersected at 2084 m TVDSS some 8 m high to prognosis whilst the Top of Tukari surface was penetrated at 2107 m TVDSS, 15m low to prediction. Predrill it was predicted that the Top of Latrobe would form the top of the Tukari trap. However, Gurnard Formation within the Latrobe Group, which was not predicted to be intersected, was found directly overlying the Tukari prospect. Log data indicates no effective reservoir development over the primary objective interval.

Tukari-1 was plugged and abandoned on 26th June 1998.

**Table 1: Prognosed vs Actual Formation Tops**

| FORMATION/HORIZON | Predicted Depth (mss TVD) | Actual Depth (mss TVD) |
|---|---|---|
| Seafloor | 93 | 93 |
| Top of Latrobe | 2092 | 2084 |
| Top of Tukari | 2092 | 2107 |
| TD | 2415 | 2241 |

## 2. INTRODUCTION

The Tukari prospect was identified within VIC/L5 and VIC/L6 on the southwestern flank of the Flounder oil and gas field. It was observed on seismic data as an amplitude anomaly within the upper section of the Tuna-Flounder Channel (TFC). The Tukari feature is situated within the axis of the channel and relied on the underlying transgressive-highstand mudstones to provide the base seal and the overlying Lakes Entrance Formation to provide the top seal for the feature.

Predrill, the reservoir section was interpreted to be comprised of high quality lowstand-transgressive fluvial/estuarine sandstones. However, the primary objective at Tukari was comprised predominantly of siltstone. The Top of Latrobe Group came in high due to the unexpected presence of the Gurnard Formation. It appears from seismic modelling that the contrast between the Gurnard Formation and the Tukari siltstone, as well as the contrast between the Tukari siltstone and the underlying shale prone section of the Tuna-Flounder Channel creates the amplitude anomaly observed on the seismic data.

## 3. STRUCTURE

The Tukari Prospect is interpreted as a stratigraphic trap formed by an incisive event (50.0-48.0my) within the later stages of the TFC system. Sediment transport within the incised valley system was to the southeast with a lowstand shoreline established along the southern flank of the Flounder feature (prograding geometries identified on G94BF Flounder 3D survey).

The Tukari incised valley system was subsequently drowned during rapid transgression with the shoreline re-established near the Tuna field. A subsequent compressional episode during the Mid Eocene initiated further incision south of Trevally #1 resulting in modification of the Tukari feature (western and southern erosion) to isolate the distal sediments in the Flounder area from the more proximal sediments interpreted south of the Angelfish-1 well.

The subsequent transgression had seen the shoreline re-established west of the Turrum Field. Erosion associated with the Top of Latrobe Group unconformity removed the Mid-Late Eocene sediments from the Flounder area, with the top seal for the Tukari play being interpreted pre-drill as mudstones and siltstones of the Lakes Entrance Formation. Post-drill results showed that the Gurnard Formation formed the top unit directly above the Tukari-siltstone. Compressional events during the Miocene to Recent have given rise to the structuring of the Tukari feature (ie. Top Latrobe Group).

## 4. STRATIGRAPHY

The Tukari-1 well intersected approximately 1991 metres of the Seaspray Group overlying the Latrobe Group. The Seaspray Group is subdivided into two units, the upper being the Gippsland Limestone and the lower being the Lakes Entrance Formation. The Gippsland Limestone intersection consisted of limestone and marl, with the underlying Lakes Entrance Formation being relatively thin to due to onlap onto the Flounder High.

The youngest Latrobe Group stratigraphy expected was the Early to Middle Eocene age incised valley fill sandstones directly below the Top Latrobe unconformity. However, instead of intersecting channel sands directly below the Top of Latrobe, a 23m interval of Gurnard formation was intersected in the Tukari-1 well. Immediately below the Gurnard Formation was the Tukari channel fill however, the channel fill comprised of siltstone instead off the predicted sandstone. The base seal to the predicted reservoir is provided by transgressive-highstand offshore mudstones and minor interbedded siltstones (Lower P.asperopolus spore/pollen zone).

Due to the absence of sandstone and hydrocarbons within the Tukari reservoir objective, the total depth of the well was shortened and drilled only to the basal interval of the Tuna Flounder Channel. Porous high quality lowstand sands (Upper M.diversus spore/pollen zone) within the basal TFC section were interpreted to be the leak point for the Tukari trap.

## 5. HYDROCARBONS

No significant hydrocarbon shows were encountered within the Gippsland Limestone or Lakes Entrance Formation in the Tukari-1 well. The target section for the Tukari-1 well, despite yielding the highest levels of gas within the well (up to 29.3 units over a background of 2-7 units) were not considered prospective due to the absence of porous sandstones.

## 6. GEOPHYSICAL DISCUSSION

The seismic interpretation of the Tukari Prospect was based upon the G94BF Flounder 3D seismic survey. This survey was acquired in late 1994 / early 1995 and processed in 1995 using pre-stack time migration. The survey was acquired in order to define infill drilling locations for the Flounder T1 reservoir.

Pre-existing seismic data includes the original G82A Flounder 3D survey and various vintages of 2D data from 1974 to 1992.

The Tukari Prospect was first recognised as a seismic amplitude anomaly on a grid of 1989 2D data, although inspection of previous vintages (including 3D) clearly show the prospect.

The G94BF 3D survey is of excellent quality at the level of the Tukari Prospect. The survey consists of 4625 line kilometres with 25 metre line spacing and 12.5 metre CDP interval.

### Time Interpretation and Seismic Modelling

The Tukari prospect was first observed as a seismic amplitude anomaly immediately underlying the Top of Latrobe group on the southern flank of the Flounder feature. Pre-drill seismic modelling (forward and inverse) suggested that the seismic response was due to low impedance material at the Top of Latrobe. The Tukari prospect is defined by the TOL and the Tukari_SB seismic surfaces. TOL is carried as a zero crossing from positive to negative (opposite to normal, supported by forward modelling) in this area and the Tukari_SB carried as a zero crossing from negative to positive.

The Tukari prospect has dip closure to the south, and relies on base seal for the eastern and western sides. The northern edge is typically truncated by the Top of Latrobe group.

Initial forward modelling suggested that a 25% porosity sand saturated with hydrocarbon (gas or high GOR oil) could generate the seismic response observed at Tukari. It could also be generated by a 30%+ porosity water sand, a coal or a low impedence shaley unit. The coal and high porosity water sand cases were regarded as geologically unlikely. Several low impedance shale units have been intersected in the post-Latrobe section (eg. Flounder-5).

These units have an impedance similar to the hydrocarbon charged sands and if present could cause the observed zero offset seismic response. However, the AVO analysis (Delta Rp) suggested the Tukari signature to be consistent with a hydrocarbon bearing sand rather than a low impedence shaley unit.

Subsequent post drill modelling indicates that the amplitude response is generated from contrast between the Gurnard and Tukari-siltstone as well as the contrast between the siltstone and the shale prone facies of the Tuna-Flounder Channel below. The AVO response observed on the seismic can now be explained by two factors,

1) Calibration tested on several different coal models but assumed coals embedded in simple lithology.
2) The AVO response was lithology related ie. changing lithology from the Gurnard Formation (high density) with a high Poisson's ratio to an anomalous siltstone (low velocity) with a low Poisson's ratio, then into a shale (high density) with a high Poisson's ratio giving the AVO gradient.

### Depth Conversion

The Top of Latrobe was depth converted using an Average Velocity approach to the Base High Velocity seismic marker and an Interval Velocity to the Top of Latrobe. This map defines the top of the Tukari prospect in the area of the amplitude anomaly. The isochron between the TOL and Tukari_SB was converted to an isopach using an Interval Velocity of 3100 m/s (from modelling) and the smoothed isopach added to the Top of Latrobe map. This surface defines the base of the Tukari prospect.

## 7. GEOLOGICAL DISCUSSION

### Regional Setting

The initial formation of the Gippsland Basin was associated with Late Jurassic to Early Cretaceous rifting and subsidence, with deposition of the predominantly volcanoclastic Strzelecki Group within a fluvial environment. Deposition of deep rift lacustrine shales and alluvial fans of the overlying Golden Beach Group along the basin margins gradually evolved into a fluvial river dominated system. A second rift phase in the Gippsland Basin began at approximately 80 my and marked cessation of the Golden Beach Group deposition with subsequent basaltic volcanism covering much of the Golden Beach unconformity surface. Late Cretaceous rifting continued along the eastern margin of Australia resulting in the separation of the Lord Howe Rise and continued opening of the Tasman Sea. At this point the Gippsland Basin became a failed rift.

The Latrobe Group was deposited in a synrift to post rift sag setting with fault controlled subsidence continuing until the Late Paleocene. Most of the Latrobe Group was deposited in a non-marine setting behind a NE-SW trending beach-barrier complex. The Cretaceous age (T. Longus spore/pollen zonation) Latrobe Group reservoirs at Flounder are located in the eastern portion of the basin where depositional settings range from fluvial to estuarine and marginal marine environments.

As sedimentation rates declined, the strandline moved to the northwest, accompanied by deposition of thin Paleocene and Early Eocene aged glauconitic sandstones, siltstones and mudstones over the eastern half of the basin.

Several episodes of channel incision and subsequent deposition of channel fill mudstones, siltstones and sandstones of the Flounder Formation occurred during the Eocene.

The initial TFC was a major incisive phase initiated by structural arching of the central basin, due to a compressional tectonic event during the Early Eocene. The uplifted terrain is interpreted to be erosionally dissected during this tectonically induced lowstand with the TFC forming as a major incised valley to the north of Trevally #1. Lowstand fluvial / estuarine sands are present at Flounder within the channel axis and are overlain by transgressive sands and shales deposited as the channel system was drowned to form a strandline some 10 km shoreward, leaving the submerged Flounder area in deepwater. Subsequent deposition during the highstand has resulted in a relatively thick sequence of offshore marine shale covering the more sand prone transgressive package.

Subsequent compressional events (six interpreted incisive phases) have seen a southward shift of the younger channel axes with general deposition of lowstand fluvial/estuarine sands within the axis of the incised valley system, overlain by offshore mudstones to distal lower shoreface facies deposited during the subsequent transgressive and highstand phases.

The Tukari feature is associated with a compressional event between 50.0-48.0my, which has initiated further incision within the TFC system and realised a shift of the incised valley system to the south of the Trevally #1 well. Sediment transport was to the southeast with a lowstand shoreline established along the southern flank of the Flounder feature (prograding geometries identified on G94B 3D survey).

The Tukari incised valley system was subsequently drowned during rapid transgression with the shoreline re-established near the Tuna field. A significant compressional episode initiated further incision south of the Trevally #1 well, resulting in modification of the Tukari feature (western and southern erosion) to isolate the distal sediments in the Flounder area from the more proximal sediments south of the Angelfish #1 well. Subsequent transgression during the Mid Eocene has seen the shoreline re-established west of the Turrum Field.

The younger Marlin Channel was cut during the Middle Eocene, possibly in response to a major tectonic event and was partially filled with distal marine mass wasted glauconitic siltstones of the Mid to Late Eocene Turrum Formation.

A third stage of erosion associated with the top of Latrobe Group unconformity occurred in response to further compression but had little impact in the vicinity of the Flounder area, showing only minor regional modification of the preceding landscape.

The end of the Latrobe Group is marked by deposition of calcareous siltstones and mudstones of the Lakes Entrance Formation in response to continued marine transgression during the Oligocene. These fine grained rocks provide the cap seal to top of Latrobe Group closures in the Gippsland Basin. A further compressional event in the Middle Miocene caused selective inversion of faults around the basin and either enhanced existing structures (eg. Flounder and Marlin Fields) or established new ENE-WSW anticlinal trends in the basin (eg. Kingfish and Bream Fields).

Near the base of the overlying Gippsland Limestone major channel incisions occurred during the Middle to Late Miocene. These erosional events may have been initiated by further structural reactivation and were later infilled by prograding limestone and calcareous siltstone depositional wedges, which ultimately lead to the formation of the present day shelf edge.

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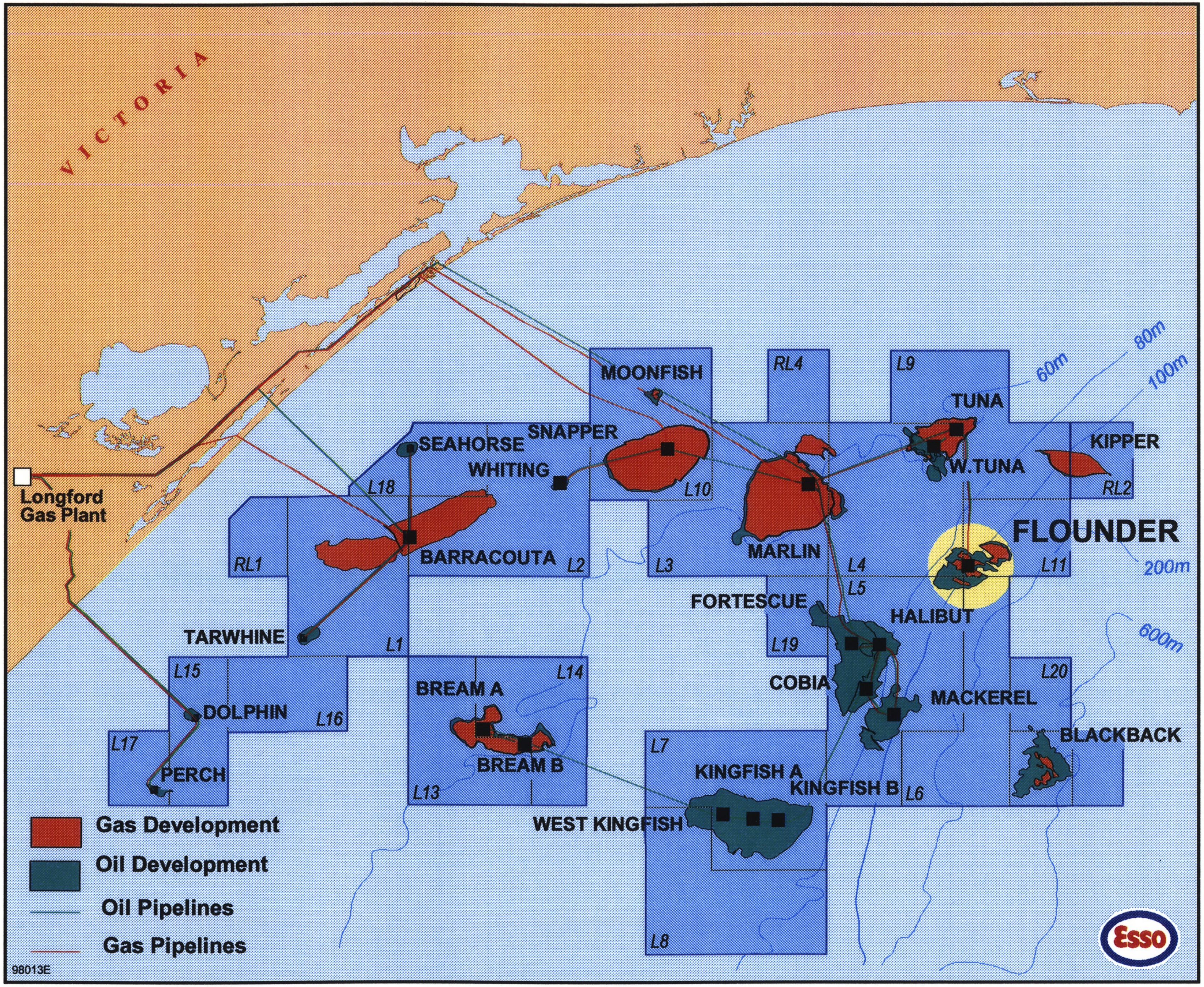
FIGURES


VICTORIA
Longford Gas Plant
MOONFISH
RL4
L9
TUNA
60m
80m
100m
SEAHORSE
SNAPPER
WHITING
KIPPER
L18
L10
W.TUNA
RL2
FLOUNDER
BARRACOUTA
MARLIN
RL1
L2
L3
L4
L11
200m
L5
FORTESCUE
HALIBUT
TARWHINE
L1
600m
L19
L15
L14
L20
BREAM A
COBIA
MACKEREL
DOLPHIN
L16
BLACKBACK
L17
L7
BREAM B
KINGFISH A
PERCH
KINGFISH B
L6
L13
WEST KINGFISH
Gas Development
Oil Development
Oil Pipelines
Gas Pipelines
L8
Esso
98013E

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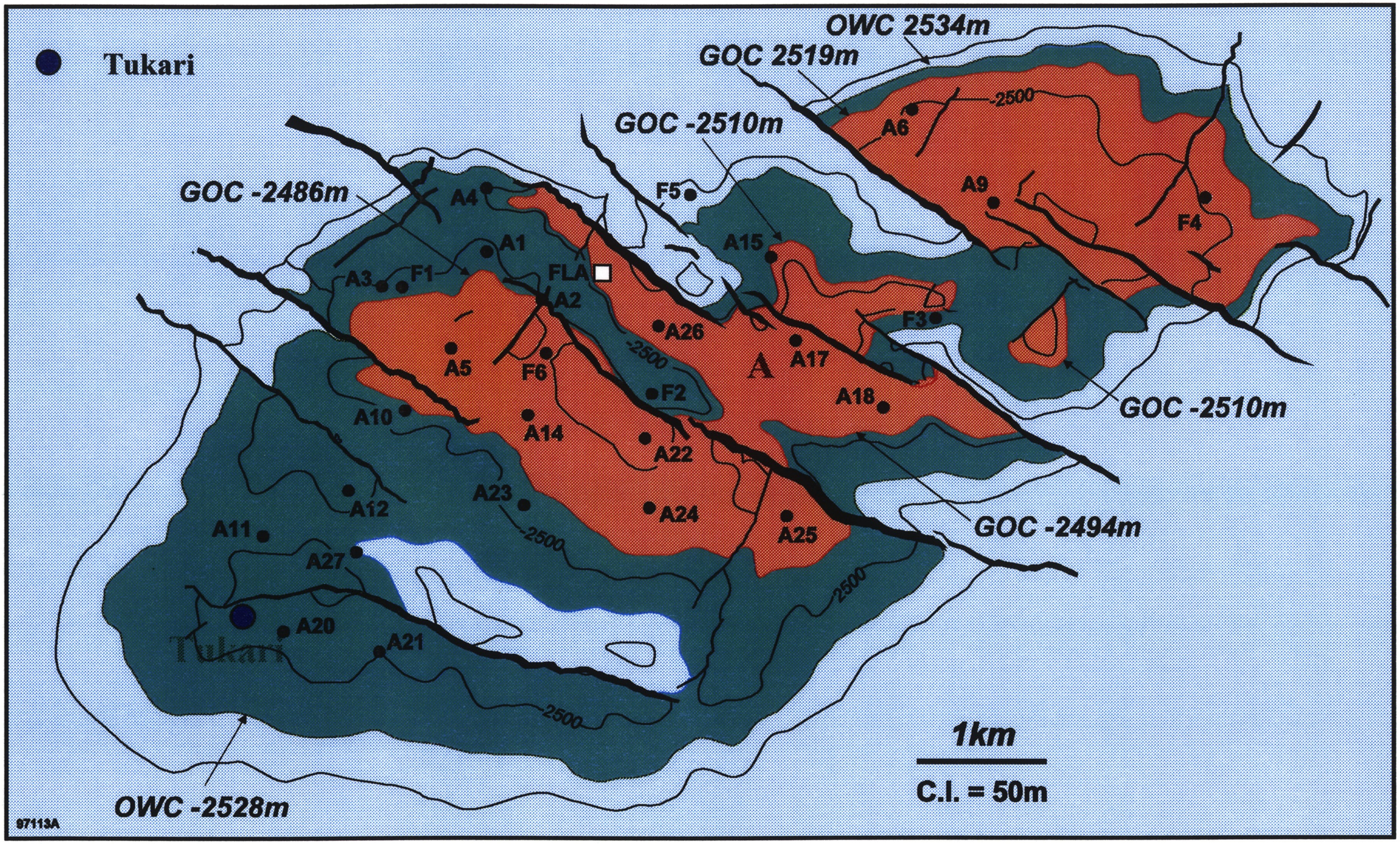
# TUKARI WELL LOCATION

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# APPENDICES

# Esso Australia Ltd

**Exploration Department**

## TUKARI 1

**Formation Evaluation**
**Log Analysis Report**

**Petrophysicist: Kevin Lanigan**
**August 1998**

Endorsed by: ..................................
FE Team Leader

Date: 31/08/98

# TUKARI 1 LOG ANALYSIS

The Tukari prospect was identified by a seismic amplitude anomaly and interpreted as a stratigraphic trap formed by an incisive event within the latter stages of the Tuna Flounder Channel system, sealed below by earlier Eocene mudstones and above by calcareous siltstones and mudstones of the lower Lakes Entrance Formation. **Tukari 1** was the second well drilled in the 1998 Flounder Drilling Programme and was drilled from Conductor 11 after the A-11 well was plugged and abandoned. Operations on **Tukari 1** commenced at 1400hrs on May 31 with the milling of 13 3/8" casing and emplacement of a cement kick-off plug. After kicking off through cement, the well spudded in new formation around 1020 metres (all depths MD unless specified otherwise) at about 0300 hours on June 4 and was drilled in 12.25" hole to a total depth (TD) of 4621 metres (reached at 1445 hours on June 19). As part of the directional drilling assembly a real-time MWD gamma ray was run by Halliburton from 1000 metres to TD, but failed intermittently below 4200 metres. At TD Schlumberger's Platform Express-AIT tool suite was initially attempted on wireline, but could not get below 1273 metres due to borehole friction in the high angle section of the well (68.5 degree inclination from vertical). The PEX-AIT combination was then run successfully on drill pipe and acquired open-hole data over the interval 4195-4608 metres.

The **Tukari 1** log data have been analysed for effective porosity and water saturation over the interval 4200 to 4600 metres using Esso's in-house SOLAR-based analysis model "K12" - which derives effective porosity from density and neutron log responses and saturation using the Dual Water model.

## DATA

### Openhole Logs Acquired

*Schlumberger Wireline data:*

1. Total Depth Logging Job

| | |
|---|---|
| PEX-NGT-AIT | 4195 to 4608m |

### Mud Data

| | |
|---|---|
| Mud Type | Petrofree |
| Mud Weight | 10.3 ppg |
| Maximum Recorded Temperature | 103 deg C |
| Time Since Circulation Stopped | 53hrs 45mins |

### Log Quality

The logs used in this interpretation were acquired in a single drillpipe-conveyed logging run. To minimize risk of damage from compression the assembly was not run to TD.

Also, there was no attempt to run a repeat section. The neutron tool was run with a bowspring (at Esso's request) and the AIT was run without standoffs at the bottom (the required non-metallic type were not available). Due to problems with the application of speed correction on previous PEX jobs, the speed correction algorithm was not applied (at Esso's request) when the data was acquired (and, thus, data used in this anaysis is NOT speed corrected).

The caliper log indicates the wellbore was slightly overgauge (usually < ½ inch) down to about 4350 metres (ie. most of the logged Lakes Entrance Formation), slightly (< ½ inch) undergauge 4401-4464 metres (lower "Gurnard equiv.-Tukari Siltstone") and substantially undergauge (mostly > ½ inch) below 4485 metres. Overall, log quality appears to be acceptable for the purposes of interpretation, however several minor intervals on the resistivity and density curves (refer PEX-AIT LQC log) exhibit questionable data (possibly due to tool standoff effects).

### Log Processing

Minor depth alignment was applied to each of the curves used in the analysis, with the high-resloution density (RHO8) used as the base curve.

## INTERPRETATION

### Logs Used (Attachment 1)

GR (standard resolution, calibrated)
RT (near identical to AHT90 – nominally 90" depth of investigation, 2' vertical resolution)
RHO8 (high resolution density)
HTNP (high resolution neutron porosity)

### Analysis Parameters

| | |
|---|---|
| a | 1.0 |
| m | 2.0 |
| n | 2.0 |
| Fluid density | 0.92 |
| Gamma Ray Clean and Shale | 30-130 API (GRMIN & GRMAX on Attachment 1) |
| Apparent Shale Resistivity | 2-5 ohmm (RSH on Attachment 1) |
| Apparent Shale Bulk Density | 2.50-2.55 g/cm3 (RHOBSH on Attachment 1) |
| Apparent Shale Neutron Porosity | 0.21-0.28 v/v (PHINSH on Attachment 1) |
| Input Hydrocarbon Density | 0.25 |
| Grain Density Limits | 2.645-2.680 g/cm3 |
| Formation Water Salinity | 30,000 ppm NaCl equiv. |
| Bottom Hole Temperature | 103 degC at 4608mMDRT |
| Seabed Temperature | 12 degC at 94.0m water depth |
| Log Datum = Rotary Table | 40.8m ASL |

**Shale Volume (VSH), Total Porosity (PHIT) and Total Water Saturation (SWT)**

Beginning with an initial value calculated from the GR, a final VSH was obtained by applying a calculated density-neutron shale value to an iterative process in the K12 program until the resulting calculated grain density fell within the preset window (2.645-2.680 g/cm3). Total porosity and total water saturation are also derived from the density-neutron data (and fluid density and apparent matrix density) during this iterative process.

**Effective Porosity(PHIE) and Effective Water Saturation (SWE)**

Effective porosity was calculated using the final VSH and PHIT values in the equation;

PHIE = PHIT – VSH*PHINSH

and the effective water saturation was then calculated using

SWE = 1 – PHIT/PHIE *(1-SWT)

Cut-offs applied in K12 were;

| | |
|---|---|
| Irreducible water saturation | 0.025 |
| VSH upper limit for effective porosity (when VSH above this PHIE set to 0.0) | 0.65 |
| Minimum effective porosity for hydrocarbons | 0.03 |

## DISCUSSION

The target section for which **Tukari 1** was drilled was the interval between the Lakes Entrance Formation and the Tuna Flounder Channel (TFC) sediments; which corresponds to the "Gurnard equivalent–Tukari Siltstone" section (4377.5-4459.0 metres) in this report. Despite yielding the highest levels of gas throughout the well (up to 29.3 units over a background of 2-7 units) this interval is not considered prospective. Only minor indications of sandstone were observed in cuttings from this siltstone-dominated interval from 4400 to 4420 metres (mostly from the "Gurnard equivalent" section).

The wireline log data also provides no indication of reservoir within this interval, with gamma, density and neutron curves suggesting only silstone and claystone lithologies. Some differentiation of the "Tukari Siltstone" section from adjacent strata is provided by the spectral gamma ray data (Attachment 2) in which the Uranium count is relatively high, ranging consistently 2-3 times higher than both the underlying TFC and overlying "Gurnard equivalent" sections. The density data also indicates the "Tukari Siltstone" to be significantly different in that the measured bulk density is substantially lower (mean of 2.37, minimum 2.15) than the adjacent strata. While the cause of this lower density has not been definitively established (main possibilities include higher gas content and/or undercompaction) it appears likely that this is the major contributor to the "seismic anomaly" upon which the Tukari prospect was based. To assist with tying the wireline log data back to the seismic data a pseudo sonic was generated from density-neutron crossplot porosity as per the procedure outlined in Appendix 1.

The K12 log analysis indicates that the only significant intervals of effective porosity were contained in sands between 4504.5-4529 metres (average 20%) and 4583-4587.5 metres (average 14%) (Attachment 3, note; minor spikes elsewhere have been edited out). These reported net porous intervals of 17.6 metres and 1.4 metres, respectively, and mean effective water saturations of 96% and 71%. The Bulk Volume Plot (Attachment 4) shows a minor amount of gas in both these zones and none throughout the remainder of the logged interval.

**Attachments**

- Attachment 1 – Input curves for K12 analysis
- Attachment 2 – Spectral Gamma Ray Plot
- Attachment 3 – VSH, PHIE and SWE from K12
- Attachment 4 – Bulk Volume Plot
- Appendix 1 – Generation of Pseudo Sonic

### Appendix 1 Generation of Pseudo Sonic

The Tukari prospect is identified by a seismic amplitude anomaly immediately underlying the Lakes Entrance Formation on the southern flank of the Flounder field. Seismic modelling indicated that this anomaly is due to low impedance strata, bounded above by the Top of Latrobe (TOL) and below by the Tukari_SB seismic surfaces. This low impedance interval was thought to be most likely produced by either a 25% porosity sand saturated with gas or high GOR oil, or a shaly unit with little or no gas. The drilling of Tukari 1 demonstrated the latter to be the case and, although a sonic log was required to definitively tie the modelled seismic response to the penetrated section, it was not run because of operational and economic considerations.

The lack of real sonic data prompted consideration of how best to generate a "pseudo sonic" curve from the other log data acquired in Tukari 1. As a starting point work done by Mike Gilbert (Memo 29/3/96) was used, which derived "pseudo sonics" from both neutron-density crossplot porosity (PHIX) and "true" resistivity (RT) data from Flounder 6. Gilbert's approach was to crossplot the sonic data against PHIX (for that interval of the well where neutron and density data was available, typically from just above TOL) and against RT where neutron and/or density data was absent. The Sonic-PHIX and Sonic-RT crossplots then had regression curves (straight lines) fitted to them, thereby defining linear "best fit" equations which were then used to produce "pseudo sonics" in other wells.

Of the four equations produced by Gilbert two were used to create "pseudo sonics" for Tukari 1;

| | | |
|---|---|---|
| Lower Lakes Entrance Fm. | DT.PSD = -185.0*log(RT) + 367.2 | ...(1) |
| Upper Flounder Fm. shale | DT.PSD = 607.4*(PHIX) + 152.0 | ...(2) |

The interval logged in Tukari 1 (4190-4605mMD) has resistivity, density and neutron data over its entirety; spanning the lower Lakes Entrance Formation (down to 4377.5m), a "Gurnard equivalent" section (4377.5-4414.0m), the "Tukari Siltstone" (4414.0-4459.0m) and an upper Tuna Flounder Channel section (4459.0m-4608.6m(TD)).

One version of a "pseudo sonic" (**DT.PSD3**) was obtained by applying equation 2 to the neutron-density data over the entire logged interval in Tukari 1, while another (**DT.PSD2**) used equation 1 for the Lakes Entrance section and equation 2 for everything below that. The resulting "pseudo sonics"are thus identical below 4378.0m, but differ by 60-80 μs/m throughout the Lakes Entrance Fm section, indicating that in Tukari 1 the algorithm based on resistivity is not a good substitute for that derived from density-neutron data.

In the post-drill analysis of Tukari 1 the primary question pertains to understanding how the "Gurnard equivalent" and "Tukari Siltstone" sections produced the seismic anomaly which defines the Tukari feature. Equivalents to these strata do not occur in Flounder 6 (from which Gilbert's equations were derived) so a new model was sought, which would more specifically relate to the strata penetrated in Tukari 1.

The "Gurnard equivalent" and "Tukari Siltstone" sections in Tukari 1 are uncommon in the Flounder region, ie. the Tukari feature had not been penetrated before and there does not seem to be drilled intersections of closely comparable sediments in other wells in the basin (at least none with substantial log data over them). This notwithstanding an attempt was made to find the best analogues to these sections in other wells which did have sonic logs, so that a "pseudo sonic" catering for this strata could be incorporated into the post-drill modelling work being done to explain the seismic response of the Tukari feature.

Several wells in the region were considered for potentially analagous sections, mostly around Flounder, including exploration wells Wrasse 1 and Teraglin 1, and also including selected wells from Blackback, Halibut and Kingfish fields. The main criteria used in selecting analagous sections were similarity of density, neutron and gamma ray log response and basic lithological descriptions.

The analagous section chosen for the lower Lakes Entrance Formation was the interval 1850-1955mMD in Flounder A2, excluding a small slower-velocity section around 1863-6m (Figure A1) which was edited out prior to determining the "best fit" straight line regression relationship (Figure A2);

Lower Lakes Entrance Fm. DT.PSD = 589.6296*(PHIX) + 190.3017 ...(3)

Figure A3 summarizes the analagous interval, showing the density (RHOB) and neutron (NPHI) curves, the calculated PHIX curve, the calculated "psuedo sonic" (DT.PSD) and the measured sonic (DT).

The analagous section chosen for the "Gurnard equivalent" section was the interval 2950-3000mMD in Blackback 1 from which the "best fit" straight line regression relationship was obtained (Figures A4 & A5);

"Gurnard equivalent" DT.PSD = 698.9456*(PHIX) + 149.7224 ...(4)

The analagous section chosen for the "Tukari Siltstone" section was the interval 2900-2950mMD in Blackback 1 from which the "best fit" straight line regression relationship was obtained (Figure A6 & A5);

"Tukari Siltstone" DT.PSD = 661.5465*(PHIX) + 146.0798 ...(5)

The analagous section chosen for the upper Tuna Flounder Channel section was the interval 1950-2230mMD in Flounder 5, excluding a few spikes (Figure A7) which were edited out prior to determining the "best fit" straight line regression (Figures A8 & A9);

upper Tuna Flounder Channel DT.PSD = 619.3809*(PHIX) + 157.8418 ...(6)

Equations 3-6 were then applied to the respective intervals of the PHIX curve from Tukari 1 to produce a third "pseudo sonic" curve (**DT.PSD**) based on the analogues outlined above.

For completeness all three "pseudo sonics" are presented with the other pertinent curves from Tukari 1 on Figure A10. However, the **DT.PSD** model is preferred over the other two due to it being more specifically tailored to the Tukari 1 well via the matching of density-neutron data with the selected analogue sections.

lower Lakes Entrance Fm

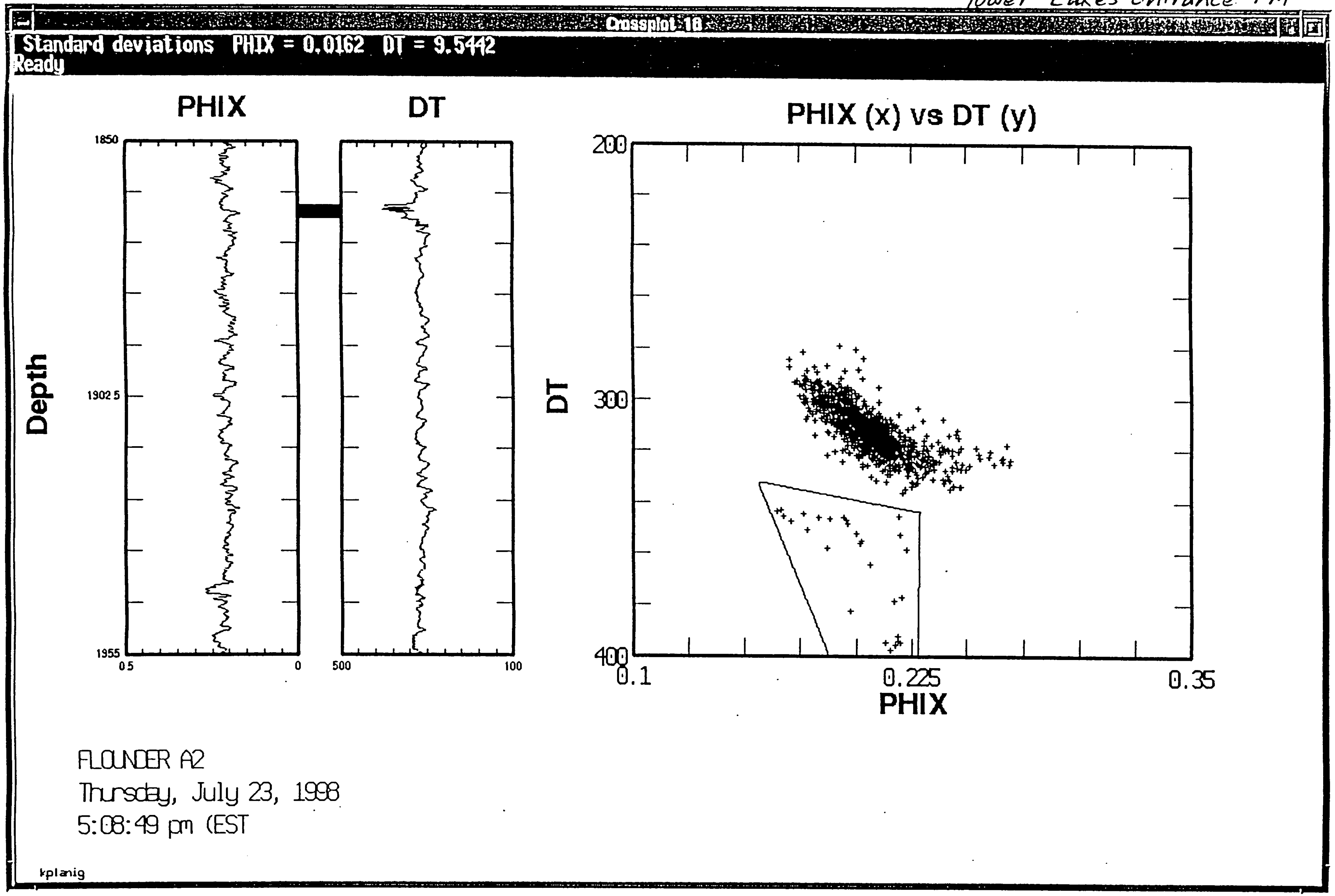



FIGURE A1a

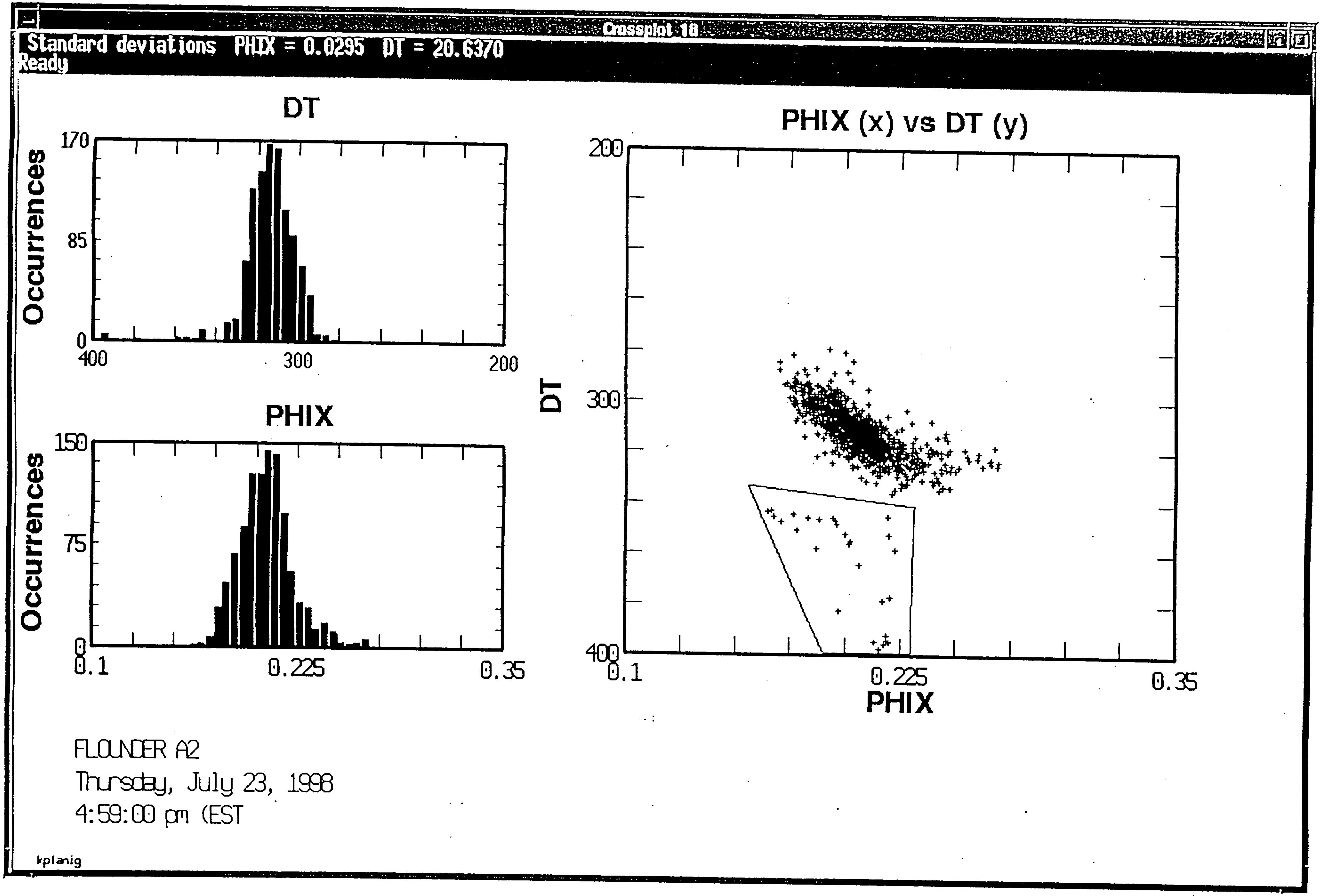

Crossplot 18
Standard deviations PHIX = 0.0295 DT = 20.6370
Ready
DT
Occurrences
170
85
0
400
300
200
PHIX
Occurrences
150
75
0
0.1
0.225
0.35
PHIX (x) vs DT (y)
DT
200
300
400
0.1
0.225
0.35
PHIX
FLOUNDER A2
Thursday, July 23, 1998
4:59:00 pm (EST
kplanig

FIGURE A16

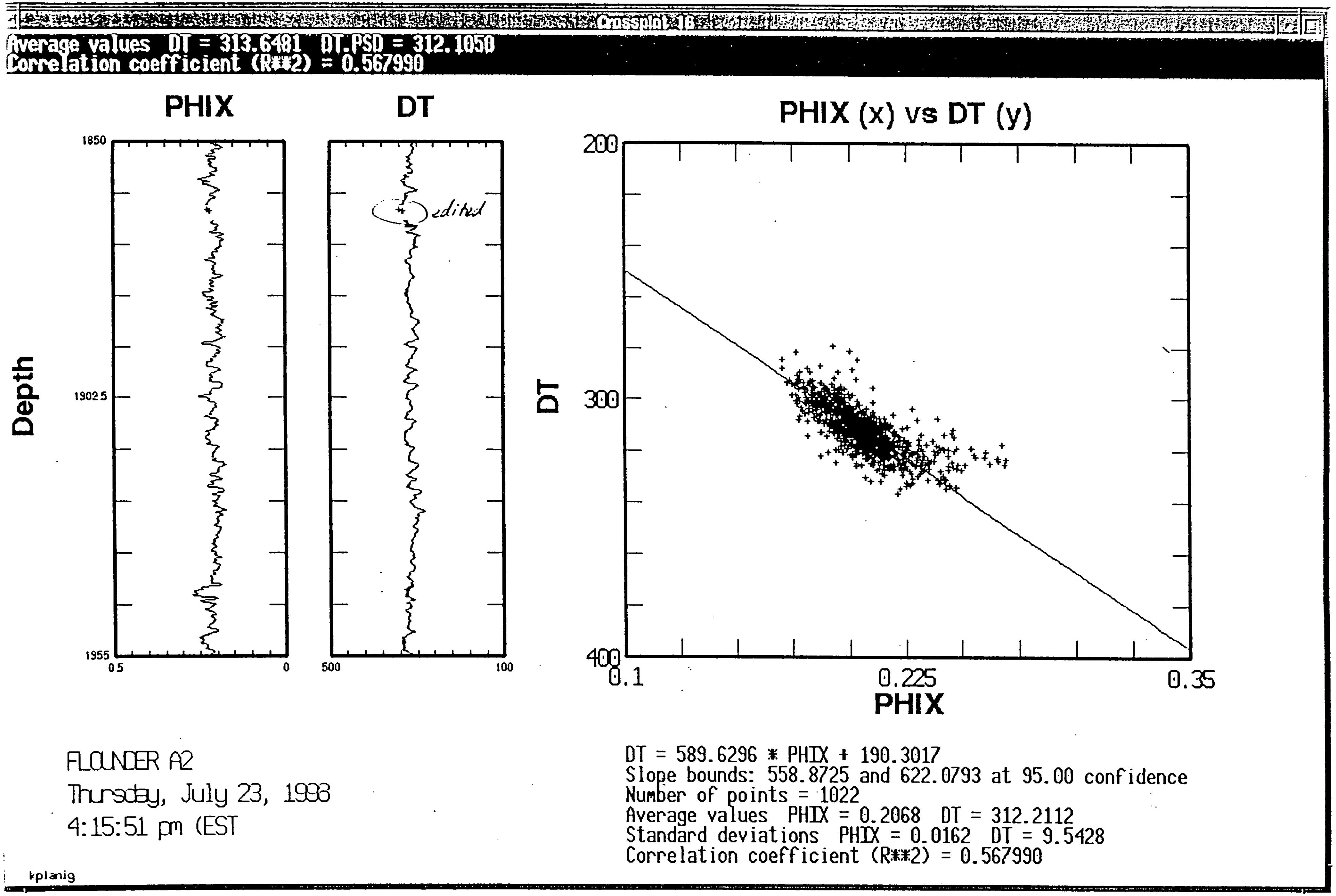
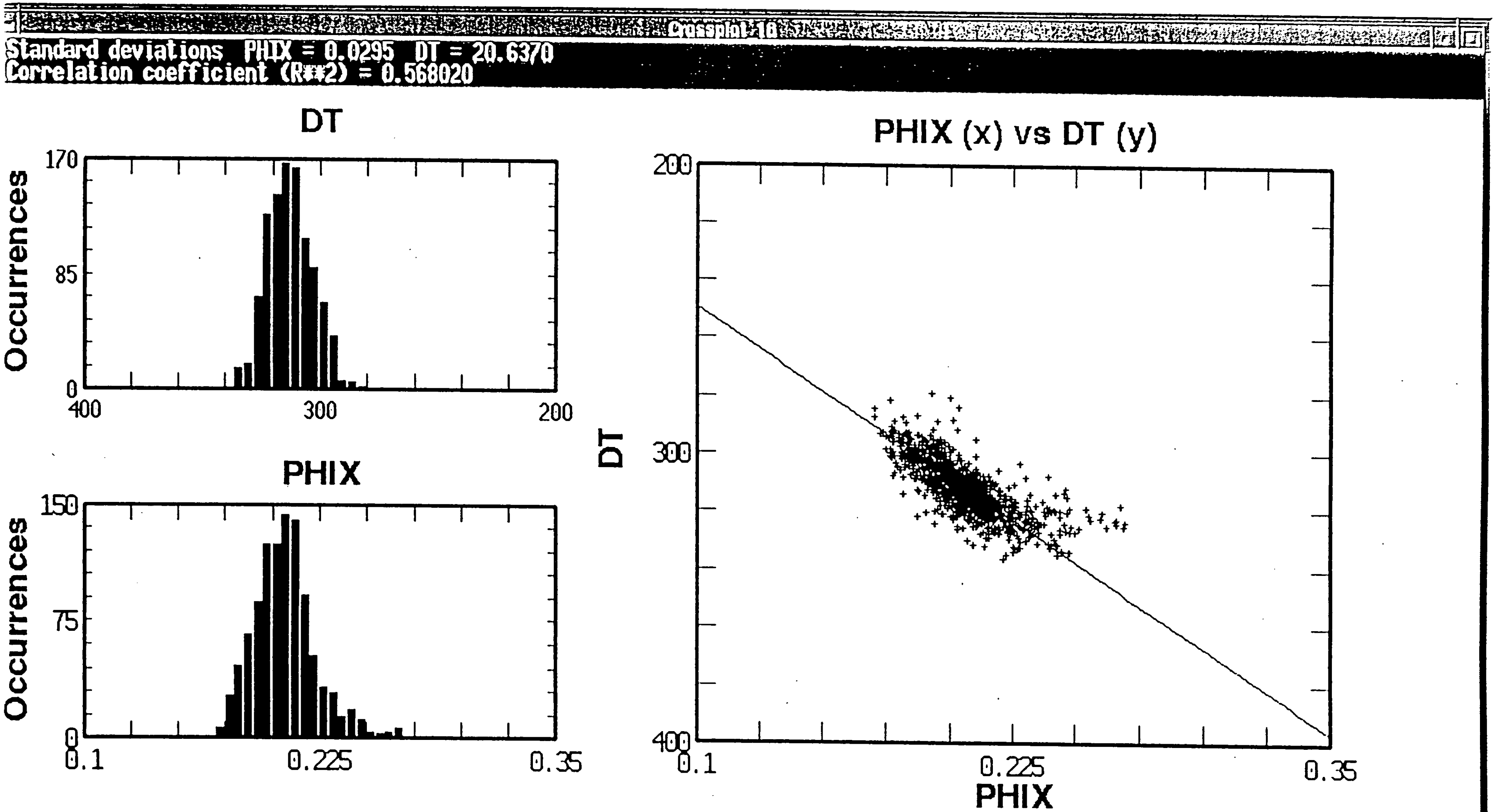

Crossplot 16
Average values DT = 313.6481 DT.PSD = 312.1050
Correlation coefficient (R**2) = 0.567990
PHIX
DT
Depth
1850
1902.5
1955
0.5
0
500
100
edited
PHIX (x) vs DT (y)
DT
200
300
400
0.1
0.225
0.35
PHIX
FLOUNDER A2
Thursday, July 23, 1998
4:15:51 pm (EST
kplanig
DT = 589.6296 * PHIX + 190.3017
Slope bounds: 558.8725 and 622.0793 at 95.00 confidence
Number of points = 1022
Average values PHIX = 0.2068 DT = 312.2112
Standard deviations PHIX = 0.0162 DT = 9.5428
Correlation coefficient (R**2) = 0.567990

FIGURE A2a




FLOUNDER A2
Thursday, July 23, 1998
5:02:48 pm (EST

kplanig

DT = 589.7145 * PHIX + 190.3007
Slope bounds: 558.9548 and 622.1669 at 95.00 confidence
Number of points = 1022 (1 off scale points were omitted)
Average values PHIX = 0.2068 DT = 312.2278
Standard deviations PHIX = 0.0162 DT = 9.5442
Correlation coefficient (R**2) = 0.568020

FIGURE A26

915467 024

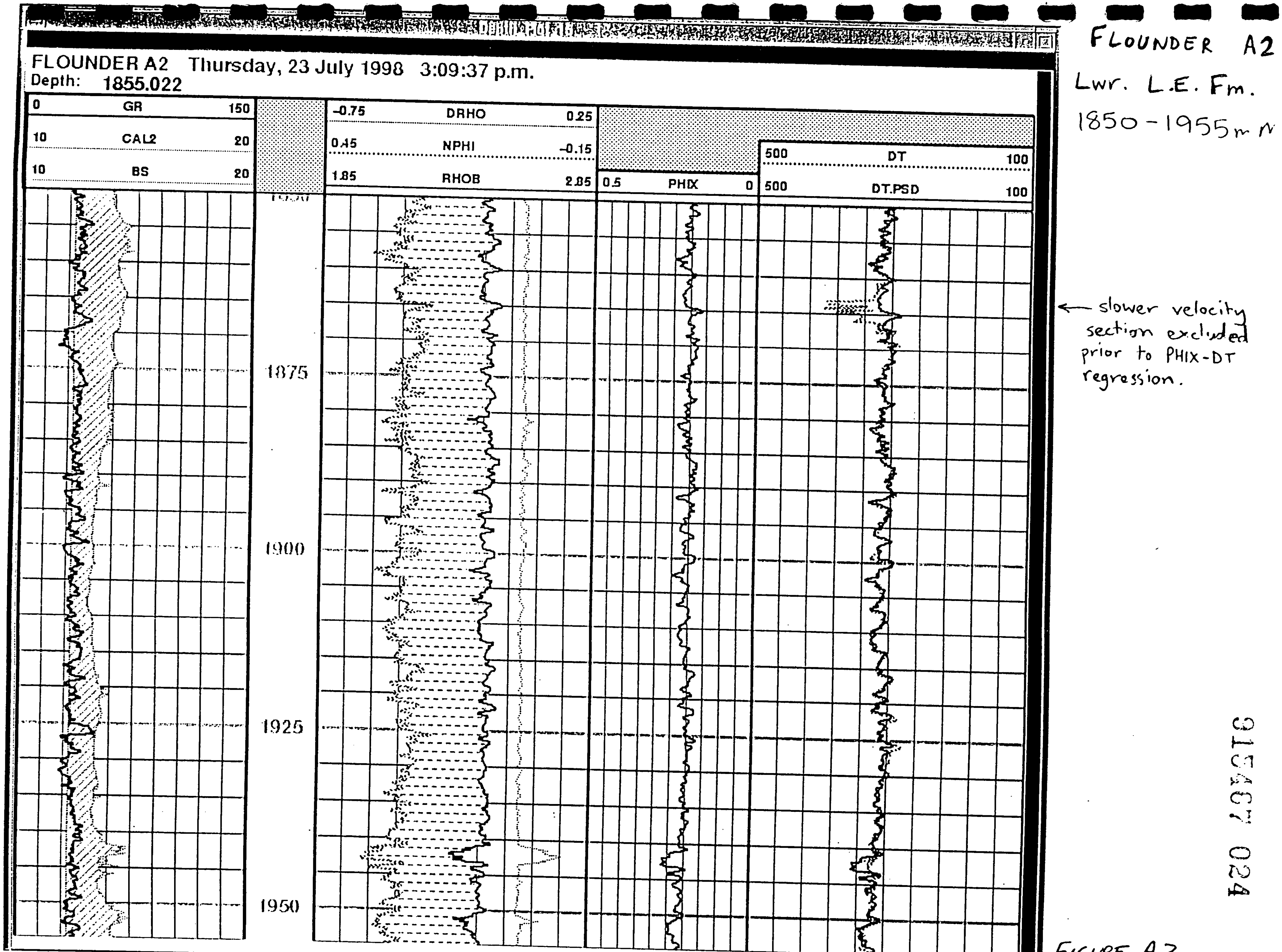
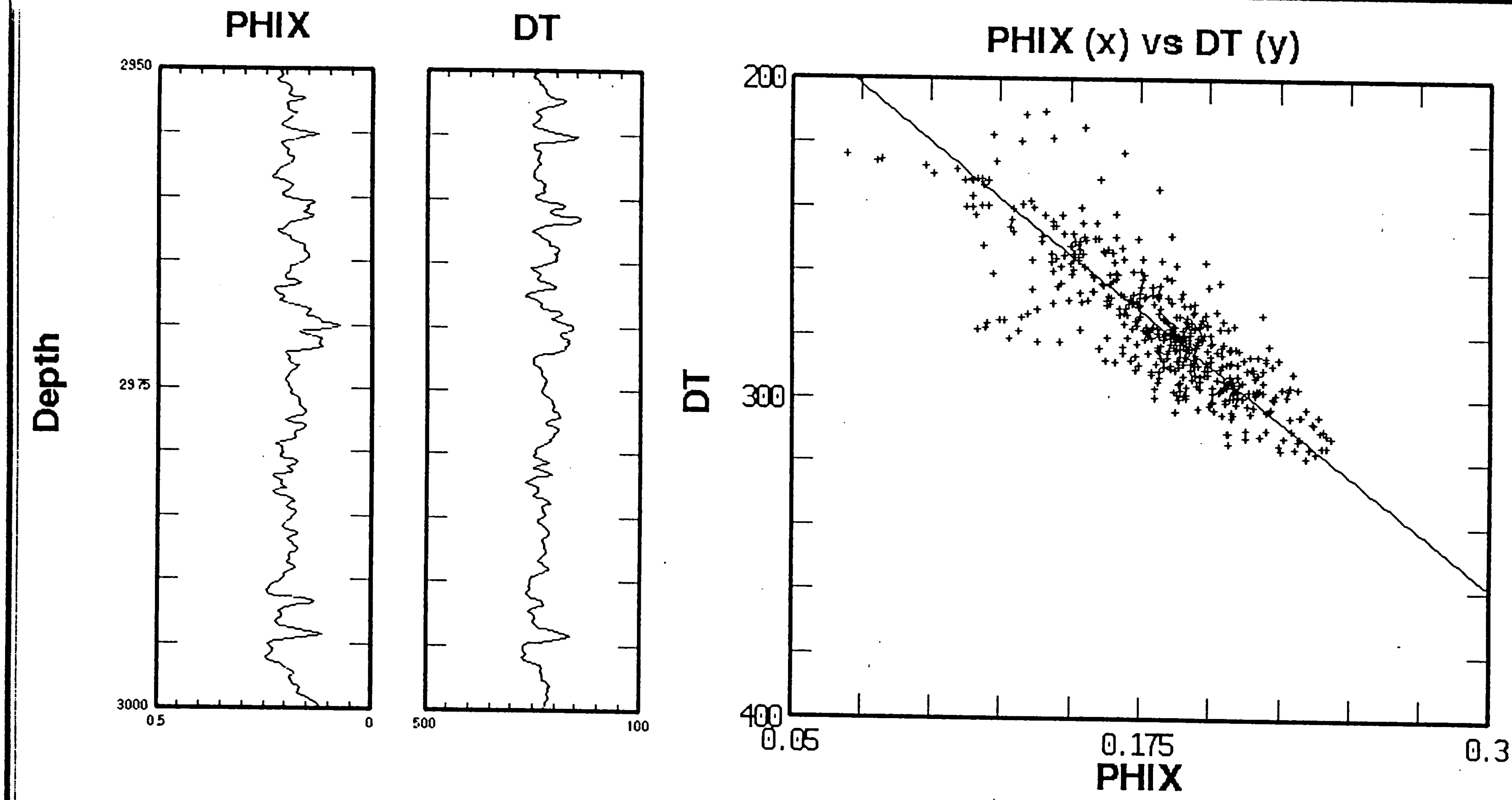



FIGURE A3

"Gurnard Equiv."

Correlation coefficient (R**2) = 0.683869




BLACKBACK 1
Thursday, July 23, 1998
5:12:49 pm (EST

DT = 698.9456 * PHIX + 149.7224
Slope bounds: 657.8469 and 742.6120 at 95.00 confidence
Number of points = 501
Average values PHIX = 0.1833 DT = 277.8687
Standard deviations PHIX = 0.0295 DT = 20.6370
Correlation coefficient (R**2) = 0.683869

kplanig

FIGURE A4a

913467 025

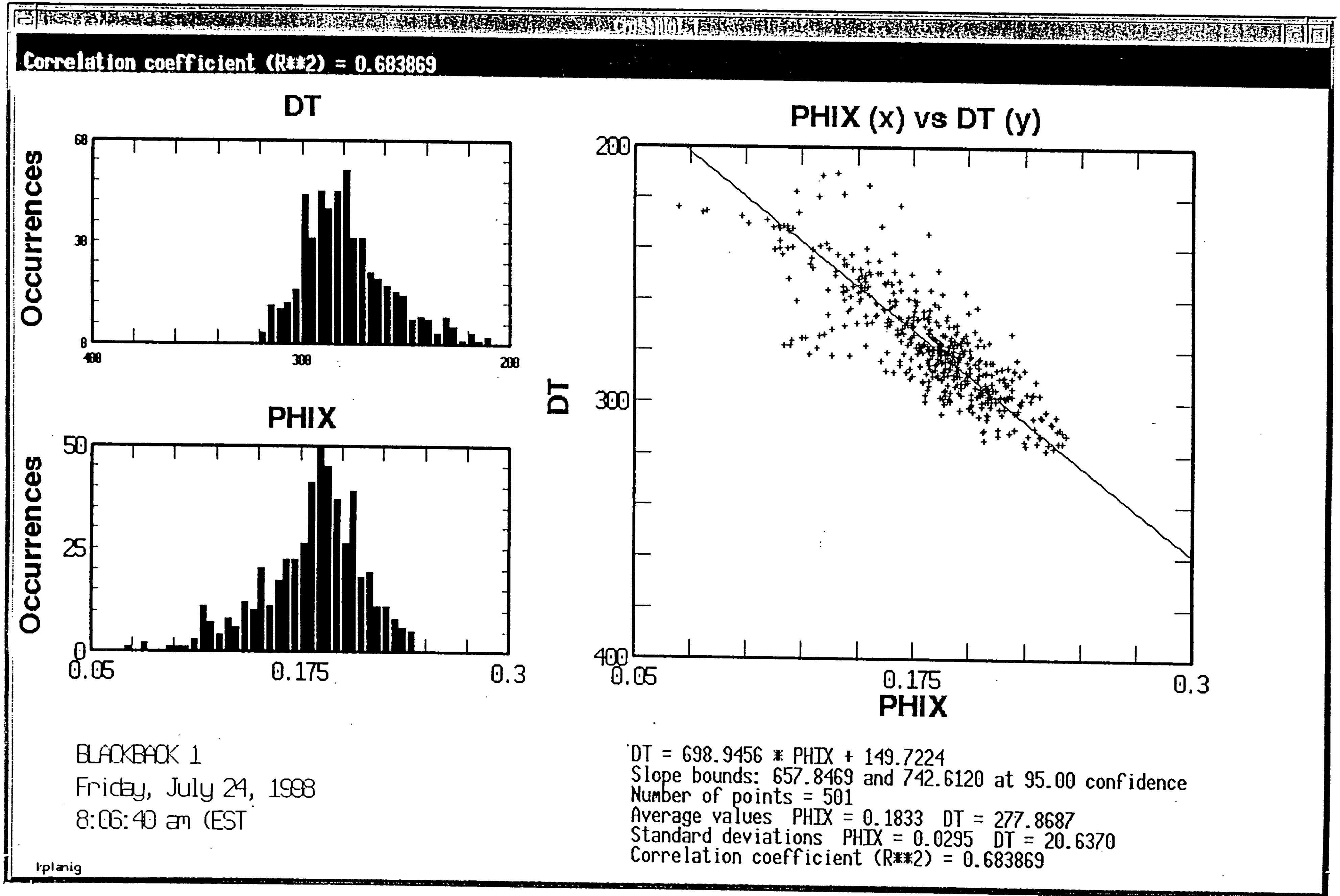
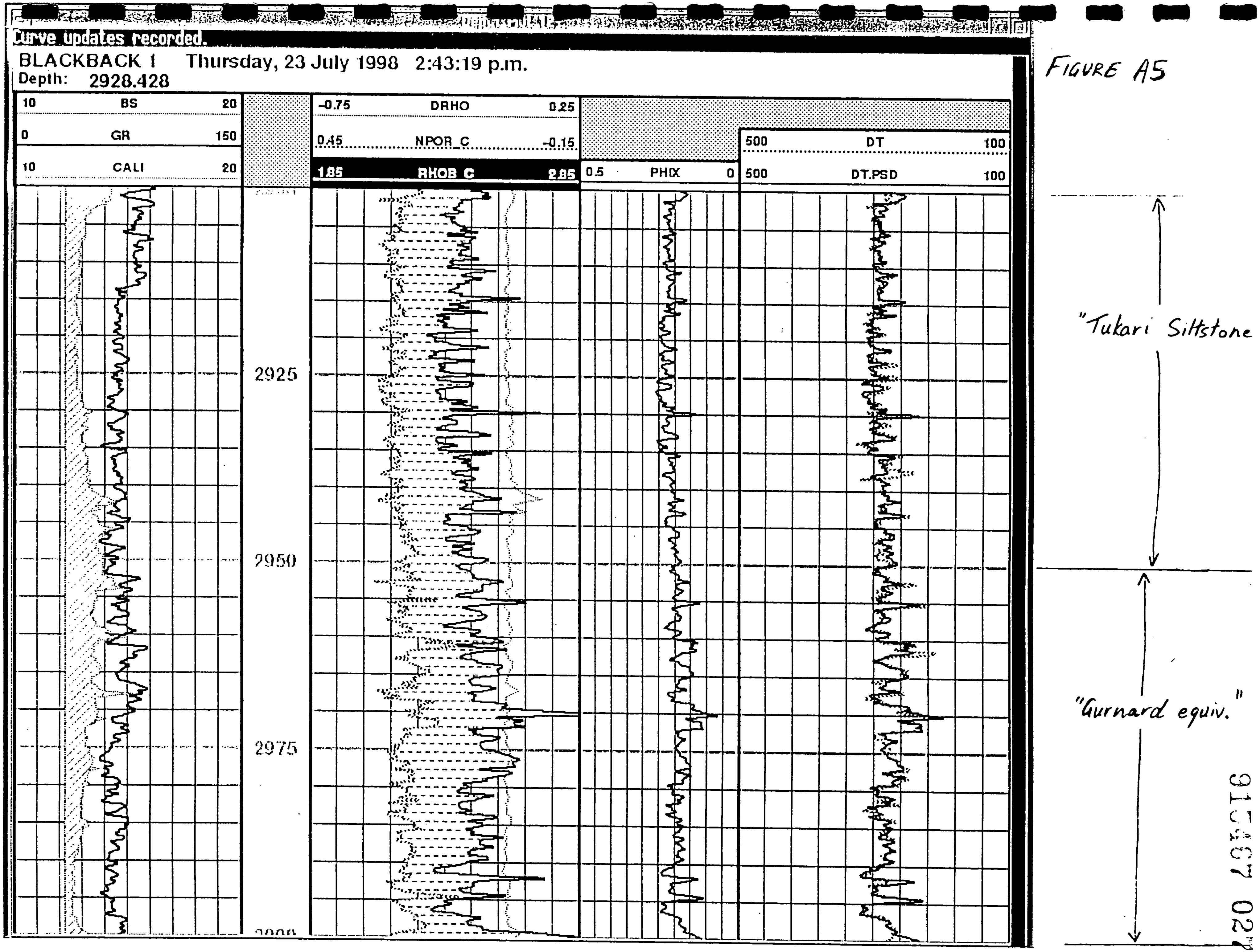



FIGURE A46

915467 026

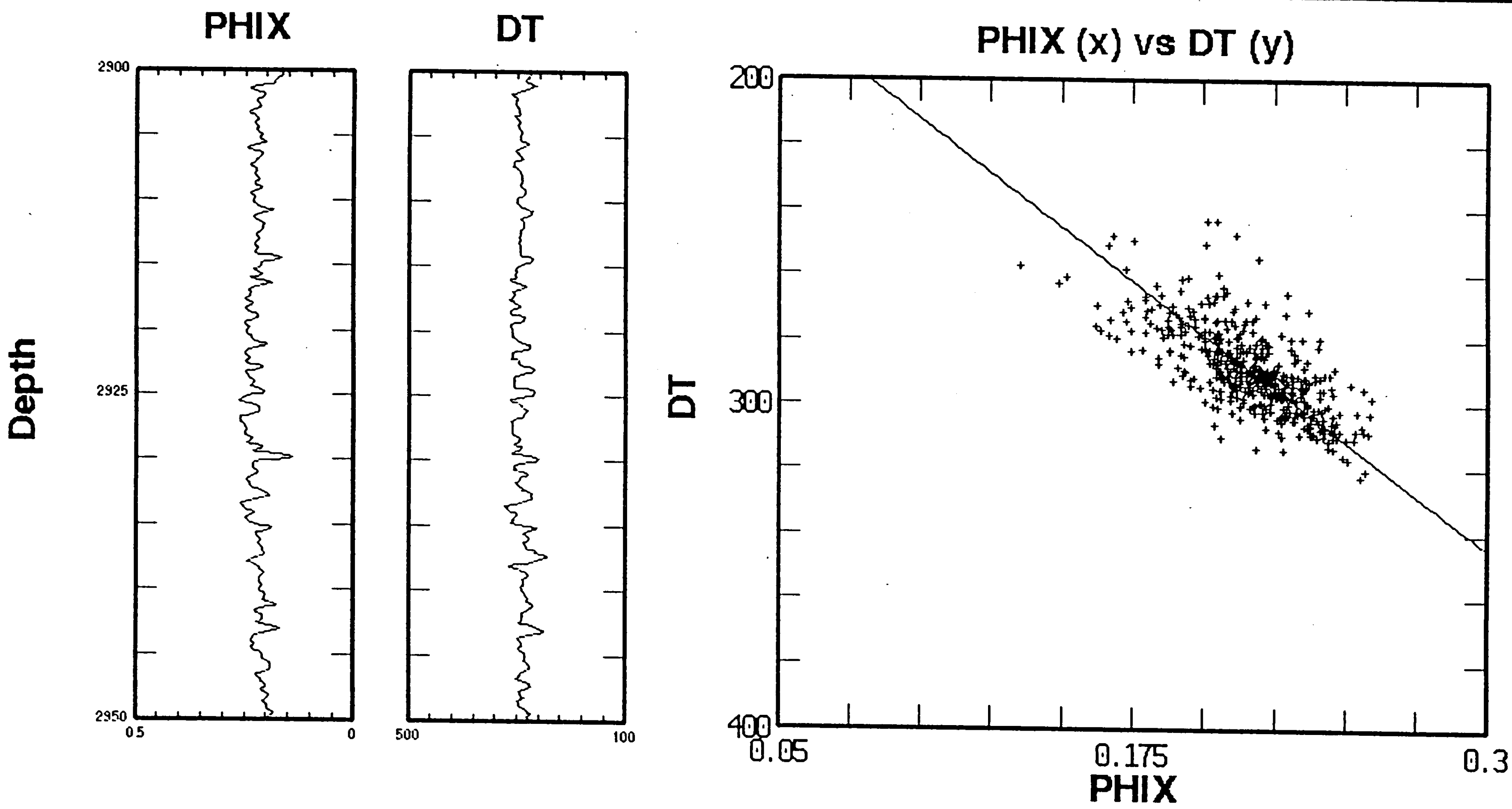
FIGURE A5



Curve updates recorded.
BLACKBACK 1 Thursday, 23 July 1998 2:43:19 p.m.
Depth: 2928.428
10 BS 20
0 GR 150
10 CALI 20
-0.75 DRHO 0.25
0.45 NPOR_C -0.15
1.85 RHOB_C 2.85
0.5 PHIX 0
500 DT 100
500 DT.PSD 100
2925
2950
2975
"Tukari Siltstone"
"Gurnard equiv."

"Tukari Stst Equiv."

Correlation coefficient (R**2) = 0.504349




BLACKBACK 1
Thursday, July 23, 1998
5:20:32 pm (EST

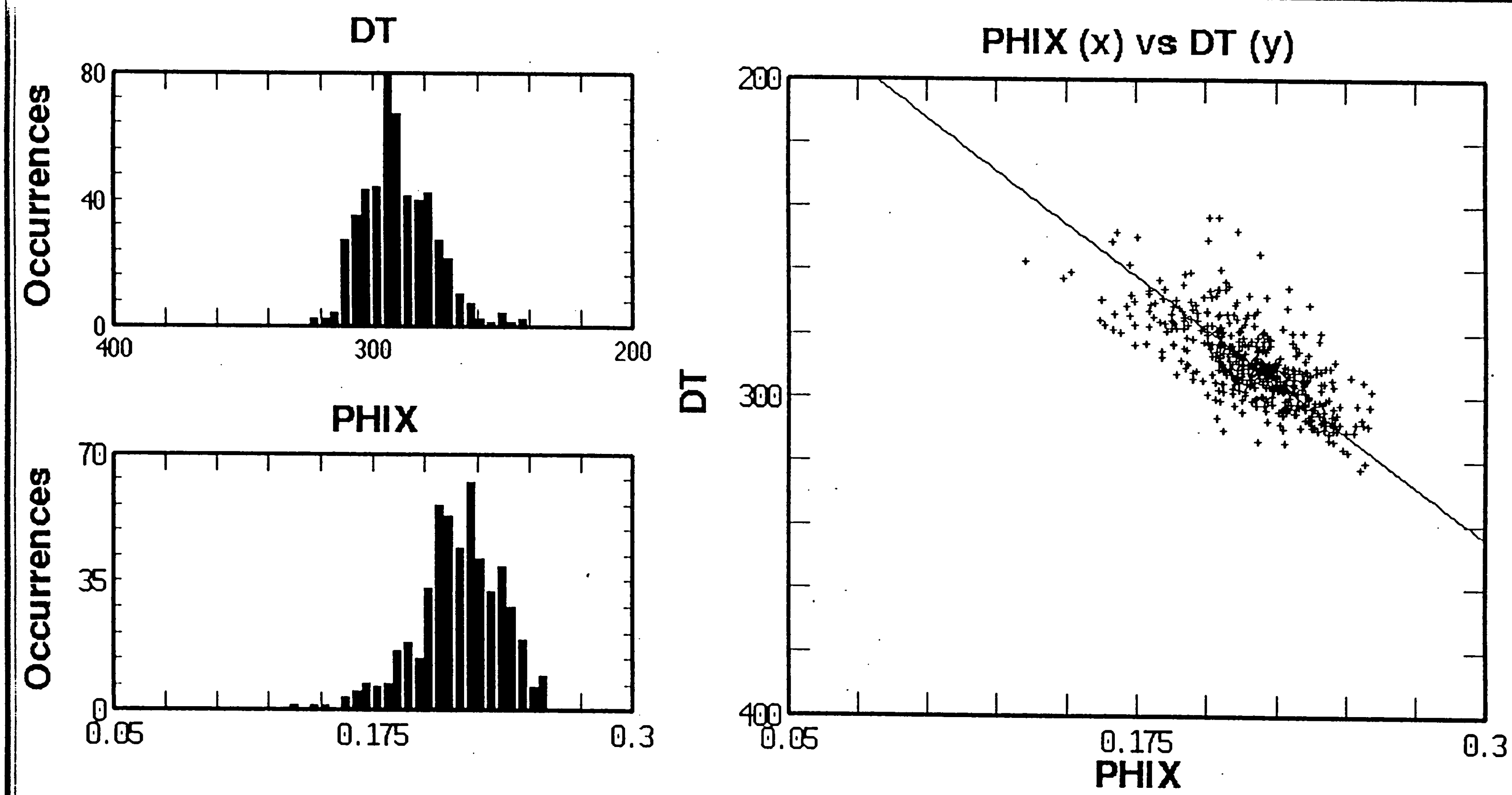
DT = 661.5465 * PHIX + 146.0798
Slope bounds: 605.5266 and 722.7490 at 95.00 confidence
Number of points = 501
Average values PHIX = 0.2172 DT = 289.7548
Standard deviations PHIX = 0.0198 DT = 13.1200
Correlation coefficient (R**2) = 0.504349

kplanig

FIGURE A6a

915467 028

915467 029




BLACKBACK 1
Thursday, July 23, 1998
5:23:41 pm (EST

DT = 661.5465 * PHIX + 146.0798
Slope bounds: 605.5266 and 722.7490 at 95.00 confidence
Number of points = 501
Average values PHIX = 0.2172 DT = 289.7548
Standard deviations PHIX = 0.0198 DT = 13.1200
Correlation coefficient (R**2) = 0.504349

kplanig

FIGURE A6b

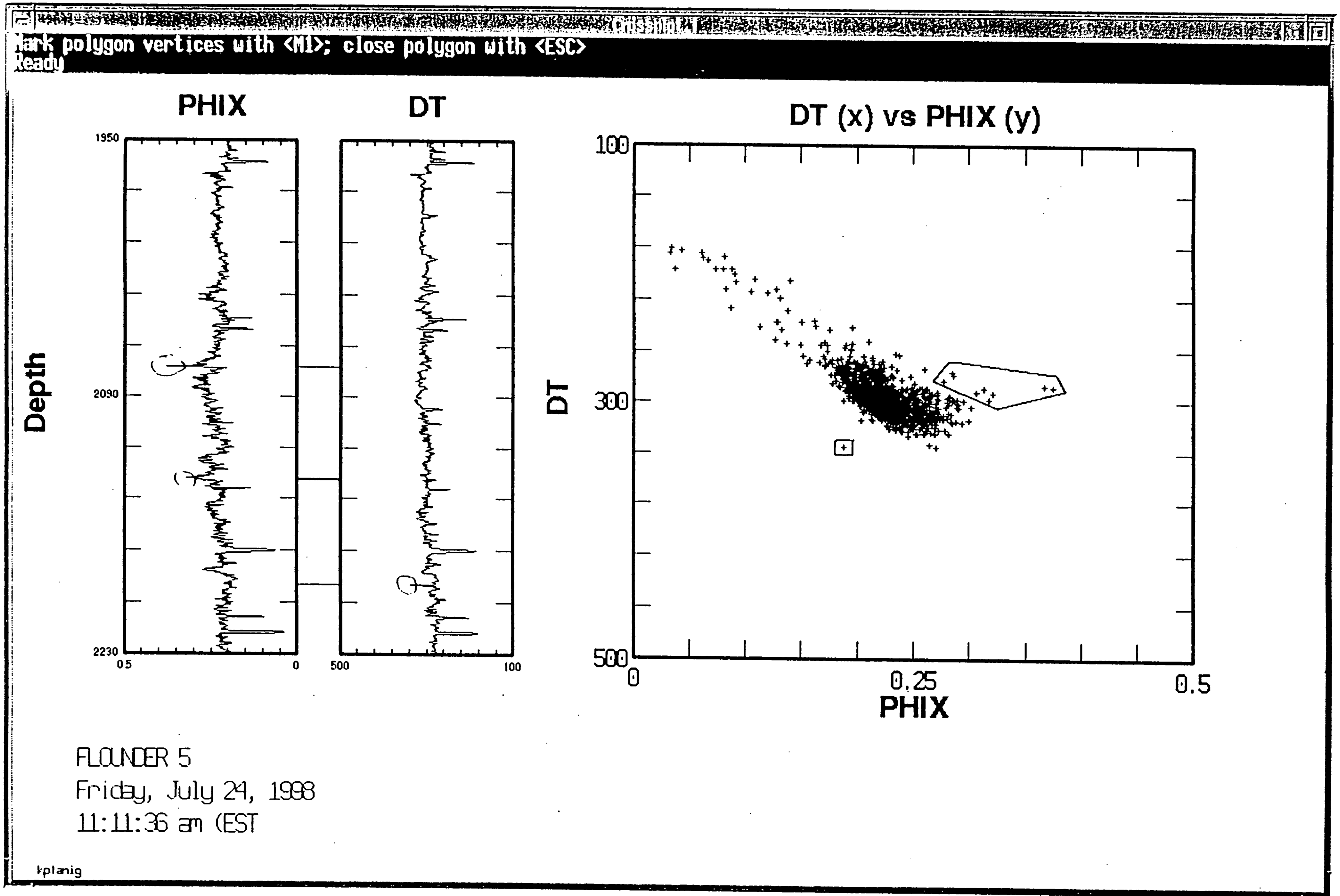
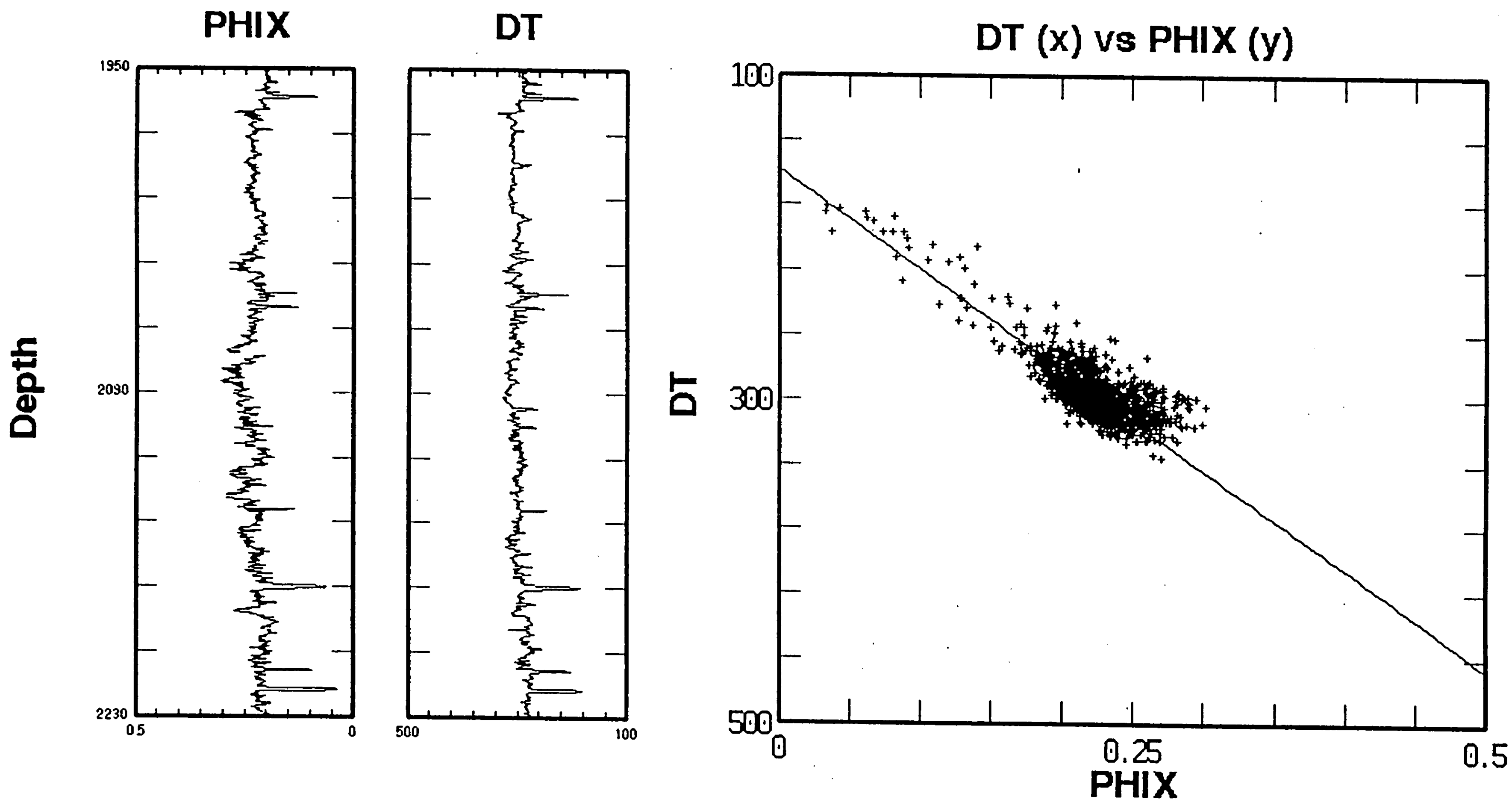



FIGURE A7

915467 030

Mark polygon vertices with <M1>; close polygon with <ESC>
Correlation coefficient (R**2) = 0.622097




FLOUNDER 5
Friday, July 24, 1998
11:14:30 am (EST

DT = 619.3809 * PHIX + 157.8418
Slope bounds: 594.4928 and 645.3110 at 95.00 confidence
Number of points = 1391
Average values PHIX = 0.2223 DT = 295.5453
Standard deviations PHIX = 0.0300 DT = 18.5580
Correlation coefficient (R**2) = 0.622097

Iplanig

FIGURE A8a

915467 C31

915467 032

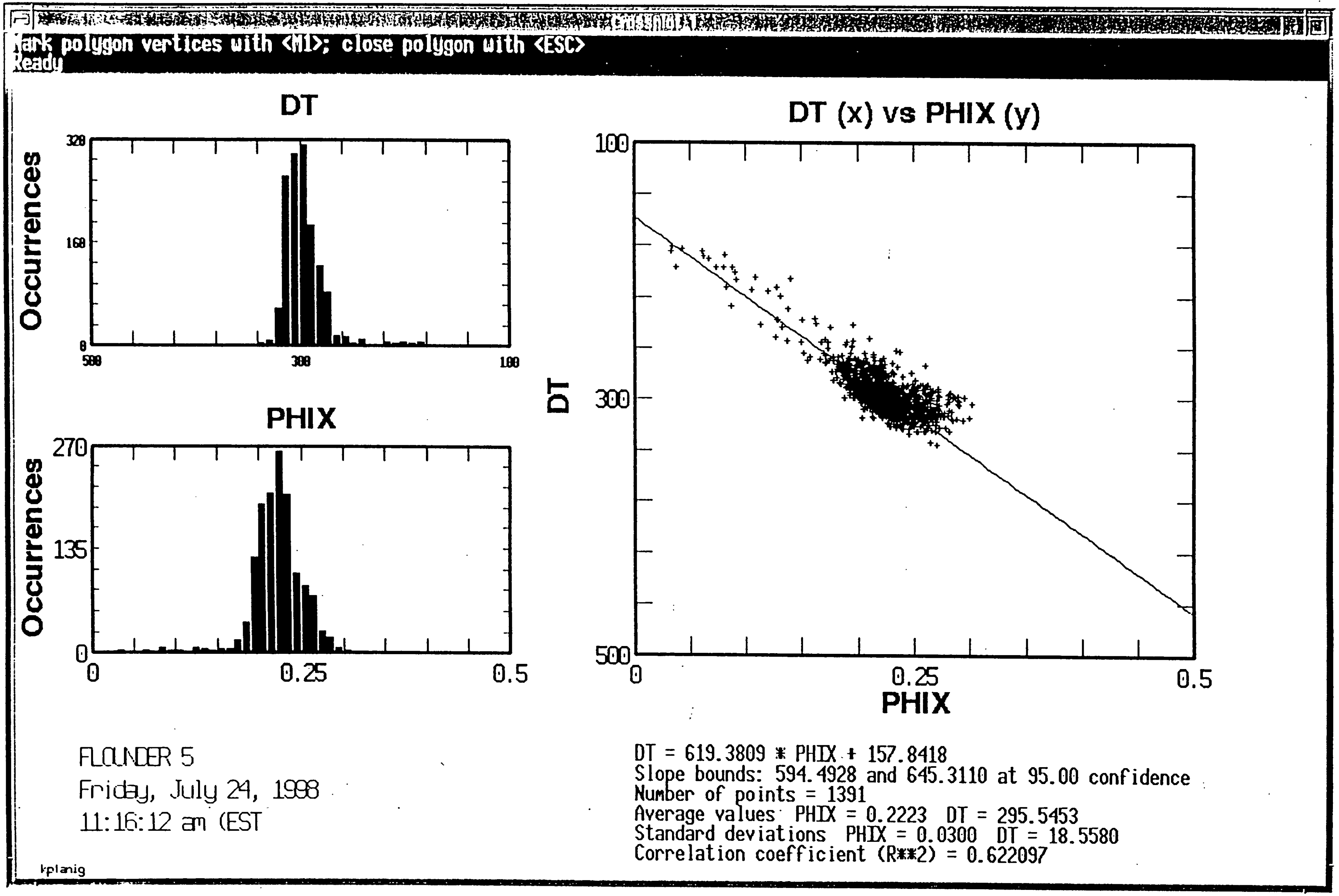



FIGURE A86

This is Page Number **915467_033X**

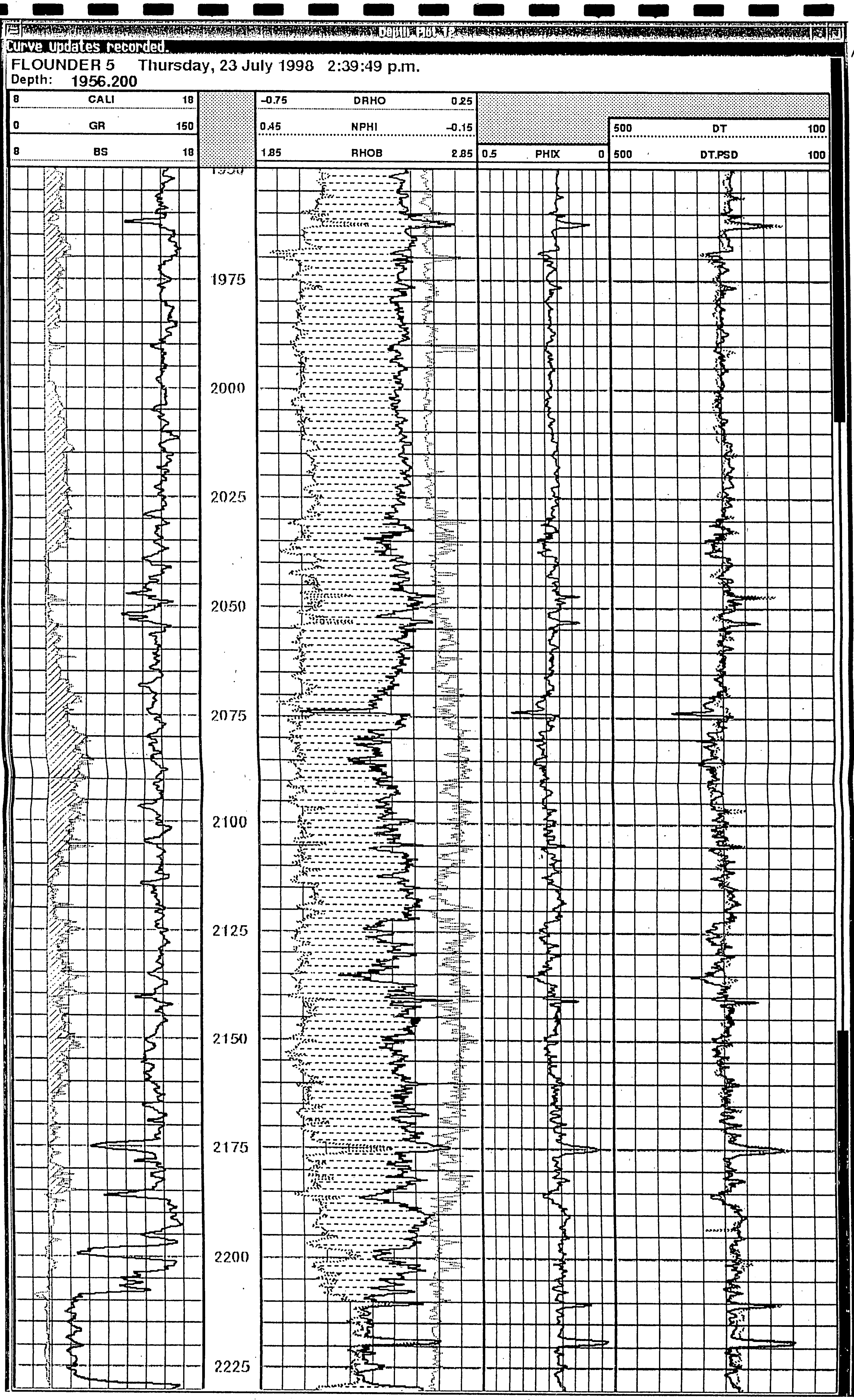
This is an enclosure indicator page.

The page that follows this page is an uncatalogued fold-out with page number:

**915467_033Y**

and is enclosed within the document PE915467 at this page.

FIGURE A9




915467_337

# TUKARI 1

Figure A10

Pseudo Sonic Depth Plot
4200-4600m MD

915467 035

PE614135

This is an enclosure indicator page.
The enclosure PE614135 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614135 has the following characteristics:

ITEM_BARCODE = PE614135
CONTAINER_BARCODE = PE915467
NAME = Tukari-1 Pseudo Sonic Depth Plot. 1:200
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = WELL_LOG
DESCRIPTION = Tukari-1 Pseudo Sonic Depth Plot. 1:200. 4200-4600 m MD. Figure A10 Esso Australia Ltd. A.J. Purdy. September 1998
REMARKS =
DATE_WRITTEN = 11-SEP-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Tukari-1
CONTRACTOR = Solar
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH = 2429.3
BOTTOM_DEPTH = 2449.6
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 036

ENCLOSURE 1

PE915468

This is an enclosure indicator page.
The enclosure PE915468 is enclosed within the container PE915467 at this location in this document.

The enclosure PE915468 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE915468 |
| CONTAINER_BARCODE = | PE915467 |
| NAME = | Flounder Field Top of Latrobe Depth Map |
| BASIN = | GIPPSLAND |
| ONSHORE? = | N |
| DATA_TYPE = | SEISMIC |
| DATA_SUB_TYPE = | HRZN_CONTR_MAP |
| DESCRIPTION = | Flounder Field Top of Latrobe Depth Map (Original). 1:25000. Esso Australia Ltd. A.J. Purdy. January 1998 |
| REMARKS = | |
| DATE_WRITTEN = | 15-JAN-1998 |
| DATE_PROCESSED = | |
| DATE_RECEIVED = | |
| RECEIVED_FROM = | Esso Australia Ltd |
| WELL_NAME = | Flounder-A11A |
| CONTRACTOR = | |
| AUTHOR = | |
| ORIGINATOR = | Esso Australia Ltd |
| TOP_DEPTH = | |
| BOTTOM_DEPTH = | |
| ROW_CREATED_BY = | DH00_SW |

(Inserted by DNRE - Vic Govt Mines Dept)

915467 038

ENCLOSURE 2

PE915469

This is an enclosure indicator page.
The enclosure PE915469 is enclosed within the container PE915467 at this location in this document.

The enclosure PE915469 has the following characteristics:

ITEM_BARCODE = PE915469
CONTAINER_BARCODE = PE915467
NAME = Tukari Seismic Interpretation section
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = SEISMIC
DATA_SUB_TYPE = INTERP_SECTION
DESCRIPTION = Tukari Seismic Interpretation section. Two-way time interval0.970-2.398 s. Shows Tukari Anomaly, Well Path and locations of Tukari-1, Flounder-A3, Flounder-A4 and Flounder-A1. Also includes map of seismic line. Esso Australia Ltd.
REMARKS =
DATE_WRITTEN =
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Tukari-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 040

ENCLOSURE 3

PE915470

This is an enclosure indicator page.
The enclosure PE915470 is enclosed within the container PE915467 at this location in this document.

The enclosure PE915470 has the following characteristics:

ITEM_BARCODE = PE915470
CONTAINER_BARCODE = PE915467
NAME = Flounder Field Top of Latrobe Depth Map
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = SEISMIC
DATA_SUB_TYPE = HRZN_CONTR_MAP
DESCRIPTION = Flounder Field Top of Latrobe Depth Map (Post Drill). 1:25000. Esso Australia Ltd. A.J. Purdy. January 1998
REMARKS =
DATE_WRITTEN = 15-JAN-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Flounder-A11A
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 042

ATTACHMENT 1

915467 043

# TUKARI 1

Attachment 1

Log Analysis Depth Plot
Input Curves For K12 Analysis
4200-4600m MD

PE614136

This is an enclosure indicator page.
The enclosure PE614136 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614136 has the following characteristics:

ITEM_BARCODE = PE614136
CONTAINER_BARCODE = PE915467
NAME = Tukari-1 Log Analysis Depth Plot. 1:200
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = WELL_LOG
DESCRIPTION = Tukari-1 Log Analysis Depth Plot. Input curves for K12 Analysis. 4200-4600 m MD. 1:200. By Solar for Esso Australia Ltd. January 1998Attachment 1
REMARKS =
DATE_WRITTEN = 28-SEP-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Tukari-1
CONTRACTOR = Solar
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH = 4200
BOTTOM_DEPTH = 4600
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 045

ATTACHMENT 2

# TUKARI 1

Attachment 2

Spectral Gamma Ray Depth Plot
4200-4600m MD

PE614137

This is an enclosure indicator page.
The enclosure PE614137 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614137 has the following characteristics:

ITEM_BARCODE = PE614137
CONTAINER_BARCODE = PE915467
NAME = Tukari-1 Spectral Gamma Ray Depth Plot
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = WELL_LOG
DESCRIPTION = Tukari-1 Spectral Gamma Ray Depth Plot. 1:200. 4200-4600 m MD. By Solar for Esso Australia Ltd. January 1998. Attachment 2
REMARKS =
DATE_WRITTEN = 28-SEP-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Tukari-1
CONTRACTOR = Solar
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH = 4200
BOTTOM_DEPTH = 4600
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 048

ATTACHMENT 3

# TUKARI 1

Attachment 3

Log Analysis Depth Plot
VSH, PHIE and SWE from K12 Sections
4200-4600m MD

PE614138

This is an enclosure indicator page.
The enclosure PE614138 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614138 has the following characteristics:

ITEM_BARCODE = PE614138
CONTAINER_BARCODE = PE915467
NAME = Tukari-1 Log Analysis Depth Plot. 1:200
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = WELL_LOG
DESCRIPTION = Tukari-1 Log Analysis Depth Plot. 1:200. VSH, PHIE and SWE from K12 Sections. 4200-4600 m MD. By Solar for Esso Australia Ltd. January 1998. Attachment 3
REMARKS =
DATE_WRITTEN = 28-SEP-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Ltd
WELL_NAME = Tukari-1
CONTRACTOR = Solar
AUTHOR =
ORIGINATOR = Esso Australia Ltd
TOP_DEPTH = 4200
BOTTOM_DEPTH = 4600
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)

915467 051

ATTACHMENT 4

915467 052

# TUKARI 1

Attachment 4

Log Analysis Depth Plot
4200-4600m MD

PE614139

This is an enclosure indicator page.
The enclosure PE614139 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614139 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE614139 |
| CONTAINER_BARCODE = | PE915467 |
| NAME = | Tukari-1 Log Analysis Depth Plot. 1:200 |
| BASIN = | GIPPSLAND |
| ONSHORE? = | N |
| DATA_TYPE = | WELL |
| DATA_SUB_TYPE = | WELL_LOG |
| DESCRIPTION = | Tukari-1 Log Analysis Depth Plot. 1:200. 4200-4600 m MD. By Solar for Esso Australia Ltd. January 1998. Attachment 4 |
| REMARKS = | |
| DATE_WRITTEN = | 28-SEP-1998 |
| DATE_PROCESSED = | |
| DATE_RECEIVED = | |
| RECEIVED_FROM = | Esso Australia Ltd |
| WELL_NAME = | Tukari-1 |
| CONTRACTOR = | Solar |
| AUTHOR = | |
| ORIGINATOR = | Esso Australia Ltd |
| TOP_DEPTH = | 4200 |
| BOTTOM_DEPTH = | 4600 |
| ROW_CREATED_BY = | DH00_SW |

(Inserted by DNRE - Vic Govt Mines Dept)

915467 054

ATTACHMENT 5

PE614140

This is an enclosure indicator page.
The enclosure PE614140 is enclosed within the container PE915467 at this location in this document.

The enclosure PE614140 has the following characteristics:

ITEM_BARCODE = PE614140
CONTAINER_BARCODE = PE915467
NAME = Well Completion Log for Tukari-1.1:200
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = COMPLETION_LOG
DESCRIPTION = Well Completion Log for Tukari-1 (Flounder-A11A). 1:200. By Solar for Esso Australia Resources Ltd. January 1998. Attachment 4
REMARKS =
DATE_WRITTEN = 26-JUN-1998
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = Esso Australia Resources Ltd.
WELL_NAME = Tukari-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = Esso Australia Resources Ltd.
TOP_DEPTH = 1000
BOTTOM_DEPTH = 4608
ROW_CREATED_BY = DH00_SW

(Inserted by DNRE - Vic Govt Mines Dept)