ID 3409

A REPORT ON THE DEPTH MIGRATION OF SEISMIC TIME DATA OVER THE PALMA OIL FIELD

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ENCLOSURES

1. SUMMARY

In an effort to define as accurately as possible the structure of the Palma Oilfield a new interpretation of the seismic data has been carried out.

The interpretation has resulted in the production of seven seismic time contour maps. These maps have been migrated and converted to depth to produce migrated depth maps of the structure.

It is felt that this treatment of the data has resulted in the most accurate delineation of the structure available at the present time.

2. INTRODUCTION

This document is a supplement to the original technical report submitted with the Application for a Production Concession (Palma) d, -CO-TR within the Exploration Permit CR47. The original report contains a summary of the geology and exploration history relating to the Palma Oilfield. However, at the suggestion of Dott. Ing. E. Messina, Tricentrol has carried out further investigations into certain aspects of the field. This new technical work covers the interpretation of seismic data over the Palma structure and its subsequent migration and depth conversion to produce contour maps in depth.

3. THE SEISMIC DATA BASE

i) DATA AVAILABLE

Three areally extensive surveys covering the zone C area of Southern Sicily include lines over the Palma structure.

Two proprietary surveys have been shot within the confines of the original CR47CO licence boundaries together with a number of individual test lines.

The surveys are listed below:

A) Regional Surveys

i) LC- prefixed lines. Shot in 1968/69 by Western Geophysical using Aquapulse as the energy source.

ii) ZC- prefixed lines. Shot in 1972 by Digicon using airguns.

iii) YC- prefixed lines. Shot in 1973 by Western Geophysical using Maxipulse.

B) Proprietary Surveys

i) C47-77- prefixed lines. Shot in 1977 by GSI for Conoco using airguns with total capacity of 1450 cu. ins.

Grid spacing on average 2 x 2 km.

ii) S79A - prefixed lines. Shot in 1979 by Exxon using gas guns as the energy source.

Grid spacing averages about 2 x 2 km and infills the C47-77 survey grid.

C) Trial Lines

i) C47-78 prefixed lines. Two lines shot in 1979 by S and A Geophysical using airguns with total capacity of 1512 cu. ins.

Line C47-78-1 passes through the Palma-1 well location.

ii) C47-82-T prefixed line. Shot in 1982 by CGG using Starjet as the source. This line passes through the Palma-3 location.

Of the regional lines described in Section A only seven from the YC and ZC and none from the LC prefixed surveys were available for this study. Most of these lines are only available in filtered stack format -two have been migrated.

All data from the 1977 survey (Section B i) above) has been migrated. Line C47-77-29 was not available in either filtered stack or migrated format.

The data from the 1979 survey (Section B ii) above) has not been migrated.

II) DATA QUALITY

Data quality is very variable but generally poor. This appears to be entirely due to geological problems there being little variation between lines of different surveys. The deepest, regionally most coherent seismic reflection is that from the Base Pleistocene although even this varies rapidly and is often highly disturbed. Beneath this event the effects of the Pliocene Allochthon result in poor, chaotic or non-existent reflections from the older section.

Near the frontal edge of the Pliocene Allochthon a fair quality stack is obtained from the Base Pliocene reflector and occasionally from the Top Hybla. Reflections within the Jurassic/Triassic section are poor to non-existent.

It is noticed that data quality improves moderately to the south and southeast of the Palma-1 well. This is in an area of deepening water and an area where the shallow Tertiary section becomes conformable with the sea floor and does not outcrop. It may therefore be that further up dip, to the northeast the effect of outcrop of the young Tertiary section is to cause disruption of ray paths and therefore degradation of stack. However, this can only be a secondary reason for the loss of data quality, the main reason being the effects of the chaotic mass of the Pliocene allochthon.

As a result of the generally very poor stack obtained on reflections within the Cretaceous and older section, 2-D seismic line migration is unsuccessful and data beneath the Base Pliocene reflection in the area of influence of the Pliocene Allochthon is considered uninterpretable on the migrated sections available.

TABLE 1

List of Picked Seismic Horizons and their Geological Identifications.

Seismic Horizon	Geological Identification
Sea Floor	
Yellow	Base Pleistocene
Orange 1	Top Pliocene Allochthon
Orange 2	Base Pliocene Allochthon
Red	Base Pliocene
Brown	Top Hybla
Blue	Top Giardini

4. THE INTERPRETATION, MIGRATION AND DEPTH CONVERSION

It was decided to carry out a 3-D migration before depth conversion of these data because:

a) Migration of the data within this geologically complex area will achieve a more realistic depth conversion.

b) Seismic section migration has been largely unsuccessful as evidenced by the examples from the 1977 survey and some of the YC and ZC prefixed lines.

c) Only half of the seismic data set is available in section (2-D) migrated format.

i) INTERPRETATION

In order to carry out this work it was necessary to interpret on the unmigrated sections all reflections separating units which it was felt would greatly affect the migration process. Such units would be those having irregular surfaces, rapidly varying thicknesses or velocities. The events picked are listed in Table 1 opposite.

The interpretation of the Yellow Horizon was straightforward.

The interpretation of the Orange-1 Horizon (Top Pliocene Allochthon) was made difficult by the interference effects caused by diffraction hyperbolae emanating from the edges of faulted blocks within, and at the surface of, the allochthon. Because of these problems an essentially smoothed pick has been made following the gross outlines of the blocks.

No coherent reflection is seen from the Orange-2 Horizon (Base Pliocene Allochthon). This event has been interpreted on generally vague hints of reflections. It is assumed to be reasonably smooth in form being the glide plane along which the allochthon has moved.

The Red Horizon (Base Pliocene) reflection is generally of good quality in front of and immediately below the frontal edge of the allochthon. Beneath the main body of the allochthon it is essentially uninterpretable.

The Brown Horizon (Top Hybla) is a very variable event, generally very poor in the north west of the area improving south eastwards. In the few places where it was totally uninterpretable it has been "formed in" below the Base Pliocene. Beneath the main body of the allochthon no attempt has been made to pick this event on seismic.

The Blue Horizon (Top Giardini) is a generally very poor reflector. In many cases it has been form picked beneath the Brown Horizon. It has not been picked outside the areas described for the Brown Horizon.

ii) THE MIGRATION PROCESS

The migration and depth conversion process requires the application of velocity fields for each seismic segment as defined by contoured interfaces and faults. A detailed description of the work to define those fields is given in section 4. iii).

Computer software produced by Sattlegger was used to migrate and depth convert the interpreted data. The software was used on a bureau basis at the offices of Computer Exploration Services in Cambridge, England.

Sattlegger's migration packages can be applied in two dimensions on interpreted seismic lines or in three dimensions on seismic contour maps. The 2-D migration operates by ray tracing methods to the digitised seismic interfaces. The 3-D migration is based on downward continuation methods - the datum plane is lowered progressively in constant depth increments.

Both methods were used during this project, the 2-D method as a check on velocities and seismic picks before beginning the 3-D method.

TABLE 2

COMPARISON OF VELOCITIES IN THE SAME LITHOSTRATIGRAPHIC UNITS BETWEEN WELLS

PALMA-1			LITHOSTRATIGRAPHIC INTERFACES	PALMA-2		
Depth m (Thickness)	Time ms TWT (Time thickness)	Velocity m/s (Interval Velocity)		Depth m (Thickness)	Time ms TWT (Time Thickness)	Velocity m/s (Interval Velocity)
1230	1345 (approx)		Top Pliocene Overthrust	850	990	
(230)	(207)	(2220)		(1545)	(1042)	(2965)
1460	1552		Base Pliocene Overthrust	2395	2032	
(538)	(422)	(2550)		(120)	(70)	(3428)
1998	1974		Top Messinian Anhydrite	2515	2102	
(806)	(481)	(3550)		(612)	(312)	(3920)
2804	2455		Top Hybla Shale	3127	2414	
(466)	(312)	(2987)		(482)	(299)	(3224)
3270	2767		Top Giardini	3609	2713	
(67)	(20)	(6700)		(50)	(18)	(5555)
3337	2787		Top Inici	3659	2731	

Interpreted, unmigrated seismic lines were digitised on the interfaces listed in Table 1. The horizon time data was posted onto seismic base maps for each horizon and computer contoured using Sattlegger contouring software. These data were then edited where necessary. It was not necessary to revert to interpreted seismic sections for editing purposes as it was possible to redigitise altered contours direct from the contour maps.

At this stage a number of NE-SW oriented dip lines through the Palma-1, 2 and 3 wells were migrated in two dimensions to test the velocity fields which were to be employed in the 3-D migration.

When both the time maps and the velocity fields were finalised the 3-D map migration and depth conversion process was begun. Because the process was of the downward continuation type it was possible to view at each interface the effects of migration. This facility allowed a continuous check to be made on the success of the migration. It was thus possible to edit points without having to restart the whole process. In this way the validity of the interpretation could be checked and any causes for interface distortions understood and corrected if necessary.

iii) VELOCITIES

Correct velocity fields will determine the validity of the migration and depth conversion operation. It is unfortunate that little control is available on velocities in this area. The Palma-1 and Palma-2 wells have sonic logs and velocity calibration surveys. Palma-3 has only a shallow section sonic log and no calibration survey.

Significant variations in velocity of equivalent geological units are apparent between Palma-1 and Palma-2. These variations are listed in Table 2 opposite.

In general, interval velocities in Palma-2 are significantly greater than in Palma-1. The depths to the equivalent interfaces are greater in Palma-2. It was thus possible that the increase in velocity was depth related and this possibility was investigated.

As part of the velocity study an investigation of the seismic stacking velocities was also made using initially three lines: C47-77-25 through Palma-1, S79A59 through Palma-2 and S79A39 through Palma-3. This study was made primarily to ascertain whether a simple areally appropriate velocity function or a contoured velocity surface should be applied to the Base Pleistocene or even to the Base Pliocene.

The velocity study indicated that two types of velocity function could be used for the depth conversion.

A mid-point time related velocity was used from the sea floor to the Base Pleistocene/Top Pliocene Allochthon of the form:

$$V_I = 1231 + 848\, t$$

where V_I is the velocity over the interval in metres/second and t is the mid point two way time of the interval in seconds.

The Pliocene Allochthon was depth converted using an interval thickness related velocity function of the form:

$$V_I = 1891 + 1054\, \Delta t$$

where Δt is the two way time thickness of the allochthon in seconds.

Similar thickness related velocity functions were used over the following intervals:

Base Allochthon to Base Pliocene,

$$V_I = 3493 - 226 \Delta t,$$

Base Pliocene to Top Hybla,

$$V_I = 5213 - 3040 \Delta t.$$

The interval between Top Hybla and Top Giardini was depth converted with a constant velocity of 3124 metres/second.

The interval between Base Pleistocene and Base Pliocene on the downthrown side of the major reverse fault was given a constant velocity of 2500 metres/second.

The velocity fields used convert seismic times to depth correctly at the well locations. However Palma-1 and Palma-2 are the only wells in the area having accurately defined interval velocities. Palma-3 has only sonic log/seismic section derived velocities as no velocity calibration survey was run in this well. Thus, outside of the well locations uncertainty exists as to the validity of the functions used.

Comparisons of these velocity functions calculated from the well logs were made with velocities obtained from the seismic data. Although a great deal of scatter was found on plots of seismic velocities the trends seen on these do appear to match the functions derived from the wells.

5. RESULTS

Computer contoured two way time structure maps were produced for each of the horizons listed in Table 1. Velocity contour maps were then produced over the intervals defined by the time maps using the functions described in Section 4) iii).

All maps were checked and edited where necessary and the data input to the migration and depth conversion package.

At this stage 2-D migration and depth conversion of three dip lines was carried out using simplified velocity functions. The results of this test were encouraging showing only a few of the digitised points being migrated to spurious locations. Examples of two of these migrations are presented as Enclosures 3 and 4.

Contouring in time at Top Giardini level shows the presence of a large structure with independent closure enclosing all three of the Palma wells. When depth converted and migrated this independent closure is lost and becomes entirely dependant upon the main reverse fault. Palma-2 is now seen to be below the oil/water contact and Palma-3 just above it.

Comparing the time (Enclosure 6) and depth (Enclosure 8) maps gives a good indication of the effects of migration during the depth conversion process. The fault plane bounding the southern side of the structure has migrated northwards between 250 metres and 1000 metres, the amount depending on the hade of the fault and the amount of dip on the beds towards the fault.

Similar structural changes between the time and depth maps are evident at Top Hybla level and at Base Pliocene. At Base Pliocene independent closure is evident both in time and depth around the Palma-1 location. Time and depth maps at this level are included as Enclosures 5 and 7. For presentation purposes contours on the downthrown side of the reverse faults are not shown on the maps.

6. CONCLUSIONS AND RECOMMENDATIONS

The 3-D migration and depth conversion of these data has confirmed the fault bound structure at Top Giardini level. It is felt that this treatment of the data has resulted in the most accurate delineation of the structure available at the present time.

However, it is important to realise the limitations of the data used in this study. The combination of poor seismic data and lack of velocity control means that the size and shape of the structure could alter significantly after more wells have been drilled. The Pliocene Allochthon has had the greatest influence in determining the depth migrated structure at deeper levels and is probably the least well defined interval in terms of time thickness and velocity. It is certain that the velocity function applied to this interval is a gross simplification of the actual velocity field.

On the basis of the results of this study it is now proposed that an appraisal well be drilled up-dip of the Palma-1 well at shot point 1117 on line C47-77-25. This location is considered far enough from the boundary fault to be safe from possible errors made in the migration of the fault plane.

PROVISIONAL WELL PROPOSAL
RESERVOIR ENGINEERING WELL
PALMA-4
OFFSHORE SICILY

SEZIONE ROCARBURI
POLI

10 LUG. 1985

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PROVISIONAL WELL PROPOSAL
PALMA-4

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Enclosures

1. SUMMARY

Well Name:	Palma-4	
Classification:	Appraisal (Reservoir Engineering)	
Licence:	d.-CC-TR "Palma Production Concession"	
Interests:	Tricentrol Exploration Overseas Ltd.	26.15%
	Santa Fe Global Services Ltd.	20.93%
	Bow Valley Industries (Europe) Ltd.	26.15%
	Norsk Hydro Italiana S.p.A.	9.34%
	Hispanoil Italia S.p.A.	17.43%
Location (provisional):	Shotpoint 1117, seismic line C47-77-25 36° 59'48.7" N 13° 43'46.57"E	
Objectives:	Lower-Middle Jurassic Inici and Giardini Formations	
Total depth:	3500 m	
Bottom Formation:	Lower Jurassic Inici Formation	
Rig:	To be contracted	
Water depth:	190m	
Spud date:	Spring 1986	
Completion date:	Summer 1986	
Drilling period:	70 days	

2. INTRODUCTION

A reservoir engineering appraisal well, designated Palma-4, is proposed to be drilled to a total depth of 3500 m with the intention of penetrating the complete oil bearing reservoir section of the Palma oil field which lies offshore Sicily, some 23 kms southwest of Licata. Drilling of the well is, of course, contingent upon award of a Production Concession over the Palma Oilfield. Tricentrol and its partners submitted an application (d.-CC-TR) for such a Production Concession on the 15th of March 1985.

The preferred location for the well is at shotpoint 1117 on seismic line C47-77-25. The geographic coordinates are:

36° 59'48.7" N
13° 43'46.57" E

The proposed Production Concession covers the area of the Palma oilfield (see figure 1) which was discovered by the Palma-1 well in 1975. Two appraisal wells were subsequently drilled in 1981 and 1984. Both these wells were located downdip from Palma-1 with the intention of proving up additional reserves. However, Palma-2 and Palma-3 were dry holes, thus demonstrating that the Palma oilfield was smaller than originally expected. Even so the proven reserves of 27 MMBBLS are still a commercially viable proposition under current conditions (refer to the technical reports attached to the application for a Production Concession). Unfortunately the drillstem testing on Palma-1 did not produce sufficiently accurate data to allow detailed design of a development scheme for the Palma oilfield. Consequently the main objective of the proposed Palma-4 is to obtain enough long term production test data to enable Tricentrol and its partners to proceed with planning and implementation of development of the Palma oilfield. Details of the proposed production testing are set out in part 6 of this document.

3. TECHNICAL REVIEW

(i) Introduction

The Palma oilfield is located offshore Sicily in an average water depth of 200 m about 23 kms from the coast. Originally discovered in 1975, the oil accumulation is contained in a north dipping tilted fault block with the reservoir consisting of porous Lower-Middle Jurassic carbonates. Recoverable reserves are modest (27 MMBBLS) but should be adequate to sustain a commercially viable development. For details of possible modes of development please refer to previous technical documentation attached to the application for a Production Concession.

(ii) Regional Geological Setting

The proposed Production Concession covers a small part of the southwest corner of the now expired Exploration Concession CR47-CO. This area lies on the junction of the Mio-Pliocene Caltanissetta Trough and the stable carbonate platform of the Ragusa Zone (see figure 1). The Caltanissetta Trough is mostly filled with massive olistostromes consisting of unconsolidated Mio-Pliocene claystones together with blocks of evaporites and limestones. The southern feather edge of these allochthonous sediments overlies the Palma oilfield. The pre-Messinian sequence in this area consists of both shallow and deep water marine carbonates similar to those seen in S.E. Sicily.

During the Lower-Middle Jurassic the Palma area was located on a shallow water carbonate platform, probably in a back reef environment, with deposition of high energy oolitic grainstones and packstones. This constitutes the Inici Formation which is the reservoir for the Palma oilfield. As the area was a paleo-high during the Middle Jurassic the overlying Giardini Formation is very condensed. By Upper Jurassic time the Inici platform was submerged and the area continued to sink progressively throughout the Cretaceous. This led to deposition of the deep water lime mudstones of the Busambra Formation which is overlain by the radiolarian claystones of the Hybla Formation. Deep water lime mud deposition continued throughout the Upper Cretaceous, this sequence being known as the Amerillo Formation. A depositional hiatus occurred during the

Paleocene-Eocene followed by sedimentation of the Ragusa Formation which consists of upper bathyl lime mudstones passing upwards into sublittoral high energy limestones. The autochthonous section is capped by Messinian Evaporites. Major faulting took place during the Pliocene coincident with movement of the allochthonous sediments into the Caltanissetta Basin.

(iii) Structure

Although the Palma area appears to have been a paleo high during the Jurassic and Cretaceous the present structure of the Palma oilfield is primarily due to Pliocene fault movements. The Palma structure is closed to the south by a major regional fault which has a vertical displacement of some 800 m. Northern closure is provided by the steep regional dip into the Caltanissetta Basin. East/West dip closure is associated with a marked change in the regional strike of the southern bounding fault.

Due to the masking effect of the Pliocene allochthonous sediments the seismic data is of moderate to poor quality which hinders structural interpretation. Since submission of the technical documents attached to the application for a Production Concession, Tricentrol has carried out a re-mapping of the Palma structure together with depth conversion and 3D migration of the resulting maps. Details of the methods used are described in a separate document.

Area of closure at the top of the Inici reservoir is 6.7 km^2 with a total rock volume of 823 million cu.m and a maximum vertical closure of 205m.

(iv) Expected Stratigraphic Succession

Quaternary to Upper Pliocene (190m to 1220m)
This section consists of light bluish grey clay, calcareous with rare siltstone horizons.

Allochthonous Sediments (1220m to 1480m)
The olistostrome material is likely to be dominated by light grey calcareous claystones with occasional buff to light grey limestones, anhydrite bands and grey green marls.

Lower Pliocene (1480m to 1940m)

Most of the Lower Pliocene is similar in nature to the Upper Pliocene except towards the base where there is an increase in the calcareous content which has resulted in pale grey to whitish marls interbedded with multicoloured claystones of the Trubi Formation.

Gessoso Solfifera Formation (1940m to 1956m)

The Messinian evaporites consist of white cryptocrystalline anhydrite with minor intercalations of yellow brown clay.

Tellaro Formation (1956m to 2003m)

This horizon is mainly comprised of grey green, occasionally yellow brown clay, moderately calcareous and silty.

Ragusa Formation (2003m to 2319m)

The upper part (Irminio Member) is a pale to dark brown packstone which tends to be glauconitic and friable. Thin pale grey claystones are common towards the base. The lower part (San Leonardo Member) is a lime mudstone, white to occasionally pale green, chalky with traces of glauconite.

Amerillo Formation (2319m to 2750m)

The Amerillo Formation consists of a white, chalky lime mudstone with chert horizons and thin layers of claystone.

Hybla Formation (2750m to 2864m)

The Hybla Formation is a dark grey green lime mudstone, firm to fissile with occasional bands of limestone and abundant pyrite.

Busambra Formation (2864m to 3215m)

This section consists of whitish, compact to hard lime mudstones partially laminated with pale grey marls.

Giardini-Inici Formation (3215m to 3500m)

The upper part of the sequence is a pale red brown calcareous mudstone with slight dolomitization interbedded with whitish mudstones. The reddish colouration is typical of the Giardini Formation. About 270 m below the top of the Giardini the dominant lithology is a white calcareous mudstone, sometimes chalky with thin calcite veins. There is a further change in lithology at around 350 m below the top of the Giardini. This section is characterized by detrital lime mudstones with patchy dolomitization. 500 m below the top of the Giardini there is an increase in the degree of dolomitization associated with the presence of dark grey argillaceous material within the limestones.

For further details refer to figure 4.

(v) Reservoir Objectives

The shallow water carbonates of the Giardini-Inici Formation are the only proven reservoir in the Palma oilfield. There is leached porosity throughout this section, mostly of a vugular type although there is some intergranular porosity in places. Average porosity in the oil bearing zone of Palma-1 is 9.5%; however, this is expected to increase to 15% in Palma-4. The reason is that in Palma-1 the average porosity increases significantly below the oil water contact and in a structurally higher position, such as that proposed for Palma-4, this increased porosity will lie within the oil bearing zone. The average porosity figures disguise the fact that there are a number of excellent reservoir zones within the Giardini-Inici Formation which have porosities well in excess of 20%.

Additionally, the proposed Palma-4 well is located closer to the main boundary fault which may have enhanced the reservoir characteristics by fracturing. Tricentrol's calculations show that Palma-4 may have potential for producing in excess of 8000 BOPD. The main objective of drilling this well is to determine the maximum flow rate that will be sustainable under normal production conditions. Details of the proposed production testing are set out in part 6 of this report.

(vi) Source Rocks and Thermal Maturity

The oil in Palma is atypical for S.E. Sicily in that it is a very light crude (43° API) compared to the heavy crude in Vega for example (16° API). This implies that the Palma oil has been sourced from a horizon other than the ubiquitous Streppenosa black shales, or that the Streppenosa has reached a higher level of thermal maturity in this area than is the case further to the southeast. Geochemical studies suggest that the Hybla Formation may have sourced oil in the adjacent Caltanissetta Basin and could also be the source of the Palma oil.

(vii) Seals

The Lower Cretaceous Hybla Formation provides the top seal for the Palma oilfield with the crossfault seal being effected by both the Hybla and Amerillo Formations.

(viii) Criteria for Well Location

The primary criteria for locating Palma-4 are the reservoir engineering considerations. These dictate that a sufficiently thick oil column be penetrated and production tested to accurately determine the reservoir characteristics of the Palma oilfield. Palma-1 encountered 88 m of gross oil column but was not properly tested and is now considered to be positioned on the southern edge of the field. In order to encounter a longer oil column it is proposed to locate Palma-4 updip from Palma-1; however, due to the limitations imposed by the seismic data quality the exact position of the major bounding fault is not known with a high degree of accuracy. It is therefore necessary to allow for some margin of error in the mapping which means that Palma-4 should be located at a safe distance from the bounding fault.

It is considered that the proposed location for Palma-4 at shotpoint 1117 on line C47-77-25 is the optimum position to achieve the reservoir engineering objectives without running the risk of penetrating the fault zone by mistake. If the prognosis is correct then Palma-4 should encounter a gross oil column of 140m.

(ix) Reserves

Using the parameters derived from Palma-1, recoverable oil reserves are estimated to be 4.29 million cu.m (27 MMBBLS). This represents a recovery factor of 40 barrels per acre/ft which is pessimistic when compared to other oilfields in Sicily. For example the Ragusa oilfield is expected to have an ultimate recovery of 77 barrels per acre/ft. It is in fact probable that the reservoir parameters of the oil column in Palma-4 will be significantly better than those for Palma-1. It is therefore possible that the recoverable reserves may turn out to be double the current estimate.

Parameters used in the above calculation are:

Area of closure	6.7 sq.kms
Oil water contact	-3355 m
Gross rock volume	823 million cu.m
Net to gross ratio	0.25
Net pay volume	238.7 million cu.m
Average porosity	10%
Average water saturation	28%
Formation volume factor	1.2
Recovery factor	35%

LOCATION MAP

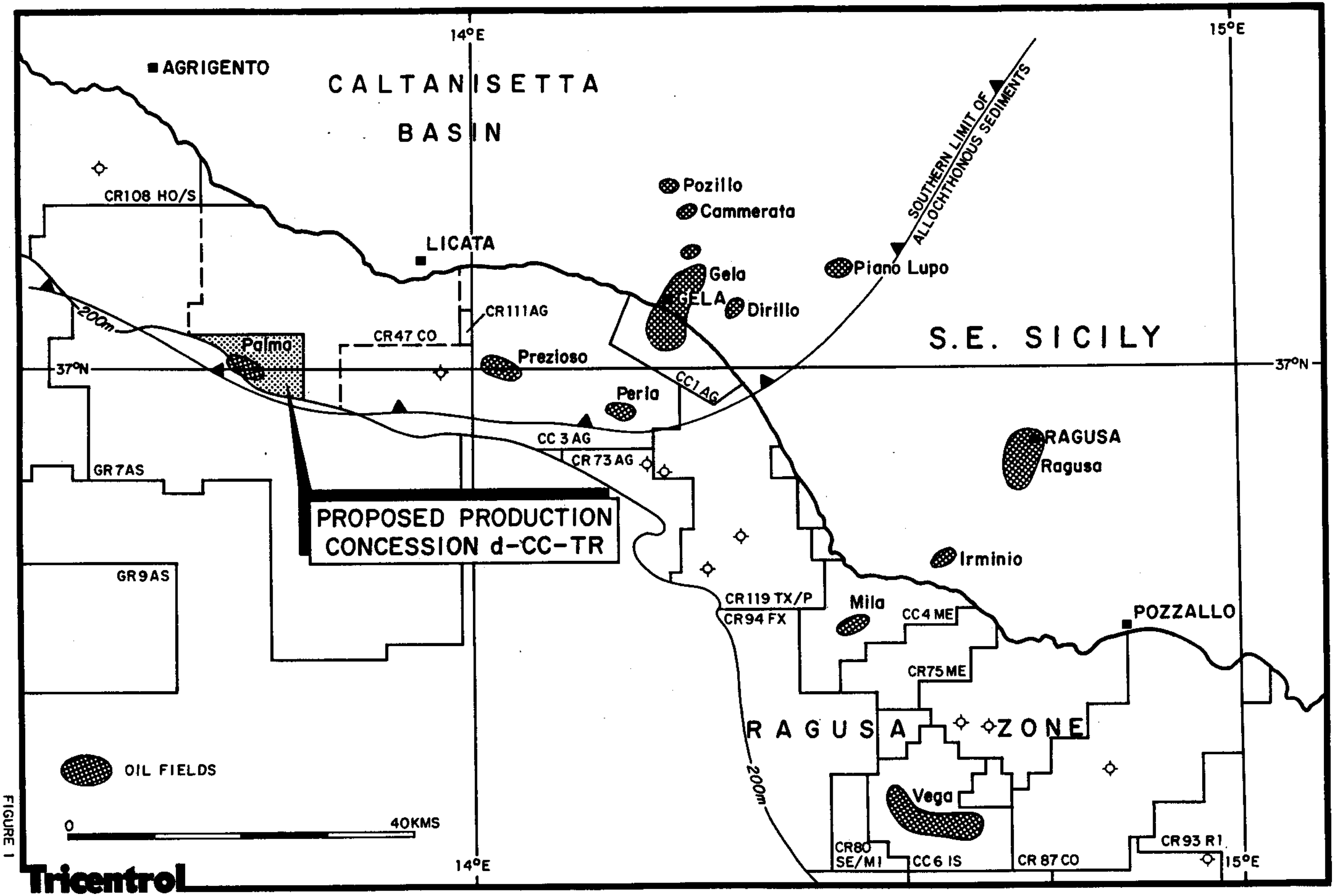
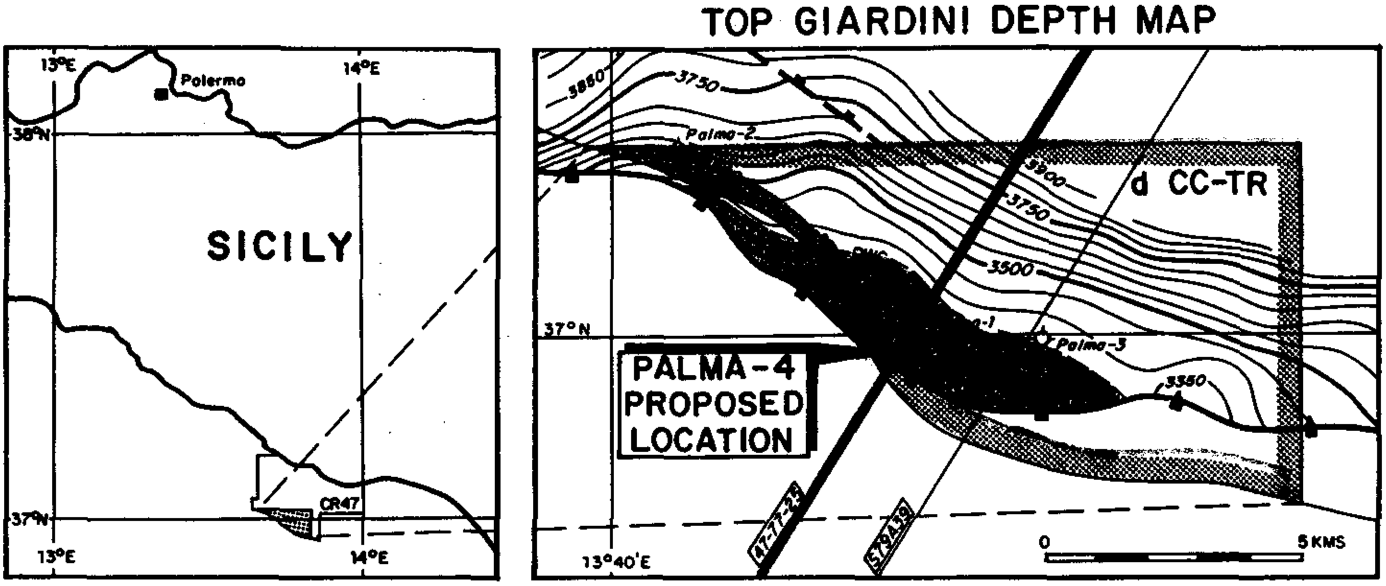


FIGURE 1

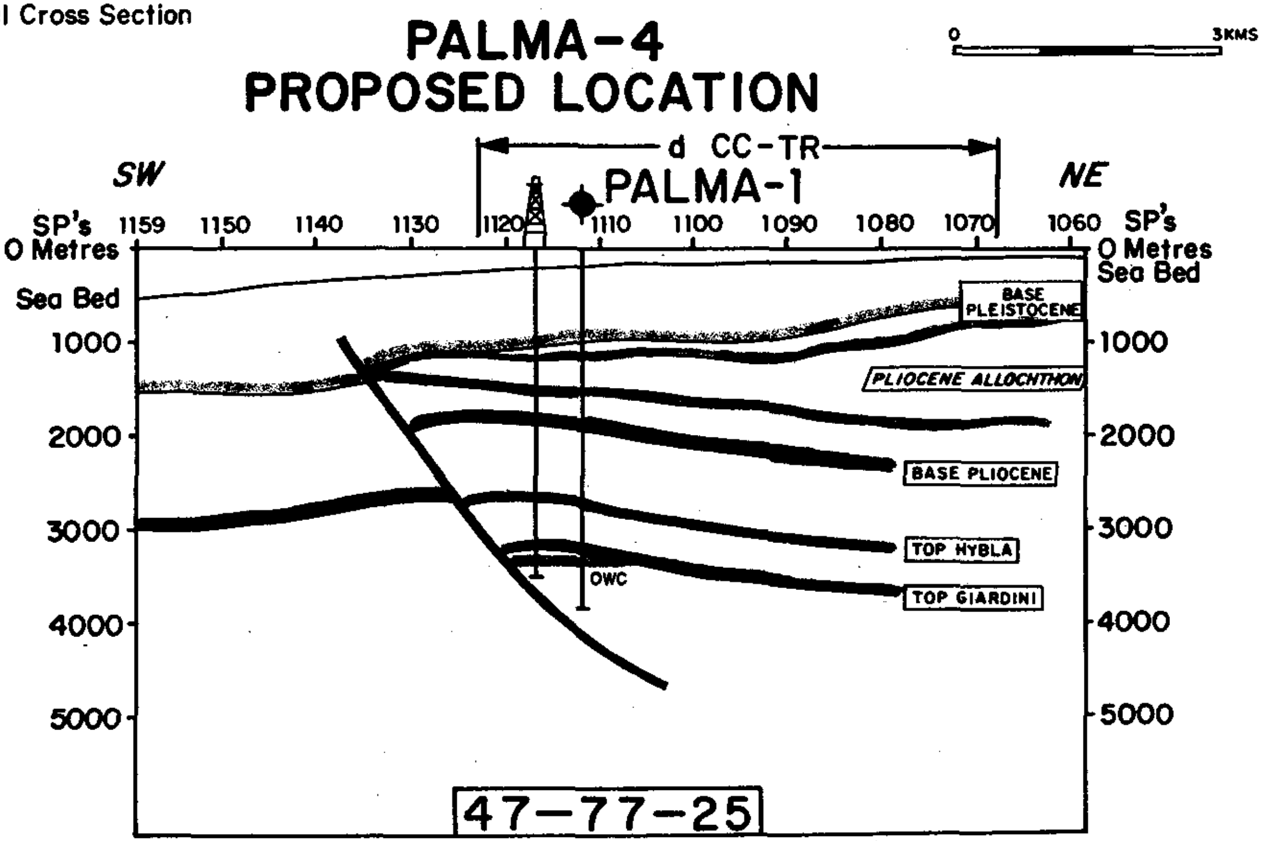
1 LOCATION

Well Name **PALMA-4**	Country **ITALY**	Area **SICILY – ZONE C**	Contractor and Rig —
Location	Geographical: Lat. 36° 59' 48·7" N Long. 13° 43' 46·57" E U.T.M. :		Line No. 47-77-25 Shot Point 1117
KB Elevation —	Water Depth 190m		

Location Map



Regional Cross Section



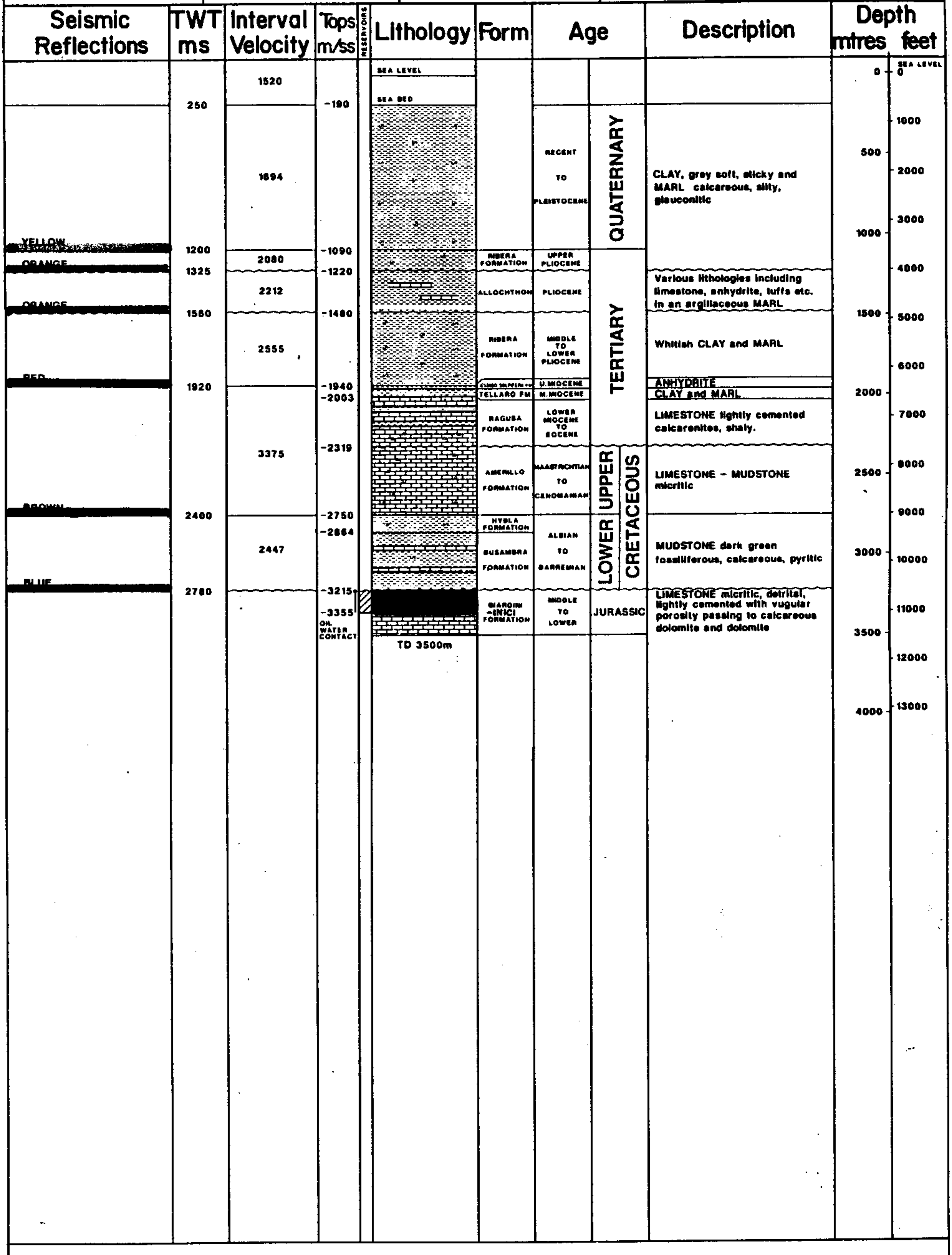
Survey Report Attached Yes ☐ No ☐

Prepared by **SRT / AJL**	Approved by	Date **JULY 1985**

FIGURE 2

4 GEOLOGICAL/GEOPHYSICAL PROGNOSIS Cont

Well Name **PALMA-4**	Country **ITALY**	Area **SICILY - ZONE C**	Contractor and Rig **–**



Seismic Reflections	TWT ms	Interval Velocity	Tops m/ss	Lithology	Form	Age		Description
		1520		SEA LEVEL				
	250		-190	SEA BED				
		1694				RECENT TO PLEISTOCENE	QUATERNARY	CLAY, grey soft, sticky and MARL calcareous, silty, glauconitic
YELLOW	1200	2080	-1090		RIBERA FORMATION	UPPER PLIOCENE	TERTIARY	
ORANGE	1325	2212	-1220		ALLOCHTHON	PLIOCENE		Various lithologies including limestone, anhydrite, tuffs etc. in an argillaceous MARL
ORANGE	1560	2555	-1480		RIBERA FORMATION	MIDDLE TO LOWER PLIOCENE		Whitish CLAY and MARL
RED	1920	3375	-1940		[illegible]	U. MIOCENE		ANHYDRITE
			-2003		TELLARO FM	M. MIOCENE		CLAY and MARL
					RAGUSA FORMATION	LOWER MIOCENE TO EOCENE		LIMESTONE lightly cemented calcarenites, shaly.
			-2319		AMERILLO FORMATION	MAASTRICHTIAN TO CENOMANIAN	UPPER CRETACEOUS	LIMESTONE - MUDSTONE micritic
BROWN	2400	2447	-2750		HYBLA FORMATION	ALBIAN TO BARREMIAN	LOWER CRETACEOUS	MUDSTONE dark green fossiliferous, calcareous, pyritic
			-2864		BUSAMBRA FORMATION			
BLUE	2780		-3215		GIARDIN -(INICI) FORMATION	MIDDLE TO LOWER	JURASSIC	LIMESTONE micritic, detrital, lightly cemented with vugular porosity passing to calcareous dolomite and dolomite
			-3355 OIL WATER CONTACT	TD 3500m				

Estimated Total Depth **3500m**	All Depths on Prognosis Below
Prepared by **ACS**	Approved by
	Date **JULY 1985**

6. PROPOSED TESTING PROGRAMME FOR PALMA-4

(i) Introduction

It is anticipated that Palma-4 will encounter a lengthy gross oil column in the Lower-Middle Jurassic shallow water carbonates. Horizons of vugular and intergranular porosity are likely to occur throughout the oil column and the reservoir characteristics may be enhanced due to the well's proximity to a major fault system.

(ii) Review of Palma-1 Testing

The testing of Palma-1 took place in 1975. From the test data and logs the following information was obtained:

(a) Oil, gas and water flow to surface without the aid of artifical lift. The following rates were measured.

Oil	:	190 BOPD
Water	:	145 BWPD
Gas	:	86.3 MCF
Choke Size	:	32/64 inch
Wellhead Flowing Pressure	:	126 psi
API Gravity	:	43

(d) The reservoir pressure measured at 9875 feet (RKB) was 4367 psi. Extrapolation to an average reservoir depth of 10,940 feet (RKB) gives a pressure of 4807 psi.

(c) Average porosity for the tested interval from the logs was 9.7% with an average water saturation of 43%.

(d) A permeability of 8 md and a skin value of +1.3 was estimated for the tested interval from available build-up data.

The test did not establish the following important information:

(a) It did not distinquish between flow from fractures and the matrix. The reservoir was not fully defined due to the short flow periods. Longer periods of flow are required in this type of reservoir.

(b) A true deliverability potential of the well was not found as the well was slugging badly throughout the flowing periods.

(c) PVT characteristics of the reservoir were not completely defined due to the lack of pressurised oil samples from the test.

(iii) Major Objectives of Test

(a) To estimate commerciality of oil bearing zone within the Inici Formation.

(b) To establish productive horizons within the well.

(c) To collect sufficient separator oil and gas samples for complete PVT analysis.

(d) To collect sufficient flow and pressure data to establish flow regime and reservoir parameters for future studies.

(iv) Expected Rates

From calculations using flow and pressure data obtained from Palma-1 an oil flow rate of 1510 BOPD could have been achieved. Based on the increased net pay for the proposed Palma-4 well and similar reservoir characteristics a rate of 8000 BOPD can be anticipated.

(v) Procedure for Testing Palma-4

Based on the information available from Palma-1 and other well tests in the area, the following is an outline of the procedures for testing Palma-4:

(a) After casing is set in the Giardini Formation the mud weight will be reduced prior to entering the Inici Formation which will be drilled with a minimal overbalance.

(b) The test will be carried out in open hole, the test interval being acid washed to remove any mudcake prior to testing.

(c) The test will consist of a short flow period followed by a build-up to confirm reservoir pressure. The well will then be allowed to clean up to remove all spent acid and mud filtrate from the formation prior to the main test period. There will be two main flow periods separated by a long build-up.

(d) The main flow periods will be of a minimum duration of 36 hours at a single stabilised rate. Build-up will be approximately 1.5 times the flowing period. Surface readout will be considered to ensure good quality data is obtained and that each flowing and build-up period is of sufficient duration for full reservoir analysis.

(e) It is likely that the complete testing programme as outlined will take a minimum of 8 days.

(f) To determine effective productive horizons in the well, consideration will be given to the use of a production logging tool during stabilised flow periods.

(g) If the results are encouraging enough the well may be suspended to be used as a future production well.

A more detailed test procedure is outlined in the Appendix.

APPENDIX

TEST PROCEDURES FOR PALMA-4
(USING A FLOATING DRILLING VESSEL)

PREPARATIONS

1) Plug back TD above oil/water contact as defined by logs and core data.

2) Acid wash complete test interval prior to test.

3) Make up surface equipment and valves 24 hours prior to DST 1. Flush lines with water from choke manifold to end of boom and check lines for any obvious leaks. Test all surface equipment plus SSTT to pre-set pressures.

4) Inspect and check operation of all surface and downhole test equipment. Calibrate all measuring equipment. Pressure test all appropriate downhole equipment.

5) Inspect and check operation of all safety equipment.

6) Hold a pre-test meeting to define responsibilities and authorities, review testing program and safety precautions as detailed in DST procedures.

7) Alert all crews, appropriate authorities, helicopter base and standby boat.

8) Dummy run to check out SSTT spacing.

PROCEDURE

9) Pick up DST string. Insert pressure and temperature recorders in bundle carriers and blank sub prior to making up on DST string.

10) Run DST string in well. Insert water cushion to full height of cushion required above tester valve. Run 6' viscous gel slug above tester valve to avoid scale damaging tester valve.

11) Land SSTT and space out string to keep surface flowhead at workable height allowing for heave and tide.

12) Circulate choke line through BOP's and out riser flow line. Close BOP choke valve. Ensure all BOP kill valves open.

13) Pick up drill string. Set packer at half the total slip joint stroke at the required depth. Land SSTT and close middle pipe rams around SSTT.

14) Connect surface flow lines. Close master valve. Pressure test rig floor flow lines and test manifold to a pre-set pressure levels using clean water. Re-open master valve and drain all test water from manifold and chicksan flow lines.

15) Maintain 150 psi on annulus prior to opening tester valve and observe for leak around packer seat.

16) Run in hole with wireline gauge if required.

17) Dismiss from rig floor all personnel not directly involved in testing operations.

18) Initial flow-pressurise annulus to specified pressure to open tester valve. For initial flow period. Conduct test as per Tricentrol test engineer's instructions.

19) Close tester valve for initial build-up period.

20) First Flow Period: Open tester valve, clean up and flow well at a stabilised rate. Flow well as per Tricentrol's test engineers instructions at stabilised rate during which time oil and gas samples will be collected at separator.

21) Close tester for final build-up (approx 1-1½ to 2 times flow period).

Second Flow Period: Open tester valve, clean up and flow well at a stabilised rate. Flow well as per Tricentrol's test engineers instructions at maximum rate. This flow period may include production logging of the well.

22) On completion of the flow periods, proceed with test string reversing procedure. Pressure annulus as specified to open reverse circulating valve. Maintain annulus pressure below 800 psi during reversing.

23) Check annulus and drillpipe for flow. Unseat the RTTS packer. Check for flow. Wait 10-15 minutes to allow gauges to record final mud hydrostatic.

24) Pull out of hole with DST string.

25) Set EZSV cement retainer at required depth.

26) Reverse drillpipe and pull out of hole.

27) Continue with abandonment or suspension programme as appropriate.