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EXPLORATION REVIEW
and
TECHNICAL EVALUATION
for

BLOCK CR100HO
SICILY ZONE C

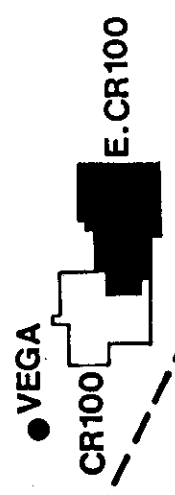
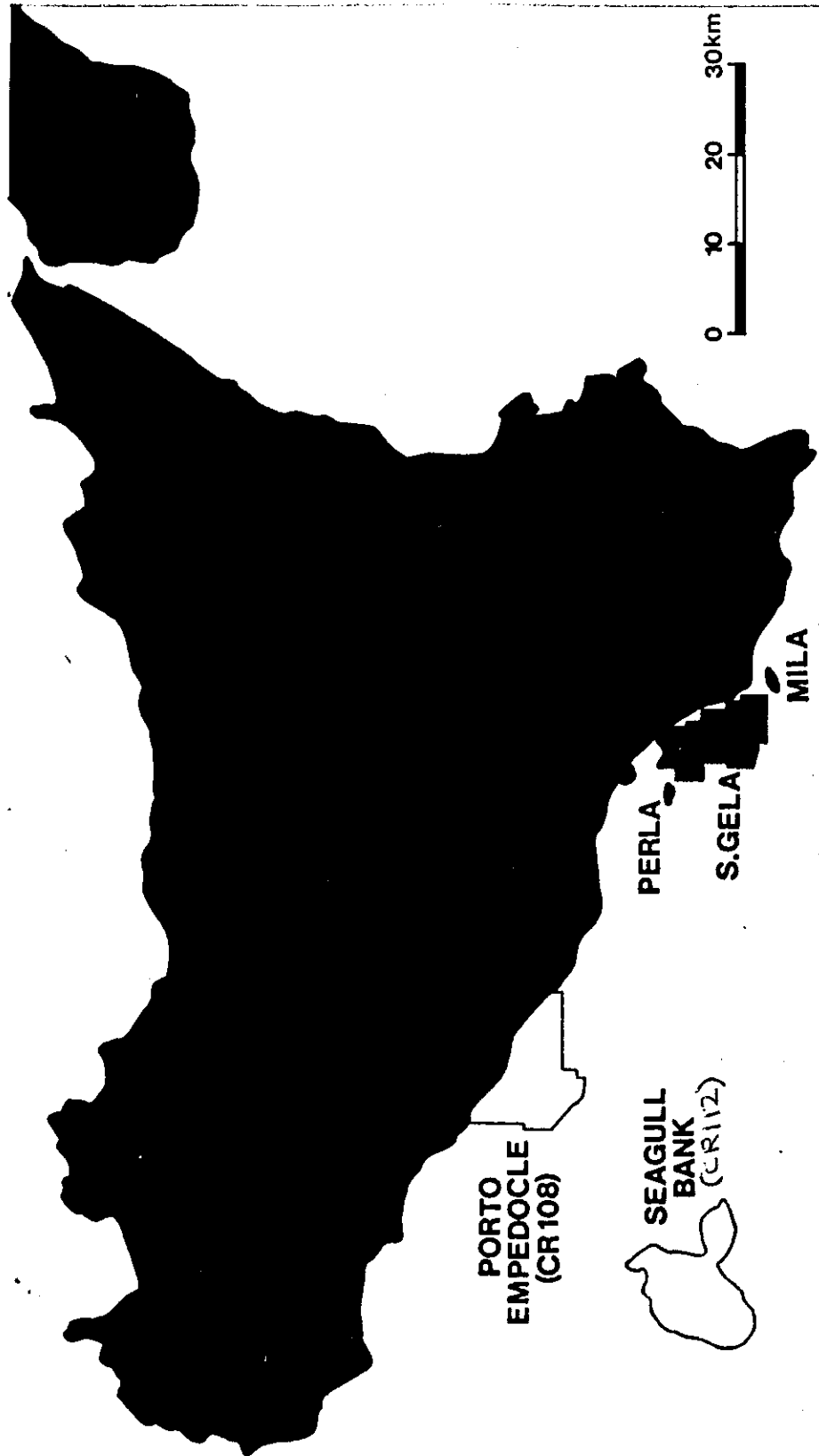
April 1984

SEZIONE IDROCARBURI	
NAPOLI	
27 APR. 1984	
PR	<i>Rbsh</i>
Sex.	Posiz.

OFFSHORE SICILY

PERMIT AWARDS & APPLICATIONS

STELLA WEST APPLICATION



42.75 87.5

● OIL FIELDS ○ PERMIT AWARDS

● GAS FIELDS ● PERMIT APPLICATIONS

78.75

● NILDE

ITALY / TUNISIA

PANTELLERIA

SEZIONE IDROCARBURI

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1. INTRODUCTION

Offshore block CR100 was awarded to Highbay Oil International and Italmin, effective the 6th May 1981. In December 1982, the Highbay interest in CR100 was acquired by Lasmo International Oil Development Ltd (LIODL) as part of a general acquisition of Highbay's international interests. This acquisition was subject to a farm-out agreement with TCPL Resources Ltd, which has led to the current division of interests in the block:-

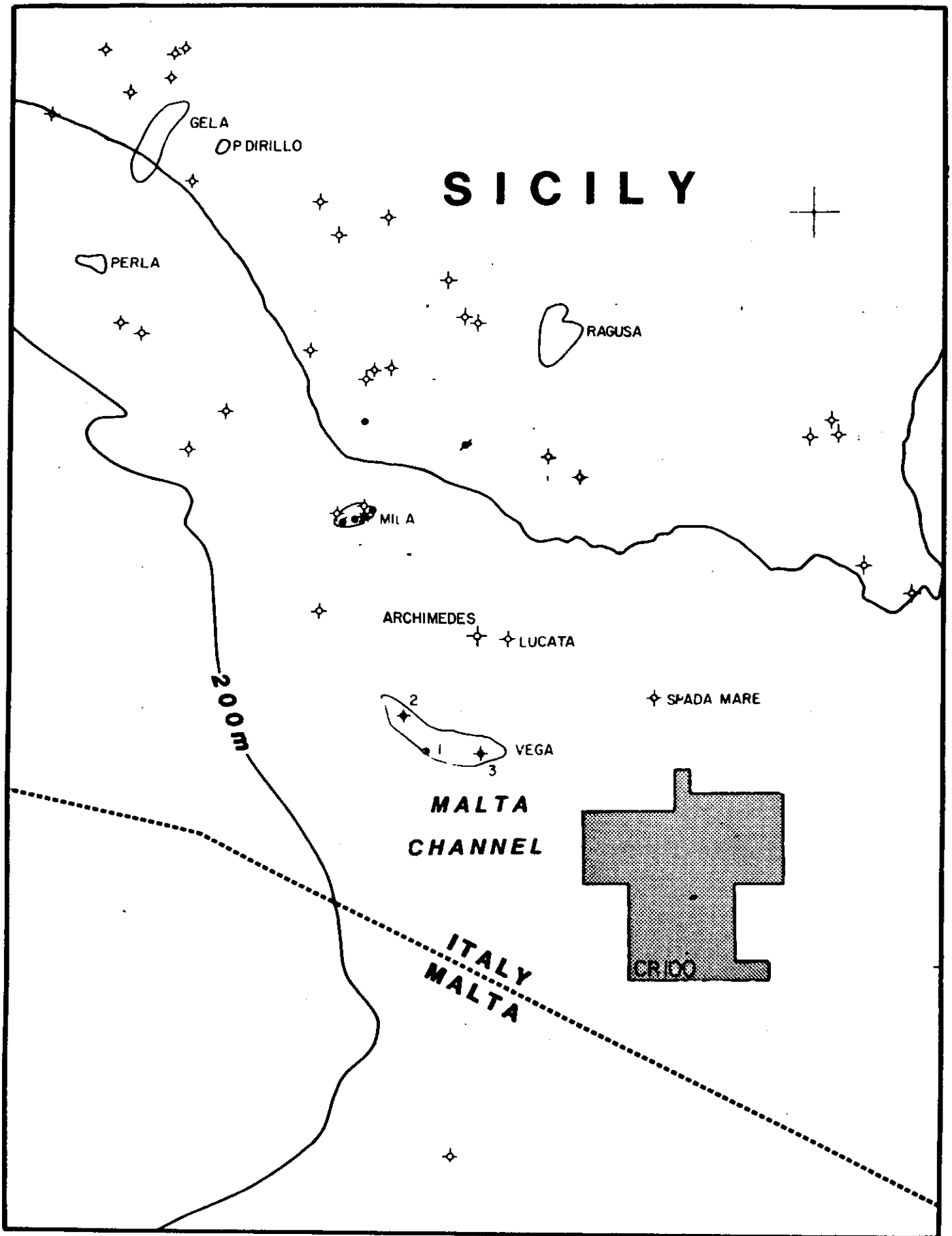
LIODL	78.75%	(Operator)
TCR	11.25%	
Italmin	10.00%	

An earlier report, submitted by Highbay, (Exploration Activity Report for Block CR 100HO, Sicily Zone C, September 1982), summarised the work undertaken by that date. Principally, that work comprised the acquisition and preliminary interpretation of 469.75 kilometres of seismic data which had fulfilled the first year's work commitment on the block.

This report describes the additional work programme and exploration studies completed by LIODL since it acquired the operatorship of block CR100, where a number of leads and prospects have now been recognised.

LIODL intend that an exploration well be drilled to test the Siracusa objective on Prospect A of block CR100.

The location of block CR100 is shown in Figure 1.



-  **LASMO LICENCE**
-  **OIL FIELD**

LASMO International Oil Development Limited
OFFSHORE SICILY CR100
LOCATION PLAT
1:500,000

Fig. 1

2. WORK PROGRAMME

The work programme completed by Hubble comprised the 469.75km, HS81 marine seismic reflection survey completed in November 1981. An improvement in quality was obtained over previously recorded data and a preliminary interpretation of the new grid was made in conjunction with a regional geological evaluation of the area.

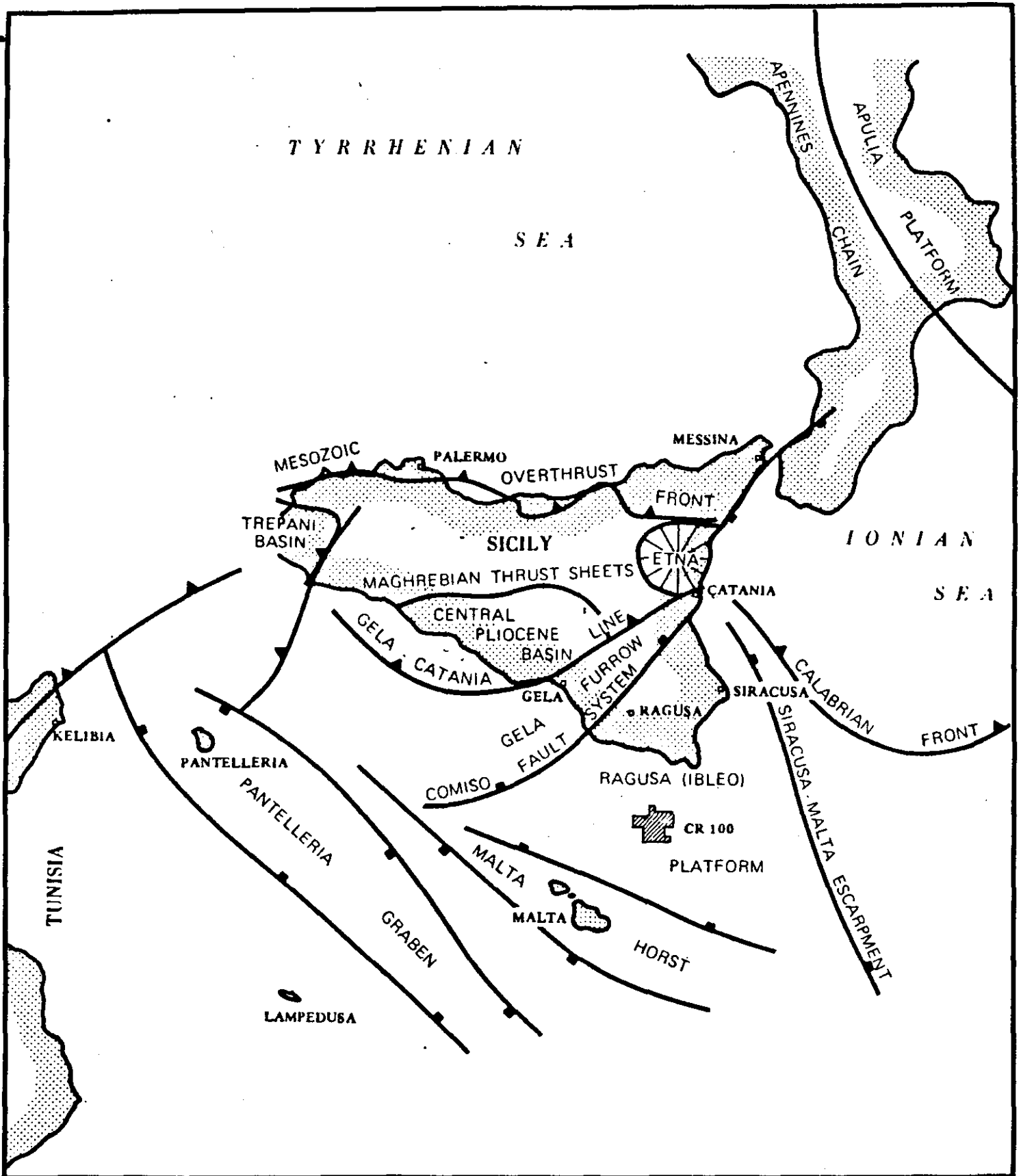
LIODL's subsequent work programme to date has concentrated on upgrading the preliminary Hubble interpretation of the block by:

- acquiring a small amount of additional seismic for prospect detailing;
- structural re-mapping of critical horizons;
- seismic stratigraphic studies carried out to define porosity fairways in block CR100.

54km of additional seismic data (prefix LT-83-) was shot in June 1983 to detail prospects in the northeast corner of the block (acquisition and processing parameters summarised in Appendix 1).

This new data is considered to show significant improvements in quality compared with the 1981 (HS-81) survey. Exhaustive processing tests were performed and the resulting sections show improved S/N and resolution characteristics, greater lateral coherency of events and improved multiple attenuation.

The interpretational geophysical work is fully described in section 3c of this report.



LASMO
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OFFSHORE SICILY CR100
REGIONAL
TECTONIC
ELEMENTS
 1:3,000,000

Fig.2

3 EXPLORATION REVIEW

a. Exploration History of S.E. Sicily

Some 500 million barrels of recoverable oil have been found to date in the southeast Sicily Basin. The existence of surface asphalt deposits in the Ragusa area had been known for many centuries: large scale commercial exploitation of asphalt began in 1918 and continues to the present. Interest in the deep oil prospects of southeast Sicily began seriously in the 1920's, and between 1927 and 1940 Agip drilled some twenty wells. Only shows were encountered but there was sufficient encouragement to renew exploration following the Second World War. After the passage of the Sicilian Regional Oil Law in 1950, Gulf was the first to acquire an exploration permit. During 1953-54 Gulf drilled the discovery well of the Ragusa oilfield which encountered 234ft of fractured, oil productive Triassic dolomites. The 29° API oil is highly undersaturated although it has a free gas cap with a high CO₂ content. Ultimate recoverable reserves of the Ragusa Field are close to 150 MMBBLS.

In 1956 Agip discovered the Gela Field located near the coastal town of that name. Again, the reservoir is fractured Triassic dolomites. The crude is a low gravity (7.3° API) high viscosity oil which, nevertheless, is capable of flowing as a result of the dissolved gas and an extensive underlying aquifer. Recovery factors are low, however, and the quoted reserves of 90-100MMBLS are probably less than 10% of the original oil in place.

Since the discovery of these giant fields, exploration results in the onshore have been generally disappointing, although small pools were discovered at Ponte Dirillo, Cammarata and Comiso. More recently, however, Agip have reported two new discoveries, at Irminio and Piano Lupa.

Offshore Sicily was opened for exploration in 1967 and the first drilling commenced in 1973. In 1976 the Perla Field was discovered by Agip, south of Gela. Production began in late 1982 from a four well platform at a rate of 3000 bopd. Oil gravity is 14° API and the reservoir is a Liassic carbonate.

Development drilling is currently underway on Montedison's Mila Field discovered in 1978. Reserves of 15 MMBBLS of 35° API oil have been established in the Triassic. First oil is planned for 1984 and production will be at a rate between 5000 and 10,000 bopd. The Mila discovery (and the Palma well at some distance to the northwest) demonstrates that light oil can be found in the offshore area.

The latest and most exciting offshore discovery is that of the Vega Field. Vega No. 1 was drilled in 1981 by Montedison some 20kms to the northwest of permit CR100 and tested 16° API, 2.5% sulphur oil at a rate of 4200 bbls per day from a thick porous Liassic dolomite. The delineation well,

Vega No.3, drilled in 1982, produced at the rate of 14,000 bopd from the same reservoir. Vega-2 drilled in 1983, was also a successful confirmation well, but long term testing was prevented by adverse weather. No official reserves have been released for the Vega Field but estimates range between 200 and 300 million barrels.

Montedison have commenced the pre-drilling of development wells through a sea-floor template whilst the permanent production platform is under construction. First production is scheduled for June 1986.

b. Geological Evolution

Licence CR100 lies in an area known as the Ragusa or Iblean platform. This relatively stable tectonic element is bounded on the east by the Malta escarpment, on the southwest by the linear system comprising the Malta horst and Pantelleria graben, and on the north by the Central Sicily Tertiary basin.

The hydrocarbon habitat was established during the Mesozoic, at which time the area was part of the North African continental margin. Stages in the evolution of the margin can thus be linked to the Mesozoic opening of Tethys and are illustrated on Enclosure 1.

A revision of the stratigraphic nomenclature for the S.E. Sicily area was undertaken by Patacca (1979). A stratigraphic scheme showing both the old and new formation names has been included in the report as Figure 3.

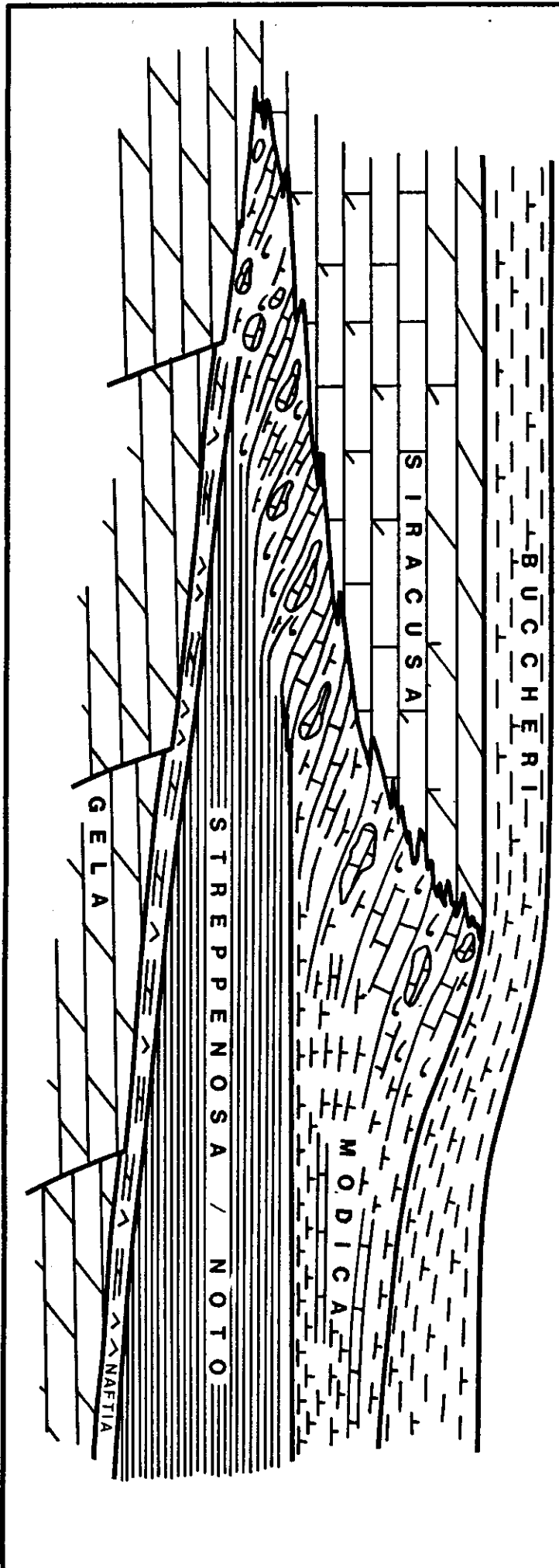
Widespread stability throughout most of the Triassic led to the deposition of a Bahaman type carbonate platform, represented by the porous dolomites of the Taormina formation (Gela formation of Patacca, 1979). Fragmentation of this platform took place in the Rhaetian with the establishment of a block-faulted basin lying in the general area between Sicily and Malta. Anoxic conditions developed in this basin, and deposition took place of thin bedded dolomites with black shale intercalations (Noto formation of Patacca).

During early Liassic (Hettangian-Sinemurian) times anoxic conditions persisted in the basin, with deposition of carbonates, dark grey clays and black shales of the Streppenosa formation. These sediments become coarser toward the basin margin, and are time equivalents of open marine platform carbonates of the Siracusa formation (Patacca) which were deposited at the basin margins.

More open marine circulation was established before the end of the Sinemurian, marked by the transition from the Streppenosa formation to the overlying Modica formation. The Modica formation consists entirely of carbonates and marls, fine grained in the basin centre and coarsening towards the margins. Close to the Siracusa limestone platform the Modica is represented by coarser grained calcarenites derived directly from the contemporaneous Siracusa shelf and bank edge carbonates and may constitute a reservoir rock.

The end of the Liassic marked the transition from taphrogenic to epeirogenic subsidence in the south east Sicily area. Deposition of pelagic marls and cherty limestones of the Buccheri formation commenced throughout the area and this type of sedimentation continued until the end of the Cretaceous.

**GENERALISED FACIES RELATIONSHIPS
LATE TRIASSIC TO MIDDLE JURASSIC
(Nomenclature after Patacca et al, 1979)**



VERTICAL SCALE GREATLY EXAGGERATED

A further change in the tectonic regime took place in Late Cretaceous and Early Tertiary. Regional tilting to the south was accompanied by prominent arching along NNE-SSW lines which is interpreted as being related to wrench faulting. In the Ragusa field (Kafka and Kirkbride 1959) the Upper Eocene-Oligocene section is transgressive over truncated Cretaceous rocks, and this relationship can now be recognised offshore (e.g. Vega field). Interpretation of seismic data also indicates an earliest Tertiary age for the major southwest-plunging fold which is present in CR100.

The later Tertiary evolution of southern Sicily is part of the more general evolution of the Calabrian Arc. Although this stage of the area's evolution took place in response to predominantly compressional movements (Ghisetti and Vezzani, 1980, 1981) the Ragusa platform appears to have maintained its identity as a stable element, continuing to subside under the influence of continued southerly tilting.

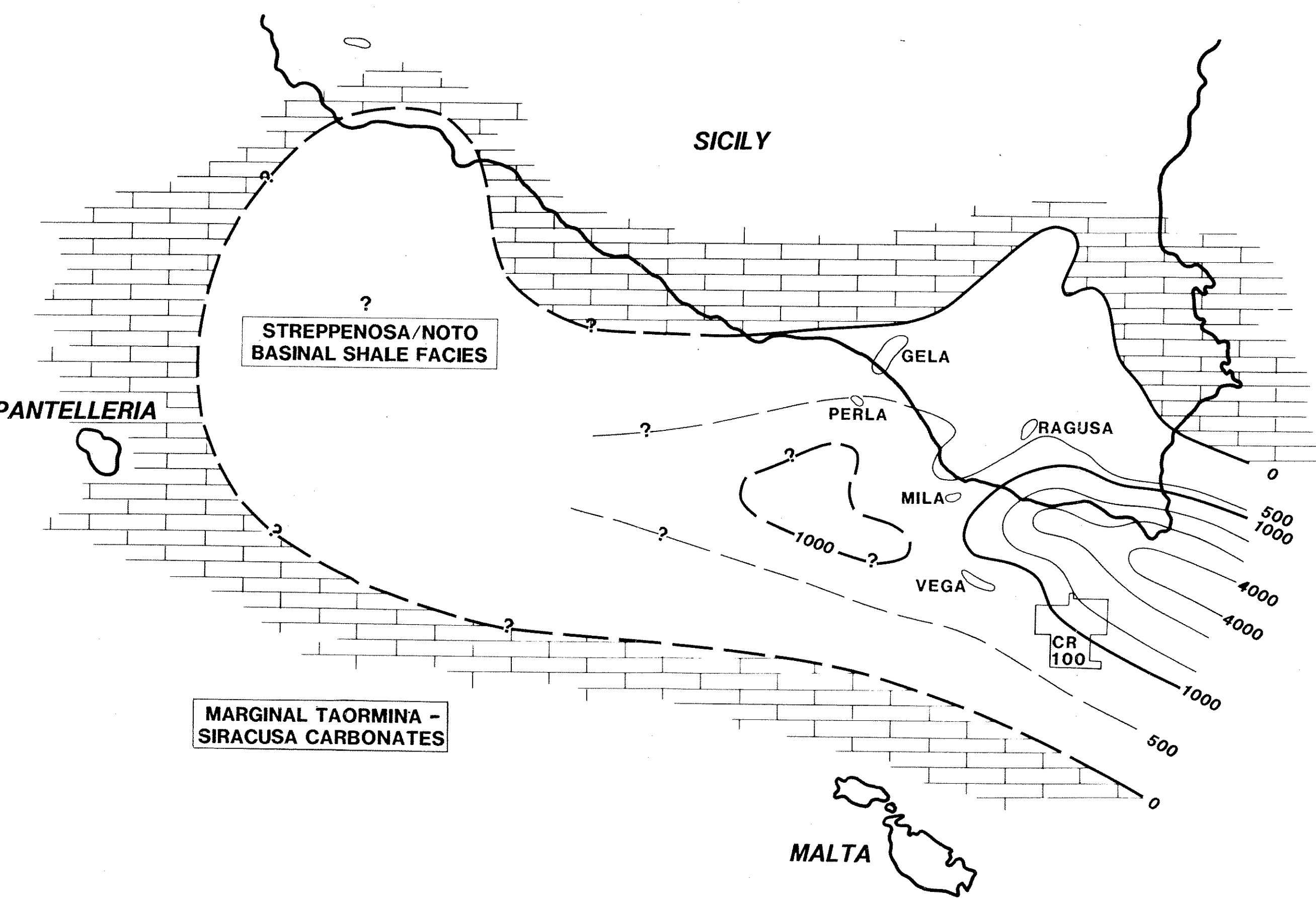
c Geophysical Evaluation

Following the preliminary Hubbay interpretation of the 470km of HS81 series data, 54km of additional seismic data (prefix LT-83) was shot by LIODL in June 1983, to provide further detail of prospects in the north-east corner of the block. The block was remapped at 1:50,000 scale at the following levels:

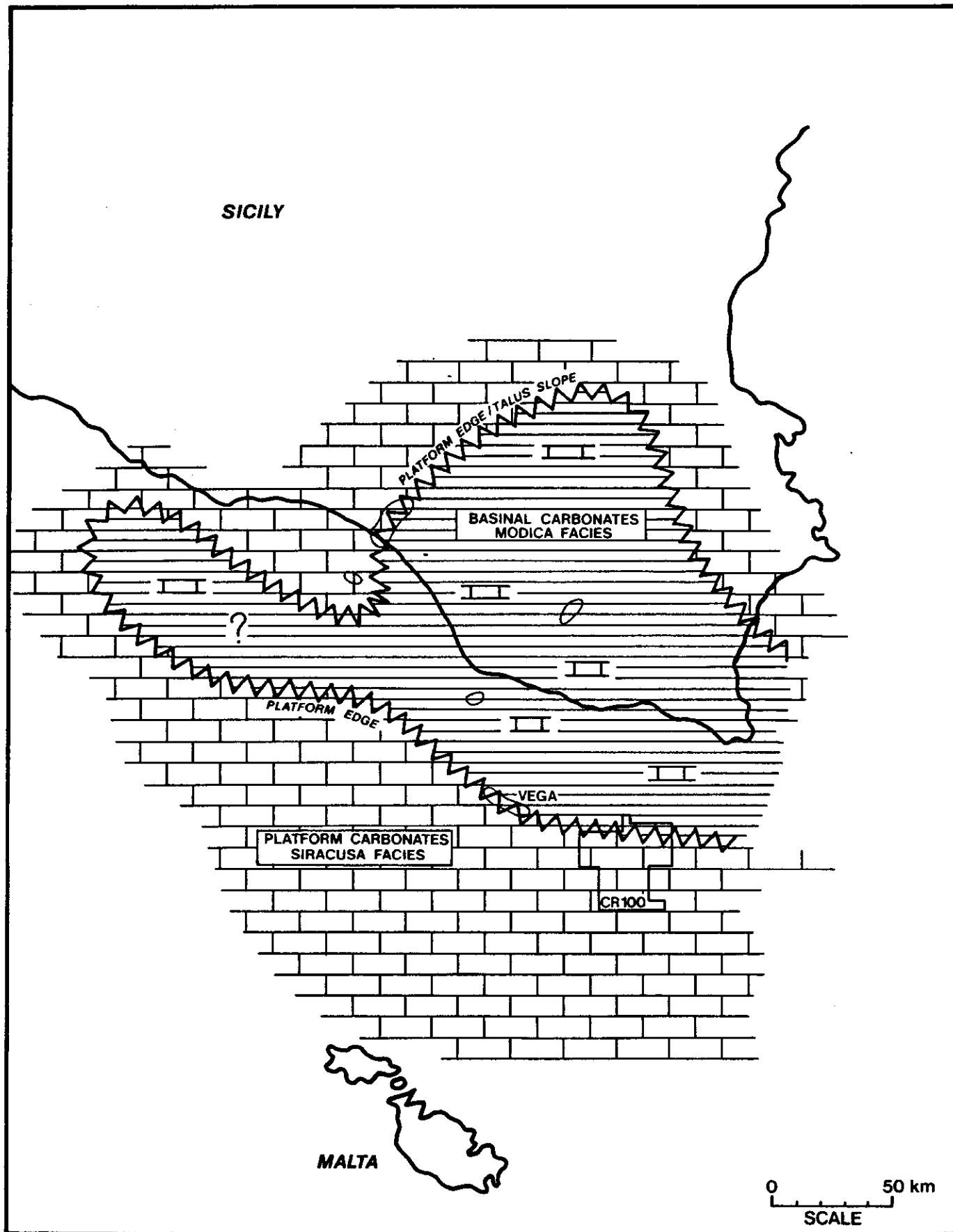
Top Messinian Evaporites	- Time Structure Map
Top Hybla	- Time Structure Map
Top Siracusa/Modica	- Time Structure Map (Encl. 4)
Siracusa Interval	- Isopach Map (Encl. 6)
Top Streppenosa	- Time Structure Map (Encl. 8)

In addition, a seismic features map was prepared, showing seismic stratigraphic character within the Siracusa interval. This is overlain on the Siracusa time structure and isopach maps to form Enclosures 5 and 7 respectively. In the absence of a well tie and a characteristic seismic signature, it was found impossible to make a map at the Taormina level in which any confidence could be placed. Consequently, the Top Streppenosa map has been used as a guide to the Taormina structural configuration. An indication of the depth to the Taormina level, at prospect locations, has been obtained by basing depth conversion on a broad band of low frequency energy lying somewhat below the Streppenosa, to which a Taormina origin may possibly be ascribed.

The critical Top Siracusa/Modica, and Top Streppenosa maps both show the block is crossed by a significant anticline which plunges south westerly through CR100. The culmination of this fold axis appears to lie to the northeast in adjacent block CR93. A sub-parallel, faulted and poorly controlled anticline also appears in the southeast corner of CR100. Trade data from Conoco block CR87 to the northwest, and published data on the Vega Field, also included on the enclosed maps, show that the major anticline which transects CR100 is one of a family of southwest trending folds of varying amplitude, probably created by a tectonic episode near the end of the Cretaceous. Leads and Prospects A, B and D are located along the main fold axis whilst Lead C lies on the faulted anticline in the southeast corner of the block (Figure 7).



LASMO
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OFFSHORE SICILY CR100
**LATE TRIASSIC-
 EARLY LIASSIC
 FACIES
 DISTRIBUTION**



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International Oil Development Limited

OFFSHORE SICILY CR 100

**LATE LIASSIC
FACIES
DISTRIBUTION**

Distribution : Widespread.

Depth : Although no reliable seismic map can be constructed for the Taormina Formation, it's shallowest point in block CR 100 is likely to be in the northeast corner of the block near the 'A' Prospect, where a depth of approximately 5100m has been postulated.

iii) Middle/Upper Jurassic fractured basinal carbonates of the Buccheri formation are rumoured to have produced up to 300bpd of heavy gravity oil in the Spada Mare well. Such developments are unpredictable however and no commercial production has yet been obtained from this interval.

b. Source

Black shale interbeds in Noto formation (Rhaetian) and Streppenosa formation (Hettangian-Sinemurian).

Richness/Maturity : No quantitative information.
Generally believed to be the source of the oil discovered to date in the south east Sicily area.

Age of generation : Probably end Jurassic for the basal Streppenosa in the deep basin.

Not until late to post Cretaceous for younger Streppenosa.

This maturation sequence allows for charging of reservoirs of different age at different times and helps to explain differences in oil character.

Migration path : Simple access to overlying Siracusa/Modica reservoirs, and underlying Taormina reservoirs.

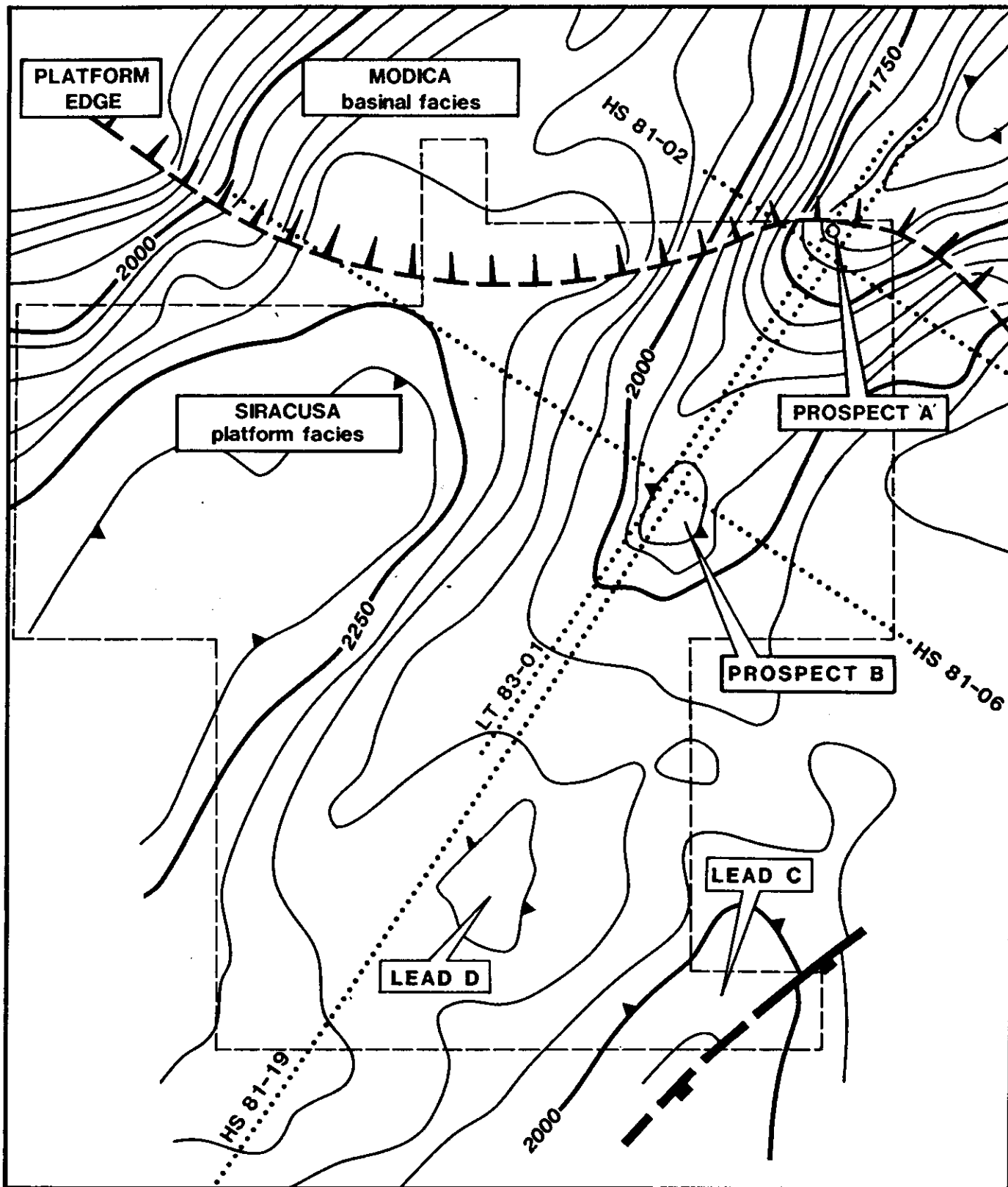
Hydrocarbon type : Oil. Considerable variability in gravity occurs in the area.





1. Common oil type is heavy, naphthenic crude (Vega field is 16° API; 2%S).

2. Lighter crude (Mila 33° API; Palma, 42° API) occurs locally.

c. Seal

Buccheri formation pelagic marls, which are regionally distributed, provide seal for Siracusa/Modica reservoirs. Noto/Streppenosa black shales provide seal for Taormina reservoirs. Both seals have been proven effective.



-  LEADS & PROSPECTS
-  SEISMIC LINES INCLUDED IN THE REPORT
-  BLOCK BOUNDARY
-  SIRACUSA PLATFORM EDGE

LASMO
 International Oil Development Limited
**LEADS
 AND PROSPECTS
 CR 100**
 BASED ON
 TOP LOWER JURASSIC
 SIRACUSA / MODICA MAP

Fig. 7

5. LEADS AND PROSPECTS

a. Prospect A

This feature is considered to be the most attractive prospect in block CR100, incorporating as it does a number of similarities to the Vega field. Its location in the northeast corner of the block is illustrated on Figure 7. It lies on the major arch which plunges southwestward across block CR100.

A total of three seismic lines crossing the prospect are included in the report as Fig. 9, 10 and 12. Seismic line LT83-01 (Fig. 9) running up the crest of the southwesterly plunging arch, illustrates the key elements of the play. Dip changes and discontinuities beneath the 'Top Streppenosa' event are interpreted as early faulting cutting across the arch. This down to the northeast fault zone appears to have formed a platform edge during succeeding Lower Jurassic times. Porous 'Siracusa' platform edge facies is interpreted to be present within the thickened Lower Jurassic interval in block CR100, while to the northeast, the thinned Lower Jurassic interval is interpreted as the tight, basinal, 'Modica' facies. The same Lower Jurassic 'Siracusa' platform edge is also visible on seismic near the Vega field and may be followed from there in an easterly direction until it crosses block CR 100 just to the north of the 'A' prospect.

Prospect 'A' consists then of a structural/stratigraphic trap at the level of the Lower Jurassic Siracusa carbonates. Closure in a NW/SE direction is provided by the end Cretaceous folding along the main arch, whilst closure to the northeast is provided stratigraphically by facies change to tight, basinal, Modica carbonates. A strong element of stratigraphic trapping is also thought to exist in the Vega field where the gross oil column appears to exceed mapped structural closure.

Siracusa Reservoir Reserves

Depth to top of structure	- 2770m (9088ft) - [1640m sec]
Depth to base of closure	- 3125m (10253ft) - [1850m sec]
Vertical relief	- 355m (1165ft) -
CR 100 area of closure	- 8km (1,976 acres)
Prospect area of closure	- 10km (2,479 acres)
CR 100 gross rock volume	- $1183 \times 10^6 \text{ m}^3$ (959,000 ac.ft)
Prospect gross rock volume	- $1456 \times 10^6 \text{ m}^3$ (1,180,000 ac.ft)
Porosity	- 15%
Oil Saturation	- 75%
Net:Gross Ratio	- 50%
Formation Volume Factor	- 1.1
Recovery Factor	- 25%
Yield	- 100 Barrels reserves per gross acre foot of reservoir

Siracusa Reserves for Prospect A amount to 96 million barrels within block CR 100.

4 HYDROCARBON POTENTIAL

The elements of the hydrocarbon potential can be interpreted from the preceding discussion of the structural and stratigraphic evolution, but will be set out here in summary form for ease of reference.

a. Reservoir Objectives

- i) Lower Jurassic dolomites and dolomitic limestone of the Siracusa and Modica formations constitute the primary reservoir objective in block CR 100.

Reservoir in Perla, Vega Fields.

Quality : No detailed poroperm information available. The following assumptions have been made - Porosity 15%, oil saturation 75%, Net to Gross ratio 50%, Recovery Factor 25%, Formation Volume Factor 1.1. These parameters equate to 100 barrels of reserves per gross acre-foot of reservoir, which is considered a reasonable figure for this type of carbonate reservoir.

Vega wells have produced up to 14,500 bopd, pump assisted.

Thickness : Up to 1600 metres.
Vega 2 had 278 metres gross oil column.

Distribution : Best reservoir potential is confined to the zone of transition from platform carbonate to platform edge talus. This zone is interpreted to run approximately east-west through the northern part of CR 100. Siracusa carbonates are the principle objective of the proposed well on Prospect A of block CR 100.

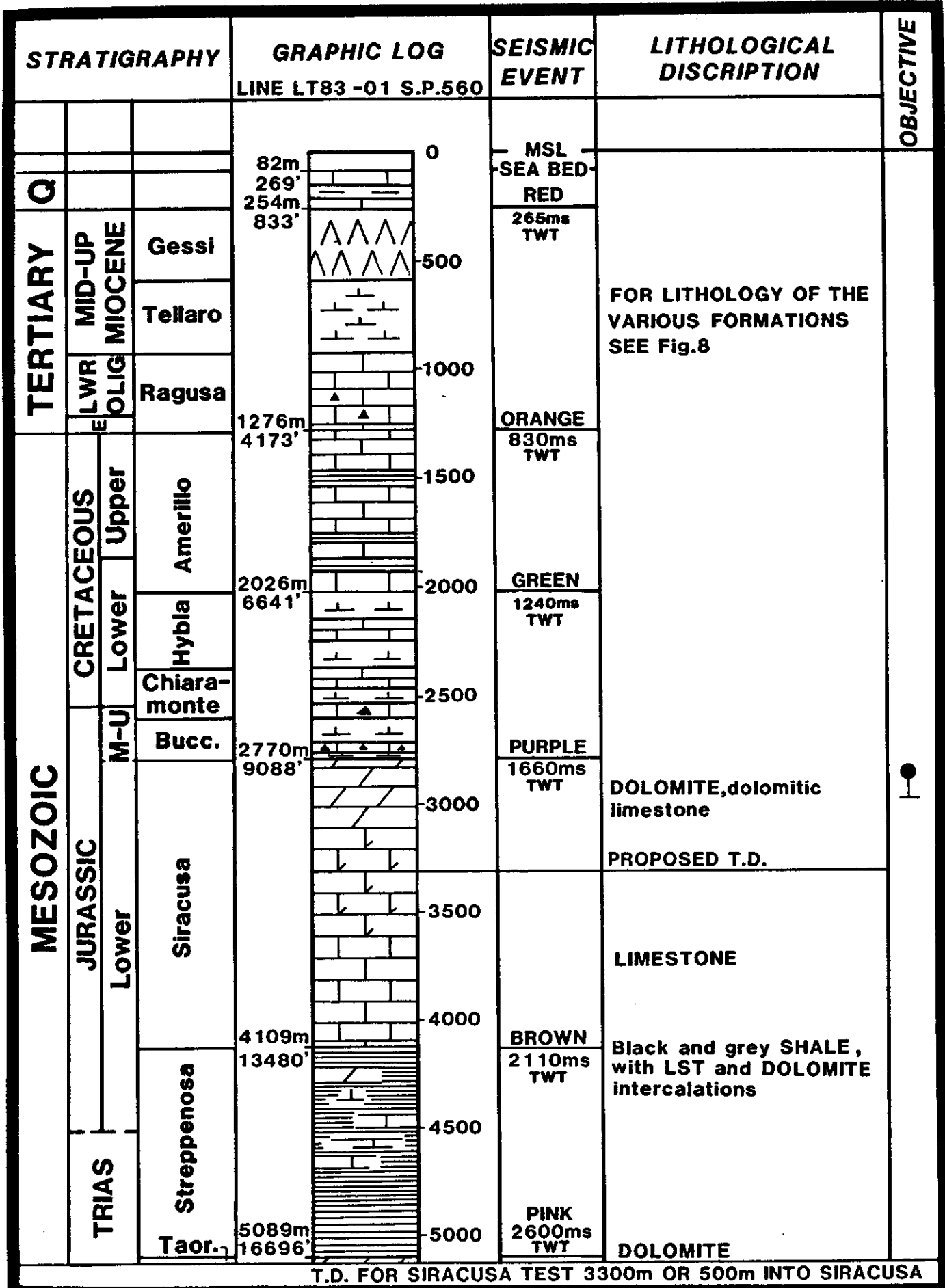
- ii) Triassic dolomites of the Taormina Formation (Gela/Naftia/Noto Formations of Patacca) constitute a secondary objective in block CR100.

Reservoir in Gela, Ragusa, Mila fields and in Irminio, Piano Lupa discoveries.

Quality : 1-16% porosity
up to 1000 md permeability (data from Gela field).
Productivity (up to 3000 bopd in Gela field) appears to depend on the presence of a well-developed fracture system.

Water drive is said to be good.

Thickness : 3000 m gross
Ragusa field has 500m pay.



T.D. FOR SIRACUSA TEST 3300m OR 500m INTO SIRACUSA

LASMO
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OFFSHORE SICILY CR100
PROSPECT A
GEOLOGICAL
PROGNOSIS

Taormina Reservoir Reserves

Vertical Relief of Trap	=	200m (656ft) - [100ms]
Area of closure	=	3km ² (741 acres) - [100ms]
Gross rock volume	=	240x10 ⁶ m ³ (195,000 acre feet)
Assume yield of		100 barrels of reserves per gross acre foot of reservoir.

Reserves for Taormina Reservoir = 20 million barrels.

This figure assumes 100ms throw on the fault at Top Taormina level. With increasing throw, or in the unlikely event of fault seal, reserves would be increased accordingly.

b. Prospect B

The location of Prospect B, on the plunging arch which crosses block CR100, is illustrated on Figure 7. It lies to the southwest of prospect A, and comprises a low relief structural closure at the Siracusa/Modica level, overlying a deeper seated Taormina/Streppenosa fault block. The local plunge reversal at Siracusa/Modica level can be seen in the vicinity of S.P. 400 on seismic line HS81-19 (Fig. 12.) This low relief closure may be formed by a porous Siracusa patch-reef development lying shoreward to the main Siracusa platform edge (Prospect A). Within the Siracusa interval at Prospect B, a seismic amplitude anomaly is visible on both line HS81-19 (Fig. 12) and crossline HS81-06 (Fig. 13). It is possible that this represents a diagenetic carbonate interface and hence could reflect the presence of hydrocarbons.

Prospect B clearly represents a possible follow-up location dependent on the outcome of drilling results on Prospect A, and current activity in adjacent blocks. The geological prognosis for Prospect B is illustrated on Figure 11.

Siracusa Reservoir Reserves

Patch Reef Model	- Area	- 2,300 acres
	Average Gross Pay	- 200 ft
	Average Net Pay	- 100ft
	Yield	- 100 barrels reserves gross acre foot of reservoir

Siracusa reserves for Prospect B amount to 45 million barrels

In the event of a shelf edge development at Prospect B, permitting greater vertical relief of the trap, reserves may amount to up to 92 million barrels.

Lead C

In the extreme southeastern corner of the block a local thickening of the Siracusa interval coincides with strong evidence of faulting. This lead lies partially outside CR100, and further work is required to determine whether the feature closes.

Lead D

A broad, low-amplitude, four way dip closure is present in the south-central part of the block, on trend with features A and B. The feature is well defined seismically, and slight Jurassic thinning is visible, providing evidence of early growth. Closure may be as much as 4,000 acres but structural relief is small. As in the case of Prospect B, Lead D may prerepresent a local patchreef development, shoreward of the main Siracusa platform edge.

6 SUMMARY AND CONCLUSIONS

Following the seismic acquisition and preliminary interpretation carried out by Huddy during 1981 and 1982, LASMO International Oil Development LTD (LIODL) have carried out seismic detailing, structural remapping, and seismic stratigraphic studies across block CR100. A fold axis has been mapped, plunging southwestward across the block, and parallel to a broader fold axis to the northwest, on which the recently discovered Vega Field is located. Regional geological studies have identified the Lower Jurassic Siracusa carbonates as the primary reservoir objective in block CR100. These are also known to be the reservoir in the Vega Field. The best porosity is thought to be found at the edge of the Siracusa carbonate platform. Seismic stratigraphic studies have been conducted, in so far as the data permit, and show the Siracusa platform edge running in an easterly direction from the Vega field across the north of block CR100.

Prospect A lies at the intersection of the Siracusa platform edge, and the main CR100 fold axis, forming a structural-stratigraphic trap with potential for reserves of 96 million barrels. LIODL intend that an exploration well be drilled on Prospect A at S.P. 555, seismic line LT83-01, to a total depth of 3300m, or 500m into the Siracusa. Consideration has been given to the potential of the Taormina objective on Prospect A. Lying at predicted depths of greater than 5000m and with potential for probably only 20 million barrels of reserves, it is not considered a viable exploration objective at the present time.

Three other less attractive leads and prospects have been identified on block CR100 but their potential will only become clear after the drilling of the first well on Prospect A.

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APPENDIX 1

Seismic Acquisition Summary

LASMO International Oil Development Ltd carried out a marine seismic reflection survey on block CR100HO on 23.6.83. Details of the survey are as follows:

(i) General

Contractor	:	Seismic Profilers
Vessel	:	m.v. Nina Profiler
Mileage	:	54km
No. of lines	:	3
Coverage	:	49 fold
Line prefix	:	LT-83-
Survey limits:	:	Between latitude 36° 23' N and 36° 33' N Between longitude 14° 52' E and 15° 00' E

(ii) Instruments

Texas Instruments	:	DFS V, 120 channels, 3 tape transports
Format	:	SEG B, 1600 BPI, Phase Encoded
Record Length	:	6 seconds
Sample Rate	:	2 msec
Filters	:	Hi-cut 128 Hz, 72 db per octave Lo-cut 5.3 Hz, 18 db per octave

(iii) Cable

Streamer	:	Teledyne 2450 metre cable
Operating Depth	:	8 metres
Group Interval	:	104 groups, near 12 groups 12.5 metre spacing far 92 groups 25 metre spacing
Streamer Noise	:	near groups 6-8 microbars far groups 3-4 microbars
Sensitivity	:	20 microvolts per microbar
Feathering Angle	:	10° maximum

(iv) Energy Source

5560 cu in airgun array

(v) Navigation

Primary	:	Trisponder
Secondary	:	Sat Nav./Sonar

(vi) Weather and Sea Conditions

Season	:	Summer
Sea State	:	1-4 Beaufort Scale
Water Depth	:	59-120 metres
Currents	:	Typically 2 knots from NW

(viii) Traffic and Fishing

Traffic : Heavy, numerous fishing trawlers,
tankers.
Difficulties
Encountered : Fishing buoys

Seismic Processing Summary

1. Record length 6 seconds.
2. Minimum Phase Resample from 2 to 4 milliseconds
3. Static Corrections: shot and streamer static 12 milliseconds
timing delay 8 milliseconds
4. Adjacent Trace Mix: 2 on 1 or near 12 traces
5. True Amplitude
Recovery : 6db per second from 0 to 4 seconds
spherical divergence correction applied
6. Pre-deconvolution
mute : Ramp length Tr 1 - 100 mSEC: Start - 0 msec
Tr 98 - 100 mSEC: Start - 2700msec
7. Velocity Filtering: Dips + 10/-5
8. Designature : Offset dependant marine wavelet
Fmin = 5Hz, Fmax = 125Hz, HC slope 72 db/octave,
LC slope 18 db/octave
9. Velocity Analysis : Using 11 depth point velscan analyses
located 1 every 1.5 kilometre
10. N.M.O. Correction : using annotated velocities
11. CDP Stack : 49 Fold
12. Migration : Wide Angle FK wave equation migration
using 90% smoothed stacking velocities
13. Time Variant
Filtering : Frequency (Hz) Time (msec)
5-50 1500
5-40 2500
5-30 3500
14. Time Variant
Scaling : 500msec gates, starting at 0 msec
15. Display : Vertical Scale: 10 cm/sec
Horizontal Scale: 80 traces/km

