ID 3018

Enterprise Oil

ITALY

BLOCK: B.R231.ET

VINTAGE SEISMIC DATA 84-87 BR 185

******

REPROCESSING TEST 92

REPORT

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Rome, 6 July 1992
713-92/SM/gg

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APPENDIX 1

- Reprocessing Progress Listing of Provisional Test Displays

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1 - BROCHURE "STEPS ON THE REPROCESSING WORK BY COMPARISON WITH OLD STACK SECTION"

2 - LINE BR 185-84-05/BR 185-87-05
FILTERED STACK MERGED (MAFK, DMOSTK, TVF)

3 - LINE BR 185-84-05/BR 185-87-05
RESIDUAL MIGRATION

4 - LINE BR 185-87-21
MAFK DMOSTK

5 - LINE BR 185-87-21
RESIDUAL MIGRATION

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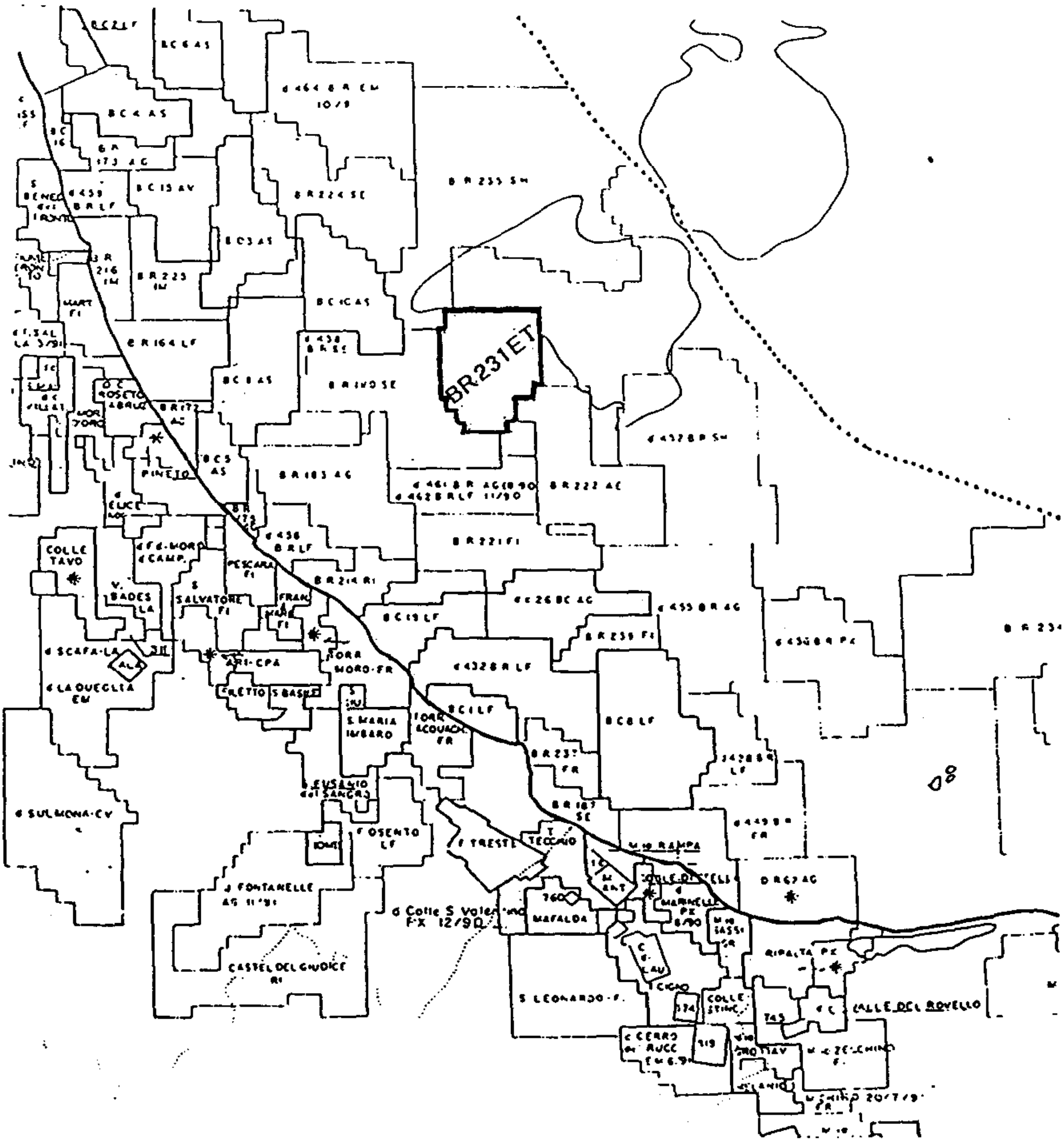
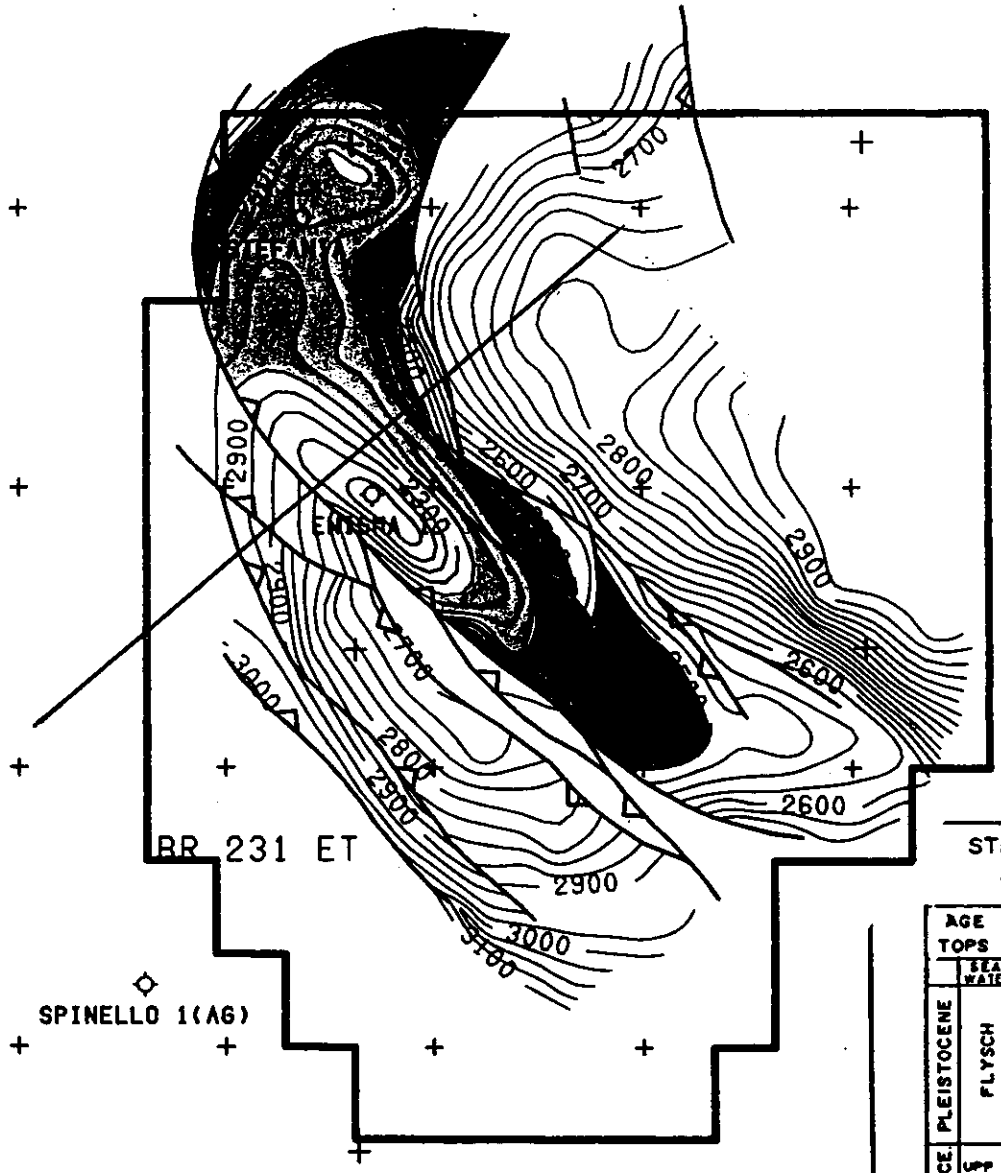


BR 231 ET

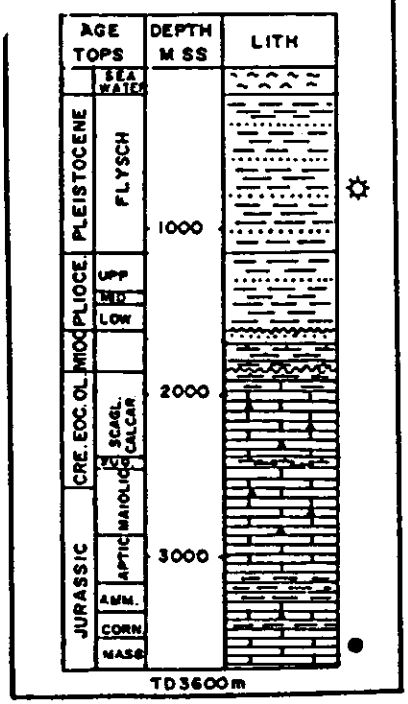
LOCATION MAP

F_1

F.2



STRATIGRAPHIC FORECAST



Minimum Closure

Most Likely Closure

Maximum Closure

0 2500 5000 m

Enterprise Oil

ENTERPRISE OIL EXPLORATION LTD.

B.R 231 ET
TWT CONTOUR MAP

NEAR TOP ROSSO AMMONITICO

K.GRASSI - DECEMBER 1991
N. 40591

1. GENERAL INFORMATION

The permit B.R231.ET is located in the Central Adriatic ("B" zone) about 50 km from the Abruzzi coast (*Figure 1*).

Joint Venture:	ENTERPRISE OIL	60%
	ELF IDROCARBURI ITALIANA	40%

1.1 Exploration Setting

The primary objective in the B.R231.ET block is the upper part of the Liassic platform known as "Calcare Massiccio Formation" made up of oolitic limestones, packstones and grainstones which are extensively dolomitized (approximate depth 3000-3300 m/2.3 STWT) (*Figure 2*).

The oil-prospect at the Massiccio Fm level comprises faulted folds generated by inversion of Triassic-Liassic extensional structures. Sealing is provided by the overlying Jurassic-Cretaceous pelagic carbonates.

A secondary objective is provided by the Quaternary clastic sediments. Biogenic gas could be trapped in the sandy units sealed by coeval shaly intervals (approximate depth 1000 m/1.0 STWT).

Based on mapping of the vintage data the Icaro prospect has been identified. This prospect has Massiccio Formation as the major objective and reserves have been estimated to be 110 MMBO (mean) with an associated risk of 1 in 6.

1.2 Vintage Seismic Data

In 1991 the J.Venture purchased 273 km of vintage seismic data, acquired by similar parameters in 1984 and 1987, during the validity of previous permit B.R185.SE, and processed at Western-Milan (1984 data) and Ensign-London (1987 data). Some of the 1987 lines are an extension of the 1984 dip lines.

The principal characteristics of data purchased are resumed on the following charts:

- *Seismic data purchase summary (Figures 3,4,5)*
- *Processing sequence 1984 seismic data by Western-Milan (Figure 6)*
- *Processing sequence 1987 seismic data by Ensign-London (Figure 7)*

B.R231.ET VINTAGE SEISMIC SUMMARY

DATE OF ACQUISITION	1984	1987
ACQUISITION PARAMETERS		
CONTRACTOR	WESTERN	WESTERN
RECORDING INSTRUMENTS	DFS V	LRS – 16A
SAMPLE RATE	2 ms	2 ms
SHOT INTERVAL	25 m	26.67 m
CABLE LENGTH	2400 m	3200 m
RECORDING FILTERS – LOW	OUT	12 HZ – 18 DB/OCT.
– HIGH	128 HZ – 72 DB/OCT.	188 HZ – 156 DB/OCT.
SOURCE ARRAY VOLUME	1040 cu in	?
FOLD	4800%	6000%
PRIMARY NAVIGATION	SYLEDIS	SYLEDIS
PROCESSING		
CONTRACTOR	WESTERN (Milan)	ENSIGN (London)

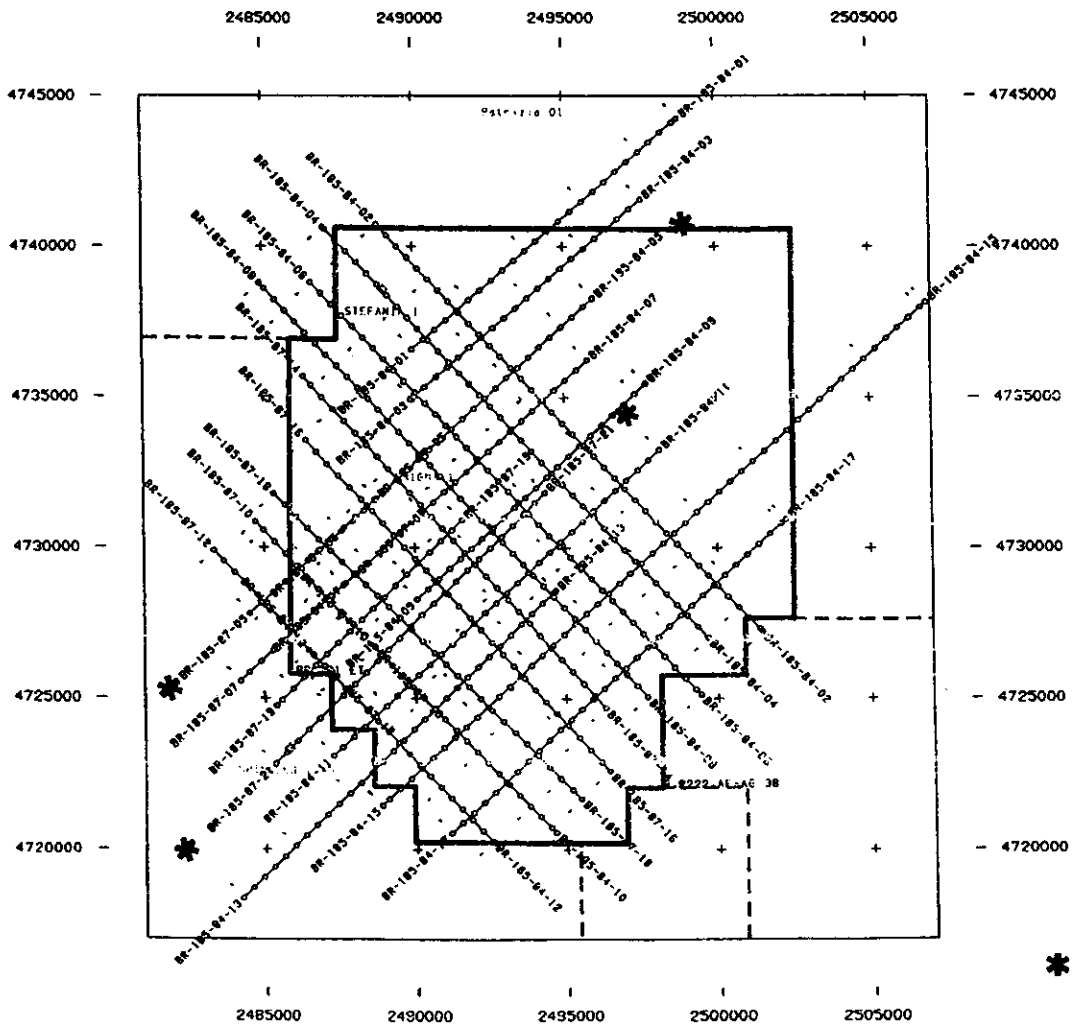
B.R231.ET

1991 SEISMIC DATA PURCHASE SUMMARY

TOT. Km 272.270

F-4

	LINE	S.P. RANGE	LENGHT Km
	BR.185.84 1	100 – 568	11.690
	BR.185.84 2	100 – 844	18.520
	BR.185.84 4	100 – 844	18.580
*	BR.185.84 5	100 – 556	11.390
	BR.185.84 6	100 – 850	18.750
	BR.185.84 7	100 – 542	11.030
	BR.185.84 8	100 – 850	18.740
	BR.185.84 10	100 – 449	8.730
	BR.185.84 11	100 – 696	14.880
	BR.185.84 12	100 – 450	8.740
	BR.185.84 13	100 – 684	14.610
	BR.185.84 15	100 –1272	19.310
*	BR.185.87 5	100 – 314	5.710
	BR.185.87 7	100 – 296	5.230
	BR.185.87 10	100 – 315	5.730
	BR.185.87 12	100 – 298	5.280
	BR.185.87 14	100 – 655	14.800
	BR.185.87 16	100 – 655	14.800
	BR.185.87 18	100 – 635	14.270
	BR.185.87 19	100 – 430	8.750
*	BR.185.87 21	100 – 578	12.750



* repr test

B.R231.ET

1991 SEISMIC DATA PURCHASE SUMMARY

TOT. Km 272.270

F-5

LINE	S.P. RANGE	LENGHT Km
BR.185.84 1	100 – 568	11.690
BR.185.84 2	100 – 844	18.520
BR.185.84 4	100 – 844	18.580
BR.185.84 5	100 – 556	11.390
BR.185.84 6	100 – 850	18.750
BR.185.84 7	100 – 542	11.030
BR.185.84 8	100 – 850	18.740
BR.185.84 10	100 – 449	8.730
BR.185.84 11	100 – 696	14.880
BR.185.84 12	100 – 450	8.740
BR.185.84 13	100 – 684	14.610
BR.185.84 15	100 –1272	19.310
BR.185.87 5	100 – 314	5.710
BR.185.87 7	100 – 296	5.230
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BR.185.87 16	100 – 655	14.800
BR.185.87 18	100 – 635	14.270
BR.185.87 19	100 – 430	8.750
BR.185.87 21	100 – 578	12.750

LINE	DBS–MIGR	DBS–RAP	DBS–TVF	FLT STACK REL. AMPL.	FLT STACK	MIGR. STACK	WST 84	ENSIGN 87	SCALE cm/sec
BR-185-84-01	x	x	x				x		10
BR-185-84-02	x	x	x				x		10
BR-185-84-03	x	x	x				x		10
BR-185-84-04	x	x	x				x		10
BR-185-84-05	x	x	x				x		10
BR-185-84-06	x	x	x				x		10
BR-185-84-07	x	x	x				x		10
BR-185-84-08	x	x	x				x		10
BR-185-84-09	x	x	x				x		10
BR-185-84-10		x	x	x*	x	x	x	x	10/20*
BR-185-84-11	x	x	x	x*	x	x	x	x	10/20*
BR-185-84-12		x	x				x		10
BR-185-84-13		x	x	x*	x	x	x	x	10/20*
BR-185-84-15	x	x	x	x*	x	x	x	x	10/20*
BR-185-84-17	x	x	x				x		10
BR-185-87-05					x	x		x	10
BR-185-87-07					x	x		x	10
BR-185-87-10					x	x		x	10
BR-185-87-12					x	x		x	10
BR-185-87-14					x	x		x	10
BR-185-87-16					x	x		x	10
BR-185-87-18					x	x		x	10
BR-185-87-19					x	x		x	10
BR-185-87-21					x	x		x	10

BR-185-84

WESTERN RICERCHE GEOFISICHE
MILAN - ITALY

AREA ADRIATIC SEA
PERMIT BR.185.84

DATE OF RECORDING JULY.1984
DATE OF PROCESSING OCTOBER.1984

RECORDING DATA

BOAT

SHOT BY	WESTERN GEOPHYSICAL
VESSEL	JUNAK
PRIMARY NAVIGATION SYSTEM	SYLEDIS
MAP/SECTION LOCATION	COP POSITION

SOURCE

AIRGUN

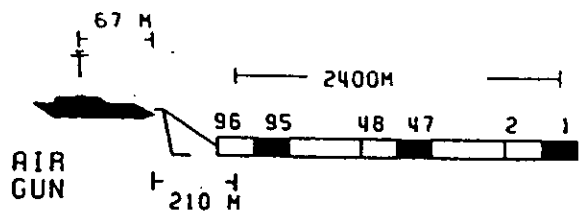
SHOT DEPTH	6 M
POPS PER KM	40
SP INTERVAL	25M

INSTRUMENTS

MAKE/MODEL	T.I./ DFS-V
REC. FILTERS HZ (LOW)	OUT
REC. FILTERS HZ (HIGH)	128HZ-72 DB/OCT
RECORD LENGTH	6 SECS
FORMAT	SEG B/1600 BPI
SAMPLE RATE	2 MS

CABLE

STREAMER	2400 M
GROUPS	96
GROUP INTERVAL	25 M



SCALES

HORIZONTAL.. 8CMS/1KM
VERTICAL.... 10 CMS/SEC

PROCESSING SEQUENCE

PROCESSING SAMPLE RATE 4 MS

DEMULTIPLEX

QUALITY CONTROL

NEAR TRACE DISPLAY AND 100%

DECONVOLUTION BEFORE STACK

GEOMETRIC SPREADING APPLIED

DECON TYPE	MIN PHASE INVERSE FILTER
WINDOW LENGTH	3 X 2000 MS
OPERATOR LENGTH	200 MS
MIN PREDICTION DISTANCE	24 MS
PERCENT WHITE LIGHT	1 PCNT

TRACE BALANCE ON OUTPUT

VELOCITY ANALYSIS

GATHER VELAN

4800%,N.M.O.,STACK

MUTE APPLIED
DYNAMIC CORRECTION

R.M.S. GAIN

TIME VARIANT FILTER

FILTERS ARE INTERPOLATED BOTH SPATIALLY AND TEMPORALLY.

FREQUENCY
16/24- 64/96
12/24- 56/72
10/18- 48/72
8/18- 40/36

BR-185-87

PROCESSING

COMPANY:	ENSIGN GEOPHYSICS LTD., ADDLESTONE WEYBRIDGE, UK.
DATE:	JUNE 1987
CONTRACT NO.:	309
DATA LENGTH:	3 SEC
SAMPLE RATE:	4 MS

1. SEG-D REFORMAT

2. RESAMPLE

DATA:	2 MS TO 4 MS
ANTI ALIAS FILTER:	90(72) HZ(DB/OCT) MIN. PHASE

3. AMPLITUDE RECOVERY

TYPE:	EXPONENTIAL
	0.000 - 0.625 SEC AT +21 DB
	0.625 - 1.275 SEC AT +14 DB
	1.275 - 2.075 SEC AT +12 DB
	2.075 - 3.000 SEC AT +5 DB

4. CDP SORT

5. DECONVOLUTION BEFORE STACK

TYPE:	MIN. PHASE LEAST SQUARES INVERSE
AUTOCORRELATION WINDOW:	
DESIGN NEAR TRACE:	300-2900 MS
DESIGN FAR TRACE:	2500-2900 MS
MAX. PREDICTION LAG:	260 MS
MIN. PREDICTION LAG:	20 MS
FILTER APPLIED:	0-3000 MS

6. TRACE AMPLITUDE BALANCE

DESIGN WINDOW:	
NEAR TRACE:	1000-2900 MS
FAR TRACE:	2400-2900 MS

7. VELOCITY ANALYSIS

	CONTOURED SPECTRA
INTERVAL:	1 KM

8. AMPLITUDE SCALING
   INVERSE EXPONENTIAL GAIN

9. NMO CORRECTION

10. STACK

COVERAGE:	6000%
MUTE:	OUTSIDE TRACE OFFSET DEPENDENT

11. SPHERICAL DIVERGENCE COMPENSATION

ALGORITHM:	T.V**2 DEPENDENCE

12. DECONVOLUTION AFTER STACK

TYPE:	MIN. PHASE LEAST SQUARES INVERSE AVERAGED OVER 11 ADJACENT TRACES
AT SP 100	
AUTOCORRELATION WINDOW:	ZONE 1
DESIGN:	300 - 1600 MS
APPLICATION:	0 - 1400 MS
MAX. PREDICTION LAG:	260 MS
MIN. PREDICTION LAG:	32 MS
AUTOCORRELATION WINDOW:	ZONE 2
DESIGN:	2200 - 2800 MS
APPLICATION:	2200 - 3000 MS
MAX. PREDICTION LAG:	260 MS
MIN. PREDICTION LAG:	32 MS

13. BAND LIMITED SPECTRUM EQUALISATION

TYPE:	MIN. PHASE LEAST SQUARES INVERSE AVERAGED OVER 11 ADJACENT TRACES
AT SP 100	
	ZONE 1
AUTOCORRELATION DESIGN:	300 - 1600 MS
APPLICATION:	0 - 1400 MS
FILTER LENGTH:	40 MS
FOUR CORNER BANDLIMITS:	30-40 TO 75-90 HZ
	ZONE 2
AUTOCORRELATION DESIGN:	2200 - 2800 MS
APPLICATION:	2200 - 3000 MS
FILTER LENGTH:	40 MS
FOUR CORNER BANDLIMITS:	15-25 TO 55-75 HZ

14. TIME VARIANT FILTER

AS SPECIFIED AT SP 100

TIME (MS)	LOW CUT (HZ(DB/OCT))	HIGH CUT (HZ(DB/OCT))
0 - 300	14(18)	OUT
1000	10(18)	90(36)
2300	8(18)	60(36)
3000	8(18)	50(36)

2. REPROCESSING TEST 92

The reprocessing test 92 was performed by Western Geophysical-London and carried on the dip lines BR 185-84-05 - BR 185-87-05, and, as a check, on line BR 185-87-21.

2.1 Objectives of the Reprocessing Test

The principal objectives of this reprocessing test were aimed at:

- *general improvement of the seismic data*
- *merging quality testing between 1984 and 1987 dip lines with the aim of homogenizing the dip data*
- *improvement of the seismic resolution of the "Icaro Structure" (main target) within and around the prospect*
- *improvement of the seismic image in the Pliocene (secondary target).*

2.2 Principal Tests Done

The reprocessing tests have been concentrated in particular on:

- *deconvolution*
- *multiples attenuation*
- *NMO-DMO velocity analysis*
- *migration time*
- *merging of the seismic data*

On Enclosure 1, in a brochure, the principal steps of the reprocessing work are represented by comparison with old stack section.

2.2.1 Deconvolution

(A) TYPE SELECTED

DBS (spiking) operator 300 ms, GAP 20 ms, 1 x 3000 window

TESTS:	**GAP**	**WINDOWS**	**DISPLAYS**
	NODBS	NODBS	DMO STACK
	4 ms	1 x 3000 ms	NMO STACK, DMO STACK
	12 "	1 x 3000 "	DMO STACK
	16 "	1 x 3000 "	DMO STACK
	20 "	1 x 3000 "	NMO STACK, DMO STACK
	24 "	1 x 3000 "	DMO STACK
	32 "	1 x 3000 "	DMO STACK

(B) TYPE NOT SELECTED

DAS operator 160 ms

TESTS:	GAP	WINDOWS	DISPLAYS
	12 ms	1x3000 ms	DMO STACK
	20 "	1x3000 "	DMO STACK
	32 "	1x3000, 2x1500, 2x2000 ms	DMO STACK
	48 "	1x3000, 2x1500, 2x2000 "	DMO STACK

2.2.2 Multiple Attenuation

The multiples have been attenuated by using the "MAFK function". This is a classic programme that applies a NMO correction to the data using a velocity function that lies between multiple velocities and primary velocities (NMO SFM).

After this operation the reflections will be over-corrected and the multiple reflections under-corrected. Then, everything is transformed in FK domain where the under-corrected events are filtered. After the data return in FX domain where an "inverse NMO" restores the reflections at the same time

they had an input. The application of this function in this case seems efficient especially in the elimination of the long period multiples.

2.2.3 NMO-DMO Velocity Analysis

A sensible improvement in seismic data is possible by a more detailed study of velocity. It was noted that the NMO sections presented a certain "dipping residual noise" associated with a general "random noise".

A first test to remove these noises was applied on the NMO section by a "FK dip filter", but a real general improvement on the "stack section" was founded only after DMO analysis.

2.2.4 Migration Time

The tests of migration has been based on the use of DMO velocities that for definition are the nearest to geological velocities.

Two series of migration tests have been run:

1) *Finite Difference Migration* of DMO stack section using 90%, 95%, 100%, 105% DMOSTK velocities.

2) *Modified Residual Migration* ("Carcated Stolt Migration" more residual Finite Difference Migration) using 90%, 95%, 100%, 105% DMOSTK velocities.

After the Finite Difference Migration the most steeply dipping seismic events remained partially unresolved. These dipping events showed much better resolution by using the steep dip algorithm of "Modified Residual Migration", in particular using 100% and 105% DMO STK velocities.

An important improvement on seismic resolution has been noted after "residual migration". This improvement can be very important fro the seismic interpretation over the "Icaro structure" (*Figures 8,9*).

2.2.5 Merging of the Seismic Data

The 1987-05 line is the natural extension of the 1984-05 line. The efficiency of a merging between these two lines must be verified in order to homogenize the seismic data, and the processing, and in order to have a better regional image for the interpretation.

Trace spacing parameters of two lines:
- line BR 185-84-05 trace spacing 25 m
- line BR 185-87-05 trace spacing 13,33 m

A trace interpolation programme has been applied on the two sections to transform their trace spacing to 12.5 m and, afterwards, the two lines were merged. This result is considered to be quite good; no particular anomalies on the stack data have been noted after trace interpolation and merging.

2.3 Final Displays and Costs

- Stack Section Display:

  - DBS-MAFK-DMOSTK-TVF-MERGE

- Migrated Section Displays:

  - RESIDUAL MIGRATION 105% V DMOSTK-MERGE
  - RAP-RESIDUAL MIGRATION

- Scales:

  - HORIZONTAL 1 km = 8 cm
  - VERTICAL 10 cm=1 sec and 5 cm=1 sec
  - VERTICAL 20 cm=1 sec (1-3.0 STWT) RAP VERSION

- Reprocessed Test Line:

  - BR 185-84-05 merged with BR 185-87-05 (Total 17.10 km)
  - Estimated costs: $ 8,500 (~ $ 500/km)
  - Reprocessing test period: 1/2/1992 to 30/6/1992 (4 months)

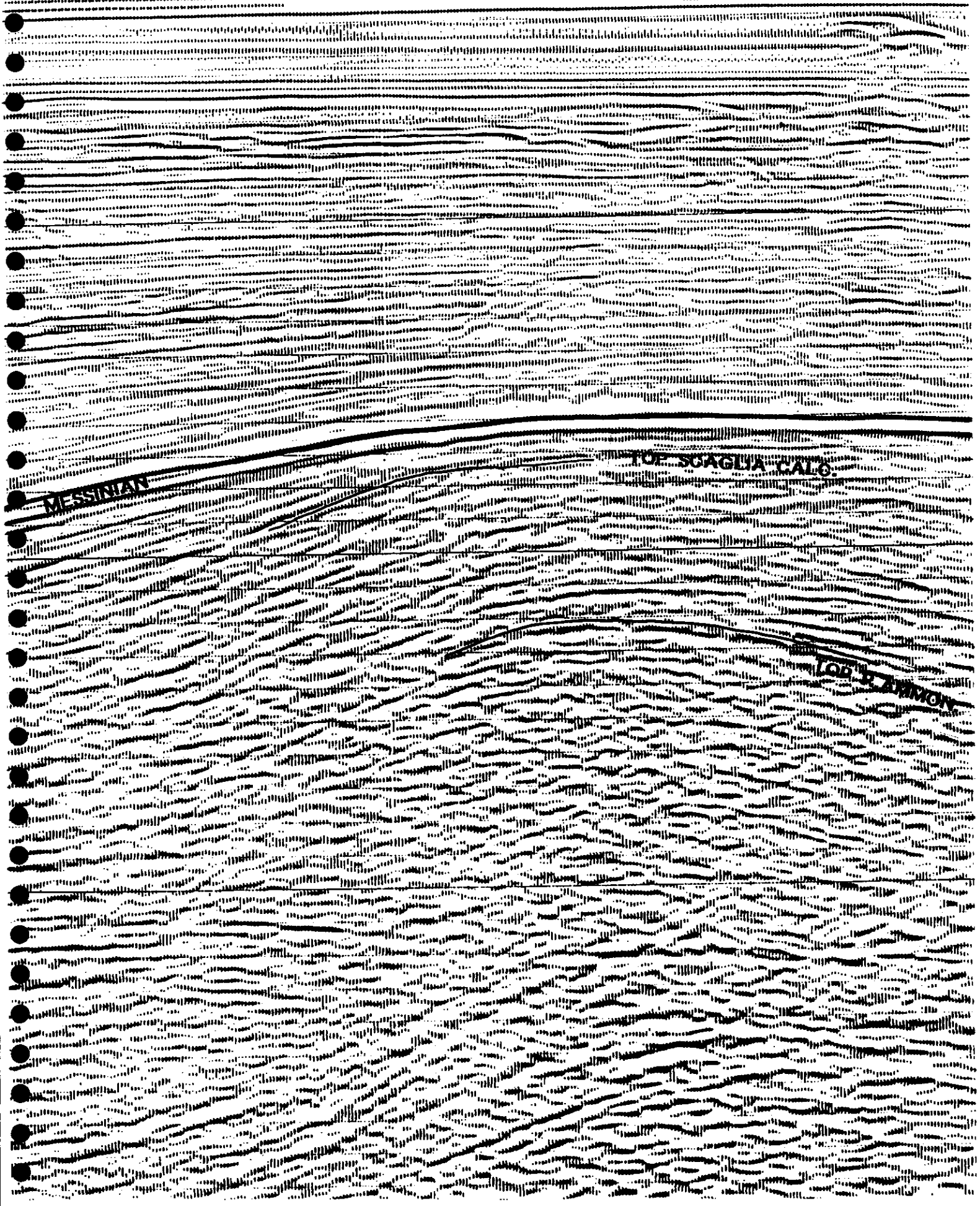
- Reprocessing Test of Control:

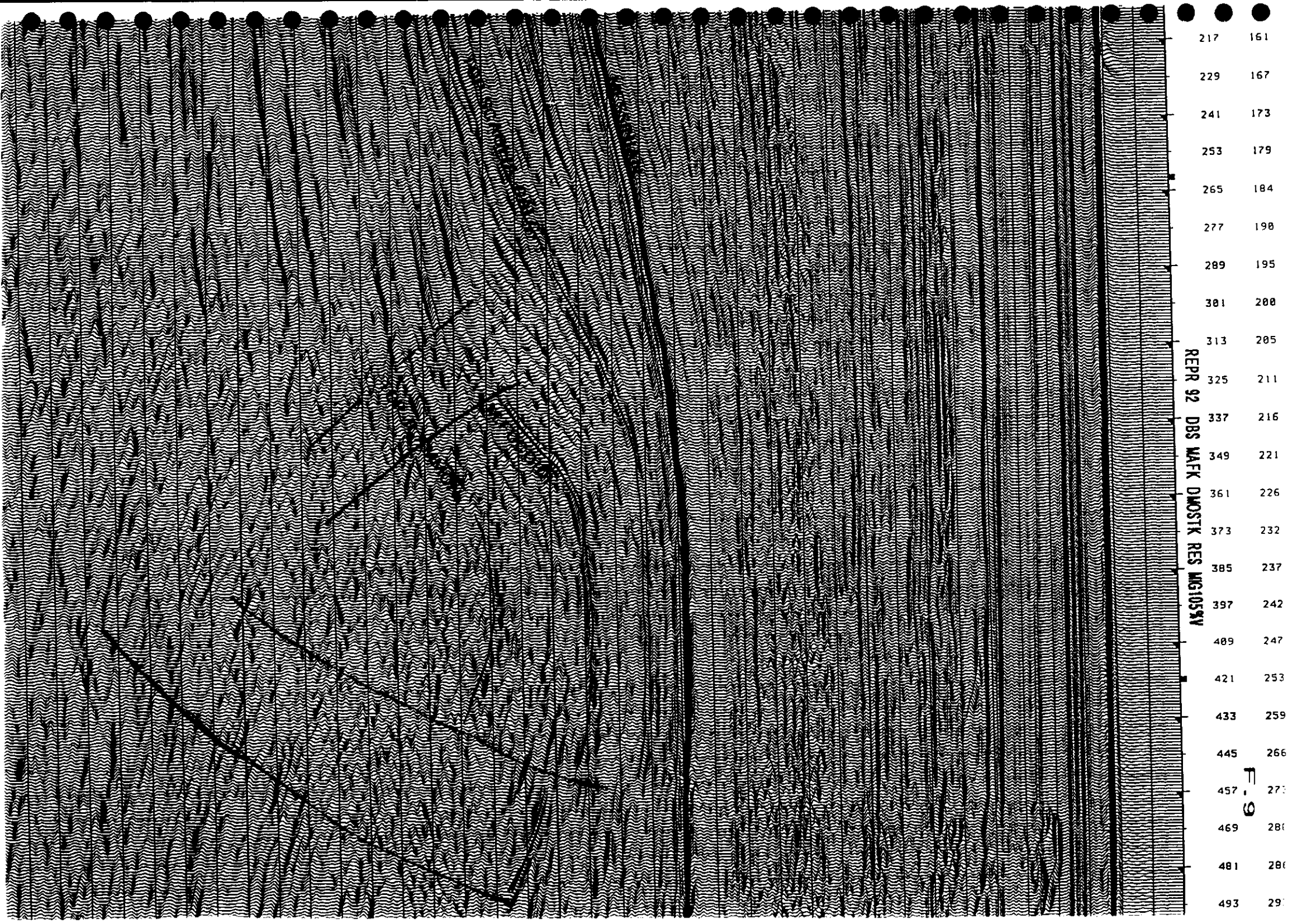
  - Line: BR 185-87-21 (Total 12.75 km)
  - Estimated costs: $ 1,750 (~ $ 140/km)

The result of this control of reprocessing quality confirms the interesting improvement of the general seismic resolution.

OLD PROCESSING

BR 185.84 05 DBS MIGR.

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229 167
241 173
253 179
265 184
277 190
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301 200
313 205
325 211
337 216
349 221
361 226
373 232
385 237
397 242
409 247
421 253
433 259
445 266
457 273
469 280
481 286
493 29
REPR 92 DBS MAFK DMOSTK RES MG105%V

Fig. 9

3. CONCLUSIONS AND RECOMMENDATIONS

(Enclosures Nos. 2,3,4,5)

Based on the final result of this reprocessing test, a reprocessing of the residual global volume of the seismic purchased, about 254.9 km, is recommended.

"Merging Data Operations" between 1984 and 1987 "Dip Seismic Data" and reprocessing 1987 data (old processing only until 3.0 sec TWT) will be essential to have a better regional seismic image and to homogenize the seismic data with the new 1992 seismic acquisition.

To obtain an homogeneous grid of seismic data (same reprocessing, displays, migrations, etc.) we suggest using the same Contractor (Western Geophysical) for the residual reprocessing work on vintage data and also for the processing of the programmed new seismic acquisition.

APPENDIX I

REPROCESSING TEST LINES BR 185-84-01/BR 185-87-01

REPROCESSING PROGRESS LISTING OF PROVISIONAL TEST DISPLAYS

LINE BR 185-84-05

1. DBS Tests
2. NMO Stack (DBS 4 ms GAP)
3. DMO Stack (DBS 4 ms GAP)
4. DMO Stack (DBS 20 ms GAP)
5. MAFK DMO Stack - DAS Test (DAS 1 Window)
6. MAFK DMO Stack - DAS Test (DAS 2 Windows x 1,500 ms)
7. MAFK DMO Stack - DAS Test (DAS 2 Windows x 2,000 ms)
8. MAFK NMO Stack (DBS 20 ms GAP)
9. MAFK NMO Stack - TVF
10. MAFK NMO Stack F.K. Filter
11. MAFK, NMO, F.K., F.D.MIG
12. MAFK, NMOSTK, F.D.MIG, F.K.
13. MAFK, DMO Stack
14. MAFK, DMO Stack (new MAFK function)
15. MAFK, DMO Stack (20 traces inside trace mute)
16. MAFK, DMO Stack (10 traces inside trace mute)
17. MAFK, DMO Stack TVF
18. MAFK, DMO Stack, F.D.MIG
19. NMO Velans
20. DMO Velans after MAFK
21. DMO Stack Panels
22. DMO Stack DAS-MIGRATION F.D.
23. DMO Stack Final
24. MAFK DMOSTK F.D.MIG. Final (100% V DMOSTK)
25. F.D.Migration Velocity Test (90% " ")
26. " " " " " (95% " ")
27. " " " " " (100% " ")
28. " " " " " (105% " ")
29. Residual Migration Velocity Test (90% " ")
30. " " " " (95% " ")
31. " " " " (100% " ")
32. " " " " (105% " ")
33. RAP of Residual Migration with RAMP Scaling
34. RAP of Residual Migration without RAMP Scaling

LINE BR 185-87-05

35. NMO Stack
36. DMO Stack (DBS 4 ms GAP)
37. DMO Stack DBS Panels
38. DMO Stack (DBS 20 ms GAP)
39. MAFK DMOSTK
40. MAFK, DMOSTK, TVF

COMPOSITE LINE BR 185-84/87-05

41. MAFK, DMOSTK, TVF, MERGE
42. Residual Migration Merged Line (105% V DMOSTK)

LINE BR 185-87-21

43. MAFK, DMO, STACK
44. Residual Migration (105% V DMOSTK)

SCALING GAIN TESTS

45.	Line BR 185-84-05	Test (A): Generalised Mean Gain	(P=.1, Q=.1, 300 ms W)
46.	"	Test (B): " " "	(P=.1, Q=.1, 500 ms W)
47.	"	Test (C): Reflection Strength Gain (300 ms smoothing filter standout 1.2)	
48.	"	Test (D): Reflection Strength Gain (300 ms smoothing filter standout 1.5)	
49.	"	Test (E): Instantaneous Gain	(500 ms W)
50.	"	Test (F): " "	(1000 ms W)
51.	"	Test (G): XAGC Gain	(RMS level 1200)
52.	"	Test (H): " "	(RMS level 1500)
53.	"	Test (I): " "	(RMS level 1800)
54.	"	RAP Playback Test	(GAIN 1DB, BAIS 0%)
55.	"	" " "	(GAIN 1DB, BAIS 0%)
56.	"	" " "	(GAIN 3DB, BAIS 0%)
57.	"	" " "	(GAIN 5DB, BAIS 0%)
58.	"	Playback Test	(GAIN 7DB, BAIS 0%)
59.	"	" "	(GAIN 8DB, BAIS 0%)
60.	"	" "	(GAIN 9DB, BAIS 0%)
61.	"	" "	(GAIN 9DB, BAIS +10%)
62.	"	" "	(GAIN 10DB, BAIS +10%)
63.	"	" "	(GAIN 10DB, BIAS +20%)
64.	"	" "	(GAIN 11DB, BAIS +20%)
65.	"	" "	(GAIN 12DB, BAIS +30%)

(All these provisional test displays are filed in EOE Rome)