6

VELOG PROCESSING
COD FIELD

7/

VELOG PROCESSING

COD FIELD - LINE PGE 7/11 X

A) - INTRODUCTION

VELOG processing consists in transforming a stacked and deconvolved seismic trace into a pseudo acoustic impedance (or velocity) trace. Such a trace shows only the fast (or high frequency) changes of the acoustic impedance since the frequency spectrum of the starting reflectivity trace does not contain low frequencies. Slow acoustic impedance changes can be derived from the stacking velocities and superimposed onto fast changes to yield an estimate of the true acoustic impedance.

It should be noticed that the transformation of a seismic trace into an acoustic impedance trace is meaningless if the seismic trace has not been well deconvolved beforehand. In other words, seismic events should be made very similar to a Dirac pulse zero-phase filtered outside the seismic band width and whose amplitude should be proportional to reflectivity. This is the primary objective of VELOG processing which runs an additional deconvolution based on the spectral properties of the studied stratigraphic sequence and its actual seismic response.

B) - QUALITY OF THE DATA

B1 - Seismic data

The line PGE 7/11-K have been reprocessed by CGG in order to fulfil the requirements of a further acoustic impedance type processing, namely :

a) the widest possible seismic band width

b) true amplitude processing

c) seismic events in their migrated position.

Basically, the main difference with SSL's processing was a continuous velocity analysis and the subsequent derivation of a smoothed velocity field for migration purposes.

The main seismic characteristics are :

1) a seismic frequency bandwidth extending up to 40 Hz at 3 sec reflection time. Therefore, a 4 ms sampling should be adequate.

2) a reasonable level of multiples, at least over the Paleocene sequence.

3) an improvment of resolution and character in general and at the Cod sand level in particular.

4) a general improvment of the S/N ratio as a result of continuous velocity analysis.

Remark :

It can be noticed that the seismic character close to large amplitude seismic events is markedly different on CGG's and SSL's sections. For instance, the bright events situated close to top Paleocene are accompanied by a fore runner on SSL's section. This is believed to be caused by the mixed phase characteristics of the phase compensation filter which might not be adapted to the actual DFS IV impulse response. Obviously, such a spurious event does not make easier Cod sand interpretation.

B2 - Synthetic data

We are not in a position to carry-out a good quality control of the basic sonic log owing to the lack of data. However, a few remarks about Sonic log quality can be made by using seismic data as a reference.

Correlation between 1X synthetic data and seismic data is poor in general and could either mean that sonic log quality is poor or that part of the stratigraphy at 1X cannot be projected onto the 7/11-X seismic line (1X offset : 450 m). Fortunately, correlation between A5 synthetic and seismic data turned out to be better (after detection of a few digitizing bugs !) and enabled us to derive a fairly good deconvolution operator.

Synthetic and seismic data correlation at shallower level (1.6 to 2.2 sec.) is poor (correlation still exists over small windows) even though there should not be any problem to project well data onto the seismic line. Also, synthetic data variations take place at 1.6 sec between A5 and 1X which are not present on the relevant seismic data. All this would tend to prove that the quality of the synthetic data was not optimum everywhere. This in conjunction with possible projection problem made our processing very difficult.

C) - ANALYSIS OF SYNTHETIC AND SEISMIC DATA AT A5 WELL LOCATION

C1 - Synthetic data

A5 Sonic log as displayed at the right hand side of the VELOG plate shows :

a) a drastic velocity character change at the top Paleocene level - where the monotonous tertiary shales contrasts with the Paleocene sand-shale-carbonates sequences.

b) a good velocity separability between shales, sands and carbonates. This separability still holds true in terms of acoustic impedance. As far as our main Cod sand objective is concerned, the cleaner sands have got a higher velocity and acoustic impedance than the shales or sandy shales. The A5 filtered velocity log shows that for the velocity (impedance) contrasts and the thickness associated with the cleaner main Cod sands, there should not be any problem to detect them by the seismic method(at least with a good S/N ratio). Unfortunately, the good separability of the cleaner main Cod sand is not confirmed by the well 1X. The impedance contrast between the cleaner sands and the shales or sandy shales is smaller at 1X than at A5 location. Is the sonic log to be suspected ? Anyhow, the main Cod sand characteristics as seen at A5 seems to be reliable and in agreement with other Paleocene sands (e.g. Forties Paleocene Sandstone). However, Cod sand velocities at the other Cod wells should be studied to confirm A5 results.

C2 - Comparison of seismic and synthetic data at A5 location

The seismic trace located at SP 172 has been correlated with synthetic velocity data within the 2500-3200 ms window for which the degree of correlation is fair - VELOG processing of the seismic trace SP 172 achieves a good match between the VELOG seismic data and the filtered velocity log, enabling us to calibrate seismic data in terms of stratigraphy. In particular, the main Cod sand which is pretty conspicuous on the filtered velocity log is very bright too on the VELOG data, making it possible to follow the Cod sand quality and/or thickness laterally.

The main stratigraphic markers such as the Paleocene marker, Top Danian, Top upper Cretaceous are easily identified on the A5 VELOG trace and furthermore the main filtered log characters are correlatable laterally. For instance, the negative low frequency character of the velocity log envelope between the main Cod sand and the top Danian is well preserved to the SW of A5. Also, velocity increases to be associated with top Danian and top upper Cretaceous can be traced laterally. A proposed interpretation has been drafted on the VELOG display.

The bottom part of the 1X filtered impedance log has been correlated with VELOG data in order to identify the top salt which is characterised by a negative very low frequency anomaly.

D) - VELOG DISPLAY INFORMATION

On the VELOG display (Pl. n° 4), the wiggle of every other pseudo-velocity trace has been effectively plotted. Still, the velocity information of the missing traces is partly preserved by interrupting or using a different color (only visible on the original Calcomp display) whenever the calibrated velocity (VELOG trace amplitude) goes beyond the predetermined values ± 500, 1500, 2500 m/s. The same axis plotting conventions are applied to every VELOG trace to make easier the manual iso-pseudo-velocity contouring. (An automatic contouring program is now available).

In order to tie the stratigraphy at the wells A5 and 1X to the seismic data, filtered and unfiltered logs have been correlated with the relevant VELOG traces. The geological markers plotted on the A5 velocity log might not be in their exact position since for this well, they were not provided to us.

Dips are about the same on the VELOG display and on the seismic section.

E) - COD SAND LATERAL PREDICTION FROM THE A5 WELL

If we assume that :

a) the stratigraphy at the wells 1X, A7 can be projected onto the seismic line.

b) the cleaner sands are to be associated with a high amplitude impedance contrast (1X Sonic does not confirm this hypothesis).

Then, the Cod sand lateral prediction from the A5 well shows that sand quality and/or thickness decreases to the NE of SP 133 (50 m SW of 1X projection) and becomes good again in the vicinity of A7 location. This Cod sand lateral development does not fit well results. However, if we relax the b) assumption, we notice that the Cod sand responses on the filtered log and on the VELOG trace are very similar. In other words, the acoustic impedance prediction has been successful at 1X projection. We would like to think that this is purely fortuitous because then, the seismic method would not be adequate for "good sand detection".

We would rather believe that the good sands are to be associated with high amplitude impedance contrasts but that the a) assumption does not hold true for 1X projection. To this respect, it should be born in mind that the well 1X is offset 450 m or 19 VELOG traces. Looking at Cod sand VELOG response in 1X area tells us that Cod sand distribution is probably not uniform along the seismic line PGE 7/11-K orientated SW-NE. Why should it be along the NW-SE direction ?

The same consideration could apply to the A7 well where the Cod sand disappear 4 traces to the SW of the A7 projection whereas the A7 well is offset 10 traces. About the presence of Cod sand in the vicinity of the A7 well, it is worth mentioning that they should be prognosed at about 9870 feet subsea and probably not deeper.

A last remark about a small fault, by no means certain, which could intersect the Cod sand at SP 141 of the PGE 7/11-X line.

F) - CONCLUSION

In spite of serious starting problems, VELOG processing has enabled the interpreter to identify without ambiguity the main Cod sands and the other formations of interest. In Cod area, impedance processing seems adequate to map sand distribution since we do see sand variations on the impedance processed sections. The results which have been obtained are in essence controversial owing to :

a) the lack of quality control means especially for 1X Sonic log

b) the lack of data for evaluating average sand acoustic properties with respect to the relevant formations. In other words, the full set of logs for the wells where a sonic log has been run should be required.

c) the offseted position of the wells and the lack of VELOG control in the NW-SE direction.

We feel that we have now obtained a suitable set of processing parameters which could be applied efficiently to clear up the controversial points.

S. GLUCK

Party : 996.95.90

PHILLIPS

COD

SW 1 **LINE** PGE7/11.K 302 NE

BOAT MOTION

PL N° 1

PAM . DBS . 4800 %

DEC 8.77

FIELD RECORDING 4800 %
Contractor GECØ

SHIP

NAVIGATION BY .... LONGVA / P.101
SHOOTING DATE ....

INSTRUMENTS

DFS IV
FORMAT .... SEGC
FILTER .... LO: 8Hz 18dB OCT. HI : 124 Hz
SAMPLING .... 2 ms

SOURCE

DEPTH .... 7.5 m
CAPACITY .... 3600 CU. INC
SP INTERVAL .... 25 m

STREAMER

LENGTH .... 2400 m
DEPTH .... 12-14 m
GROUPS 48
GROUP INTERVAL .... 50 m
GEOPHONES 30/TRACE

Source T48 47 T2 T1
230 m 2350 m
Position of SP on section

DIGITAL PROCESSING P6
Sequence in 2 ms

DEMULTIPLEX
AMPLITUDE DECAY ANALYSIS } PAM
TRUE AMPLITUDE RECOVERY }
MUTES
DECONVOLUTION
Operator Length 150 ms
Derivation windows for near trace
i) 200 2500 ms ii) 1500-4000 ms
Application windows for near trace
i) 0-1500 ms ii) 1500-6000 ms
CONTINUOUS VELOCITY ANALYSIS
DYNAMIC CORRECTIONS
STACK 4800 %
GUN AND CABLE STATIC CORRECTIONS (+14 ms)
FILTER 8-70
ANALOG DISPLAY

POLARITY
GEOPHONE COMPRESSION = TAPE NEGATIVE NUMBER
= DISPLAY WHITE

TIME ORIGIN : SEA LEVEL

HORIZONTAL SCALE 40 traces km
1 km

COMPAGNIE GENERALE DE GEOPHYSIQUE
6, Rue Galvani - 91301 - MASSY - FRANCE

LINE PGE 7/11.K

CDP 58 SP 11

TIME	NMO VEL	INT VEL
125	1500	1500
825	1891	1952
1675	2022	2141
1875	2022	2022
2650	2070	2181
3100	2163	2645
3250	2268	3841
3550	2637	5153
3950	2960	4980
5400	3691	5183
		5000

CDP 82 SP 35

TIME	NMO VEL	INT VEL
125	1500	1500
825	1832	1885
1650	1984	2125
1825	2012	2259
2600	2046	2123
3025	2114	2489
3200	2269	4109
3400	2482	4727
3525	2723	6444
5375	3072	3645
		5000

CDP 106 SP 59

TIME	NMO VEL	INT VEL
125	1500	1500
800	1834	1889
1625	1983	2117
1825	2017	2274
2550	2080	2230
3000	2110	2272
3150	2183	3321
3350	2539	5737
3475	2732	5893
5375	3189	3888
		5000

CDP 130 SP 83

TIME	NMO VEL	INT VEL
125	1500	1500
800	1833	1888
1625	1983	2118
1775	1994	2109
2475	2016	2070
2950	2100	2492
3100	2163	3156
3300	2427	4967
3500	2779	6161
5350	3268	4034
		5000

CDP 154 SP 107

TIME	NMO VEL	INT VEL
125	1500	1500
800	1846	1903
1625	2012	2160
1775	2014	2035
2500	2071	2204
2925	2091	2204
3000	2097	2318
3275	2360	4284
3500	2897	7034
5400	3252	3820
		5000

CDP 178 SP 131

TIME	NMO VEL	INT VEL
125	1500	1500
800	1827	1881
1600	1987	2135
1750	2004	2177
2450	2033	2103
2925	2123	2537
3050	2147	2647
3175	2263	4195
3375	2562	5428
5325	2756	3062
		5000

CDP 202 SP 155

TIME	NMO VEL	INT VEL
125	1500	1500
800	1831	1885
1600	1972	2103
1775	2006	2293
2500	2079	2247
2925	2106	2258
3075	2157	2981
3300	2420	4723
3600	2741	5073
5325	2830	3007
		5000

CDP 226 SP 179

TIME	NMO VEL	INT VEL
125	1500	1500
800	1862	1921
1600	1995	2119
1775	2004	2084
2550	2080	2244
3000	2099	2203
3125	2174	3523
3275	2286	3953
3700	2834	5445
5400	2947	3179
		5000

CDP 250 SP 203

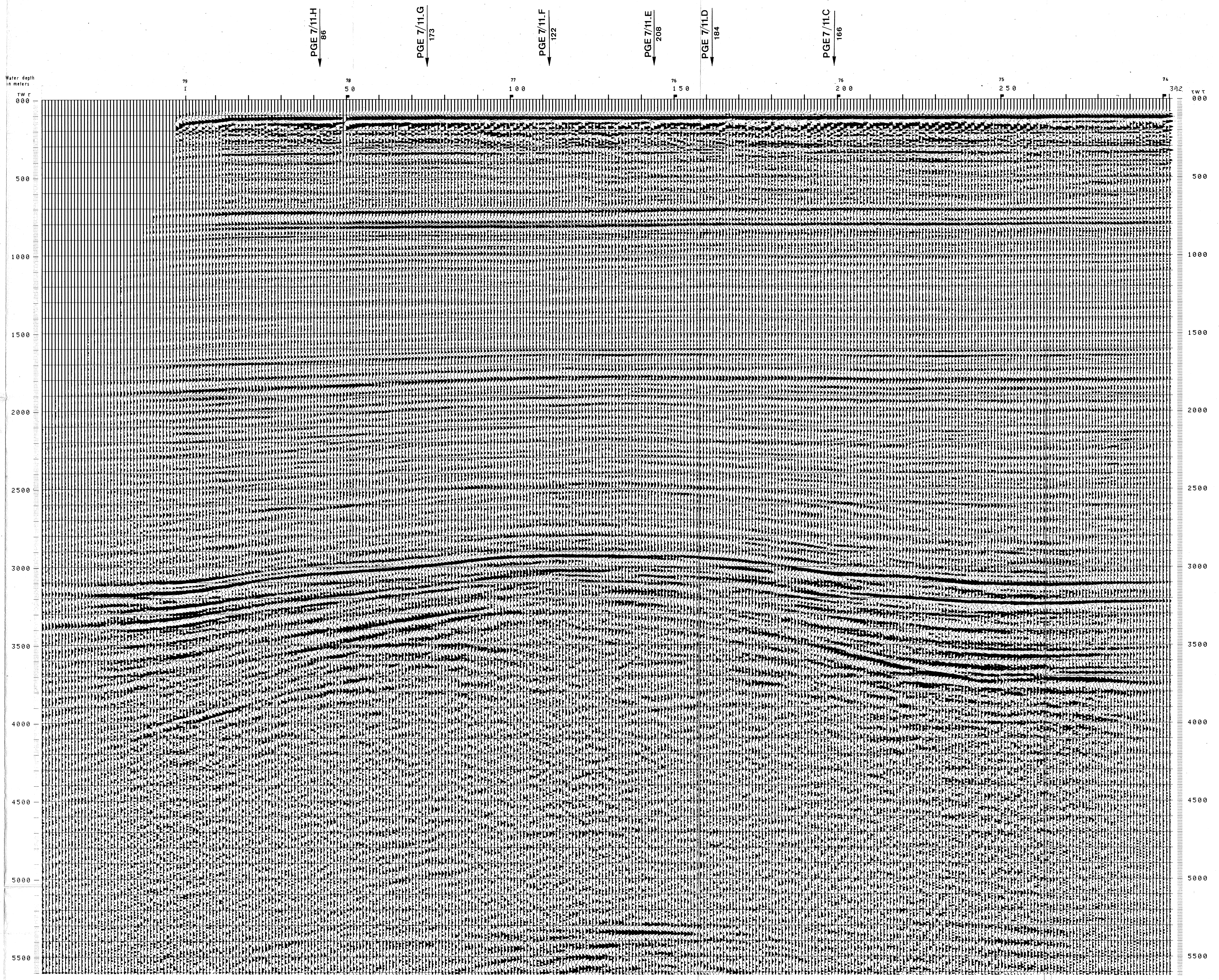
TIME	NMO VEL	INT VEL
125	1500	1500
800	1854	1912
1625	1995	2122
1775	1991	1947
2575	2091	2297
3050	2146	2422
3175	2199	3233
3325	2431	5352
3575	2851	6134
5450	3356	4152
		5000

CDP 274 SP 227

TIME	NMO VEL	INT VEL
125	1500	1500
800	1857	1915
1625	2004	2136
1825	2027	2204
2575	2099	2264
3075	2142	2351
3200	2182	3002
3400	2544	5817
3625	2821	5514
5300	3090	3604
		5000

CDP 298 SP 251

TIME	NMO VEL	INT VEL
125	1500	1500
800	1881	1943
1625	2000	2108
1825	2021	2184
2600	2109	2302
3100	2132	2247
3200	2136	2256
3400	2553	6148
3750	2843	4825
5425	3331	4223
		5000



Party : 996.95.90

PHILLIPS

COD

SW 1 **LINE** PGE7/11.K 302 NE

BOAT MOTION →

PL N° 2

MIGRATION AFTER PAM

DEC.22.77

FIELD RECORDING 4800 %
Contractor GECØ

SHIP

NAVIGATION BY .... LONGVA / P-101
SHOOTING DATE ....

INSTRUMENTS

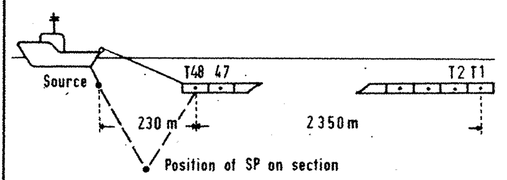
DFS IV
FORMAT .... SEGC
FILTER .... LO : 8Hz 18dB OCT - HI : 124 Hz
SAMPLING .... 2 ms

SOURCE

DEPTH .... 7.5 m
CAPACITY .... 3600 CU-INC
SP INTERVAL .... 25 m

STREAMER

LENGTH .... 2400 m
DEPTH .... 12-14 m
GROUPS 48
GROUP INTERVAL .... 50 m
GEOPHONES 30/TRACE



DIGITAL PROCESSING P6
Sequence in 2 ms

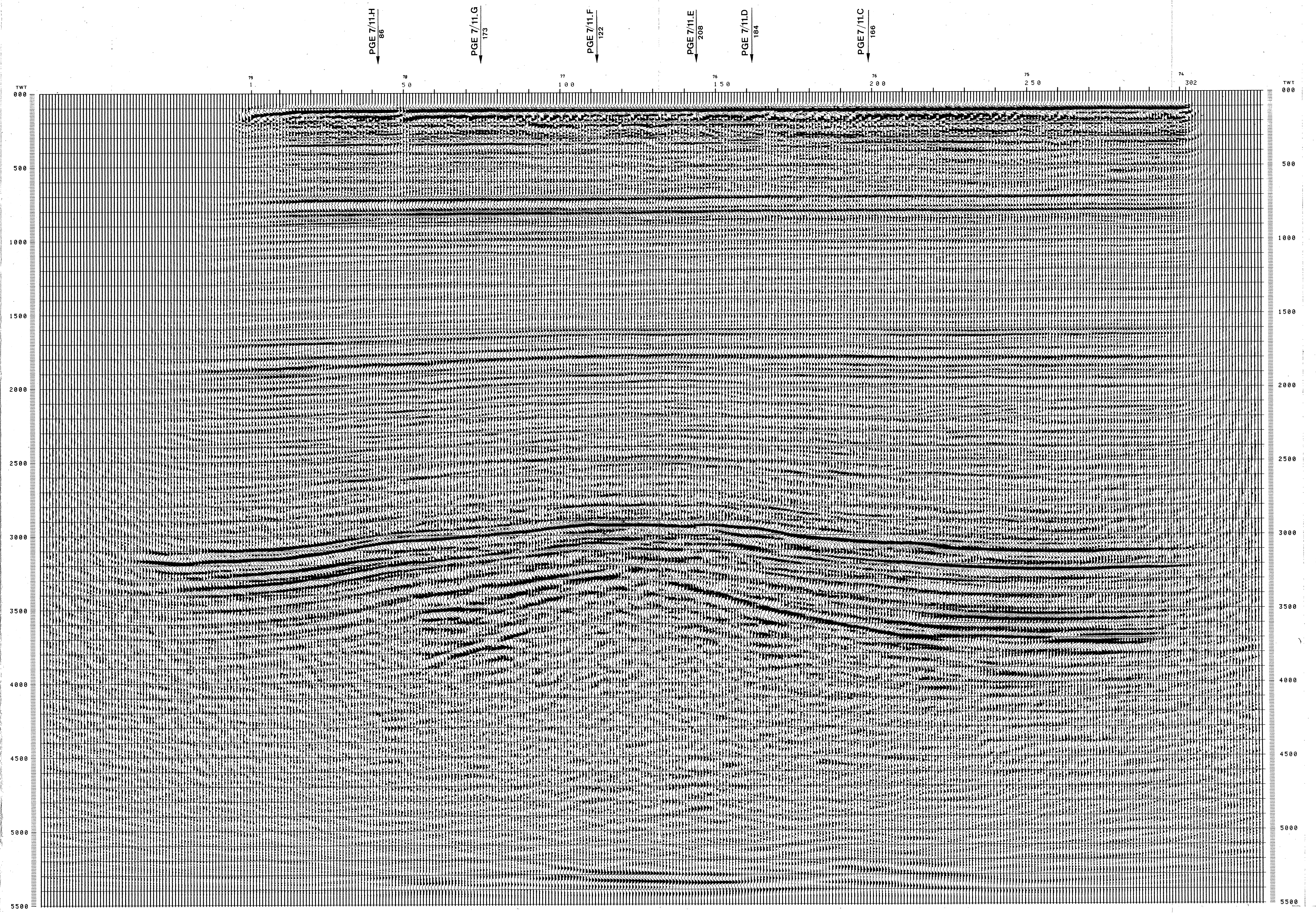
DEMULTIPLEX
AMPLITUDE DECAY ANALYSIS } PAM
TRUE AMPLITUDE RECOVERY }
MUTES
DECONVOLUTION
Operator Length 150 ms
Derivation windows for near trace
i) 200 2500 ms ii) 1500 - 4000 ms
Application windows for near trace
i) 0 - 1500 ms ii) 1500 - 6000 ms
CONTINUOUS VELOCITY ANALYSIS
DYNAMIC CORRECTIONS
STACK 4800 %
GUN AND CABLE STATIC CORRECTIONS (+14 ms)
FILTER 8 - 70
MIGRATION IN TIME
ANALOG DISPLAY

POLARITY
GEOPHONE COMPRESSION = TAPE NEGATIVE NUMBER
= DISPLAY WHITE

TIME ORIGIN : SEA LEVEL

HORIZONTAL SCALE 40 traces / km
1 km

COMPAGNIE GENERALE DE GEOPHYSIQUE
6, Rue Galvani - 91301 - MASSY - FRANCE



Party : 996.95.90 **PHILLIPS**

COD

SW 1 **LINE** PGE7/11.K 302 NE

BOAT MOTION →

PL N° 3

DBS_4800 %

JAN.12 78

FIELD RECORDING 4800 %
Contractor GECØ

SHIP

NAVIGATION BY .... LONGVA/P_101
SHOOTING DATE ....

INSTRUMENTS

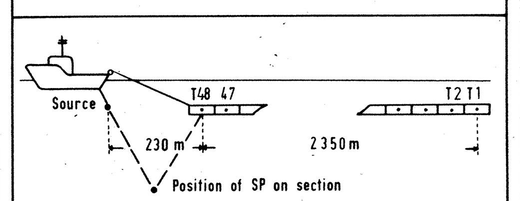
DFS IV
FORMAT .... SEGC
FILTER .... LO:8Hz 18dB OCT_HI:124Hz
SAMPLING .... 2 ms

SOURCE

DEPTH .... 7,5 m
CAPACITY .... 3600 CU_INC
SP INTERVAL .... 25 m

STREAMER

LENGTH .... 2400 m
DEPTH .... 12_14 m
GROUPS 48
GROUP INTERVAL .... 50 m
GEOPHONES 30/TRACE



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HORIZONTAL SCALE 40 traces / km
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COMPAGNIE GENERALE DE GEOPHYSIQUE
6, Rue Galvani - 91301 - MASSY - FRANCE

LINE PGE 7/11 K

CDP 58 SP 11

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CDP 106 SP 59

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CDP 298 SP 251

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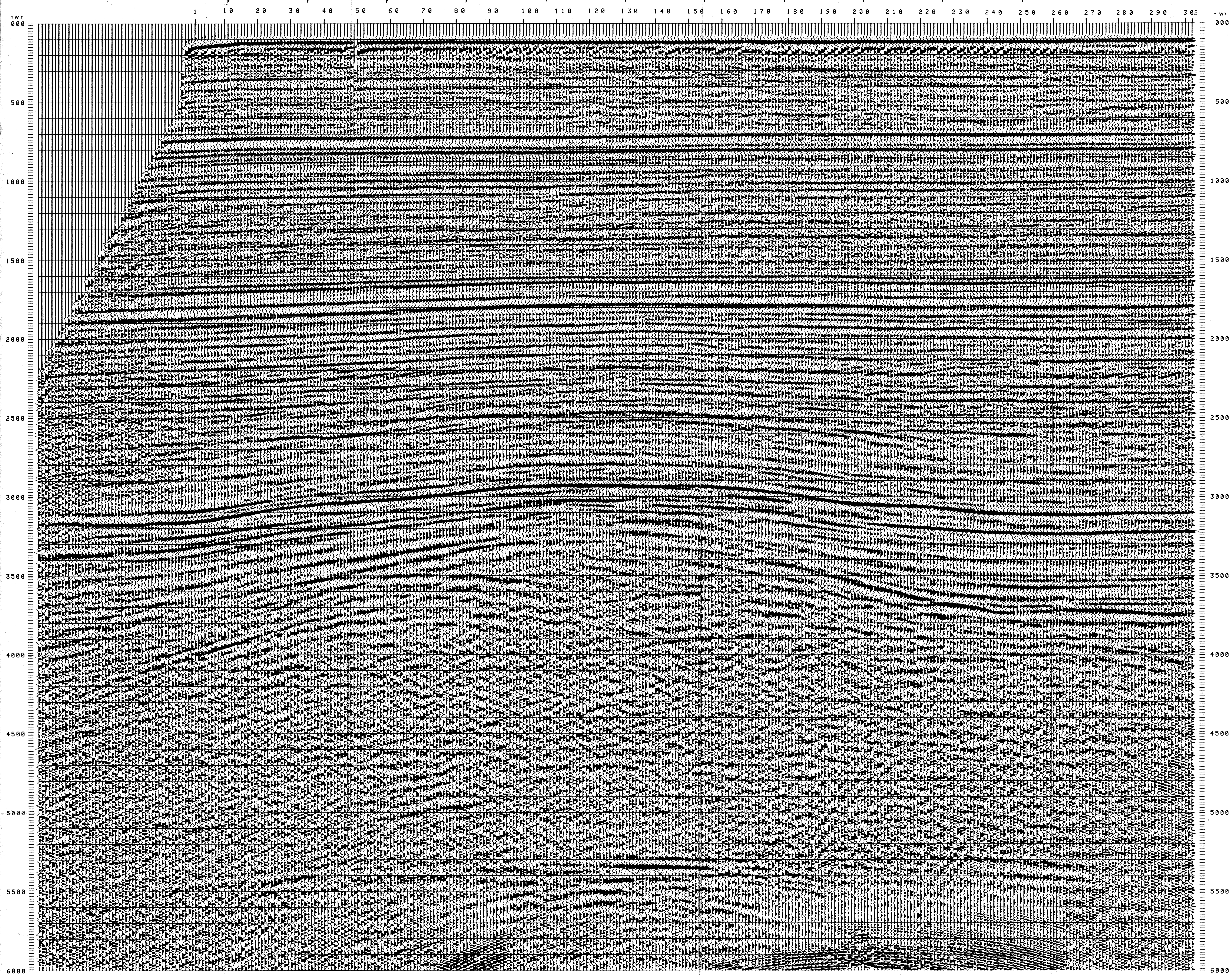

Party : 996.95.90 **PHILLIPS**

COD

SW 1 **LINE PGE7/11K** 285 NE

BOAT MOTION →

PL-N° 4 "VELOG" JAN.11.78

SYNTHETIC DATA PROCESSING
- 7/11 - A 5 and 7/11 - 1 X sonic and density log digitizing
- Log filtering and displaying
- Synthetic seismogram derivation

SEISMIC DATA PREPROCESSING : Sampling rate : 2 ms
- 4800% stack
- Band pass filtering 8/70 Hz
- Wave equation migration "WEMIG"

PSEUDO VELOCITY PROCESSING "VELOG"
- Stratigraphic deconvolution operator design from synthetic and seismic data at 7/11 - A 5 location (derive window : 2500 - 3070 ms)
- Stratigraphic deconvolution application (2700 - 3500 ms)
- Pseudo velocity calculation (HF component)
- Calcomp display of VELOG traces (every other trace)
- Isovelocity contouring (contour interval : 1000 m/s)

+1500 + 500 - 500 m/s - 1500 m/s

Horizontal scale : 1 / 3330

COMPAGNIE GENERALE DE GEOPHYSIQUE
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