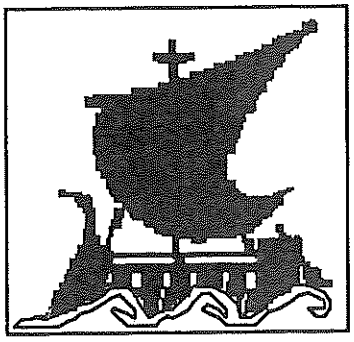
European Commission
Directorate General for Science, Research and Development
Directorate for Environment

Advanced Study Courses in Marine Science and Technology



MAST

Insights on the formation and evolution of Mediterranean basins

6-24 July, 1998

SEA-CRUISE GUIDE-BOOK

on board Research Vessel « Tethys II » (CNRS-INSU, France)

directed by Jacques DEVERCHERE

MAST'98

Sea-Cruise Guide-Book

Cruise : GEOLIG

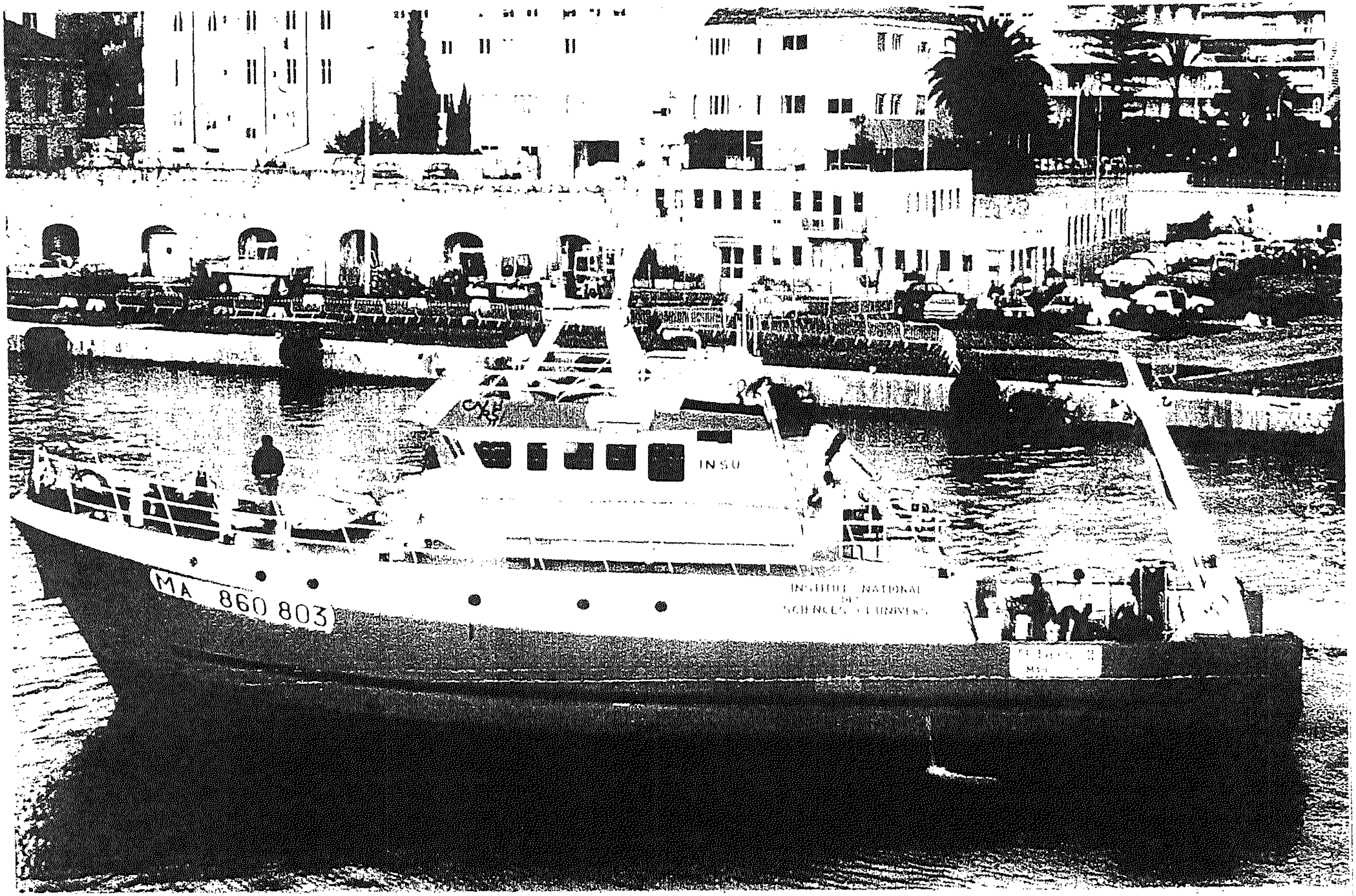
July 15-19, 1998

- **The Research Vessel « *Tethys II* » (CNRS-INSU, France)**

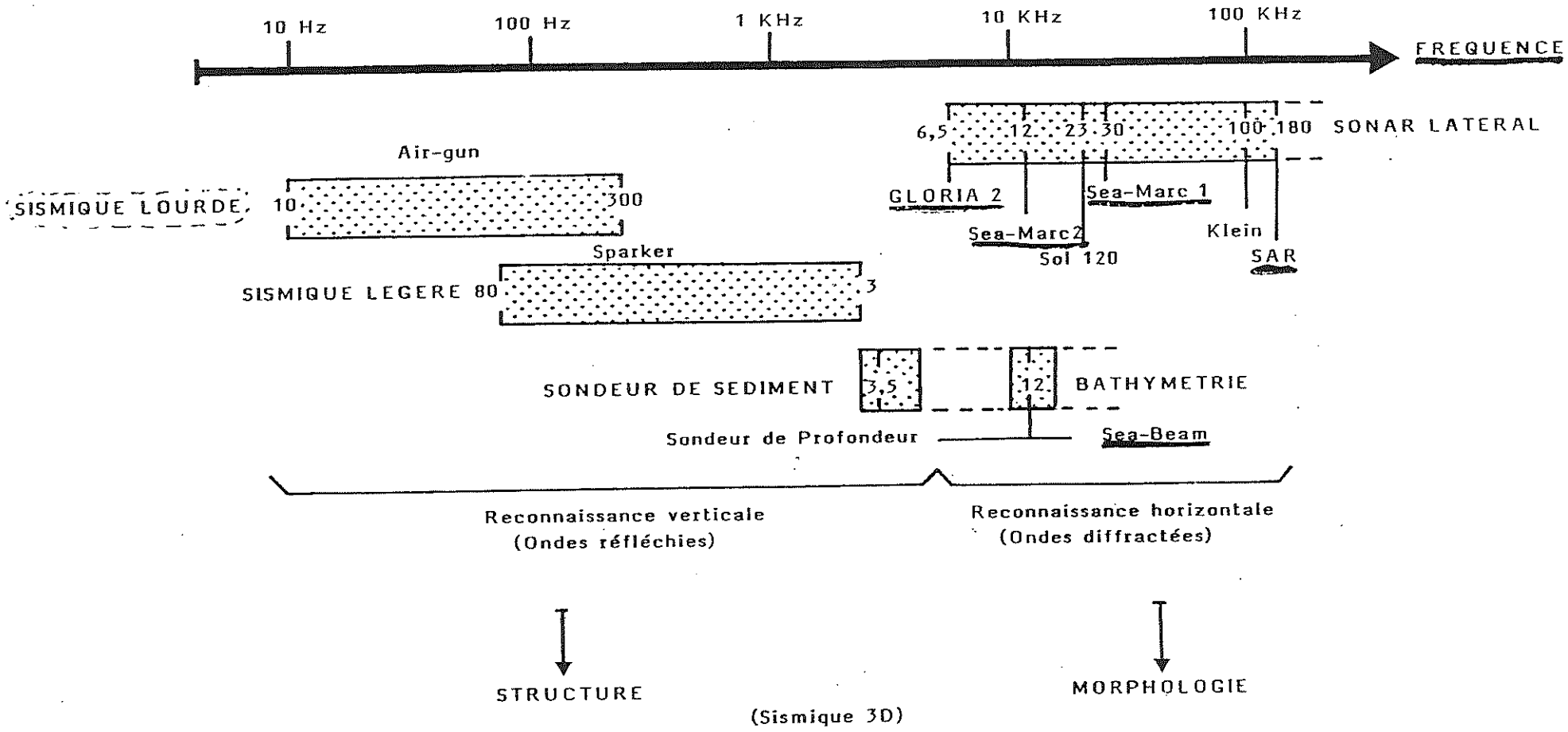
- **Seismic source and mode of acquisition of data**
  - the seismic operation mode
  - the air gun : how it works
  - the bubble pulse and its signatures
  - Time and frequency response of sources
  - Tuned air-gun arrays
  - Vertical and horizontal resolution

- **Detailed bathymetric maps of the Ligurian sea**

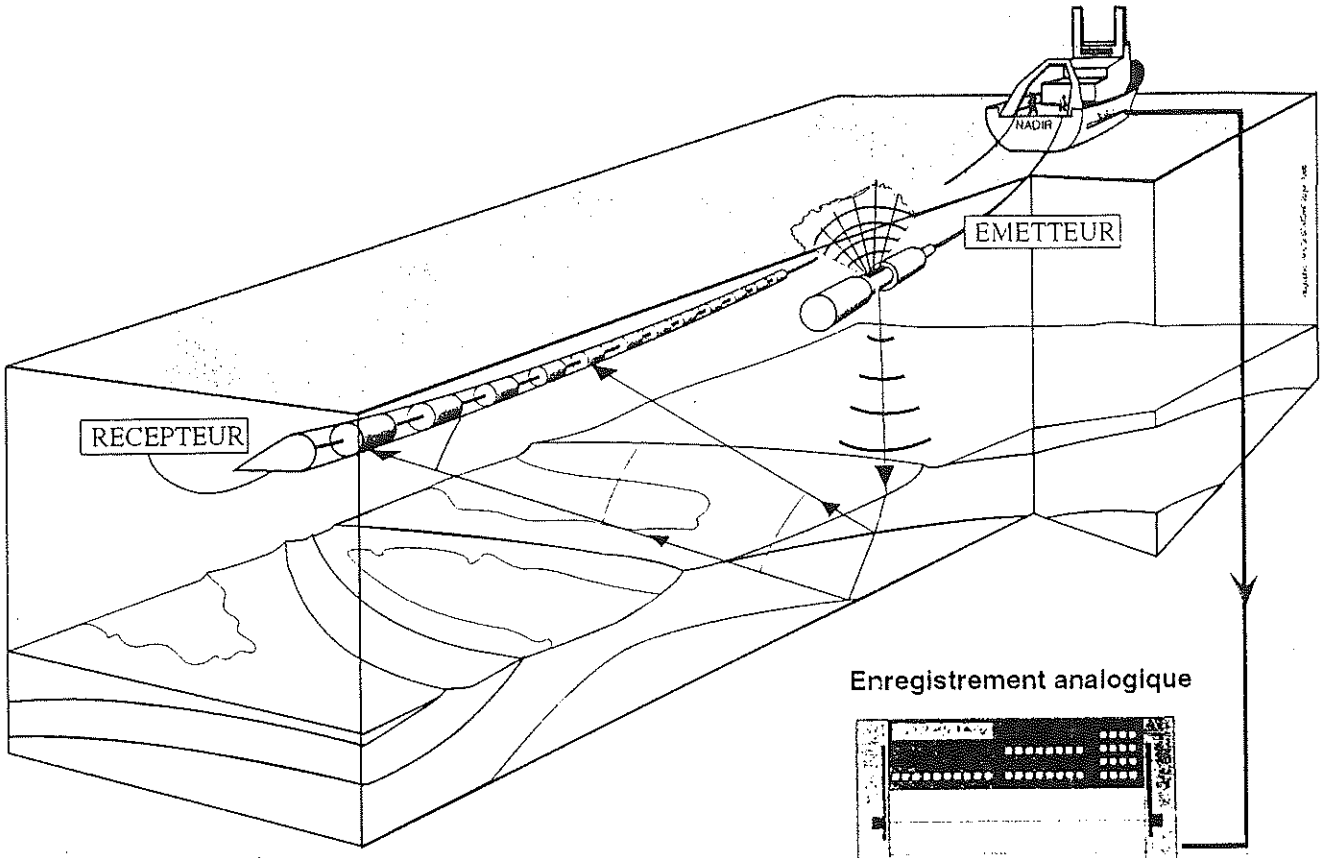
- **Main useful constraints for seismic identification of reflectors**
  - Map of previous monochannel seismic lines in the Ligurian sea
  - Outcrops of rocks in the Ligurian sea (CYLICE cruise, from Guennoc and Sosson)
  - Velocity and structure in the deep basin
  - Example of monochannel seismic lines across the Ligurian sea
  - A typical seismic monochannel line in the northern margin of the Ligurian sea
  - Multichannel seismic lines (MALIS'95) : maps and examples (MA02, 14, 15, 19, 24,25)
  - Main lines in NW Corsica : J306 (IFP), B (Gennesseaux et al., 1989), map of monochannel seismic lines from SIBONI'94 and DYNLITH'97 cruises (profiles used onboard), and table of the characteristics of acquisition for these lines.


MA 860 803
INSU

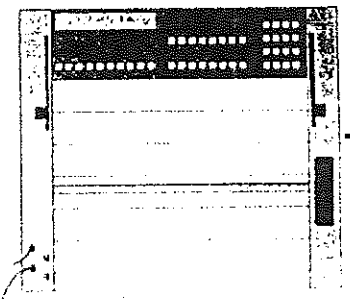
FREQUENCE D'EMISSION DES SOURCES ACOUSTIQUES
utilisées pour la reconnaissance du sous-sol marin

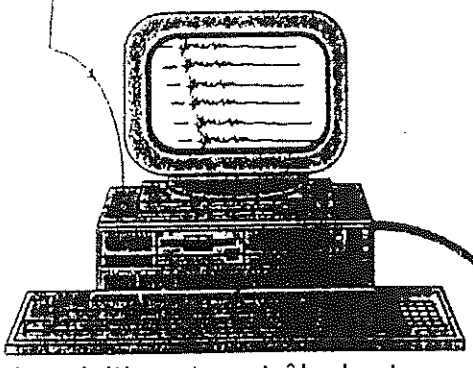


CHAINE SISMIQUE

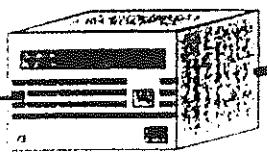


Enregistrement analogique





Acquisition et contrôle des traces

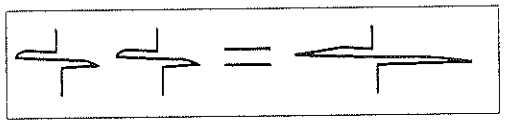


Enregistrement num érique des traces sur Magnéto-optiques avant transfert sur Exabyte au format SEG-Y

Géométrie d'acquisition

↓

Sommation



↓

migration

↓

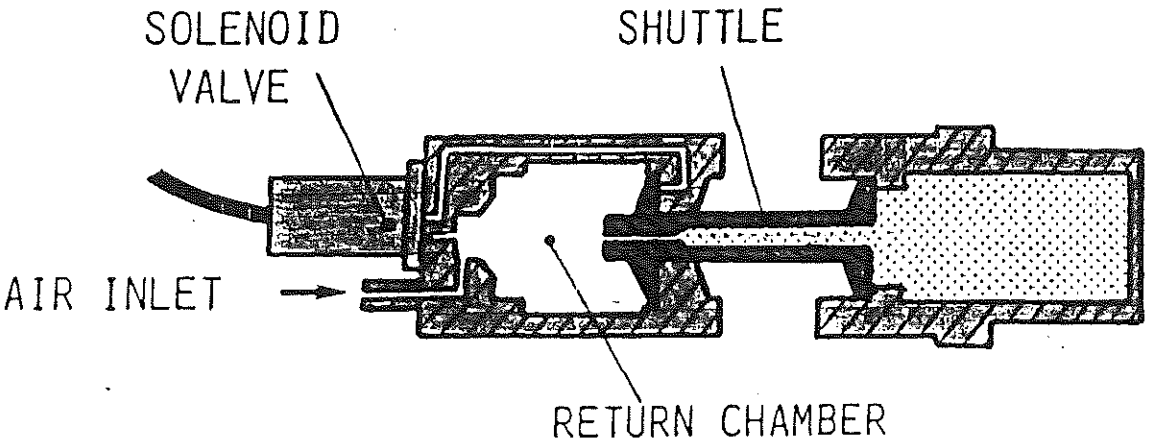
FILTRAGE

↓

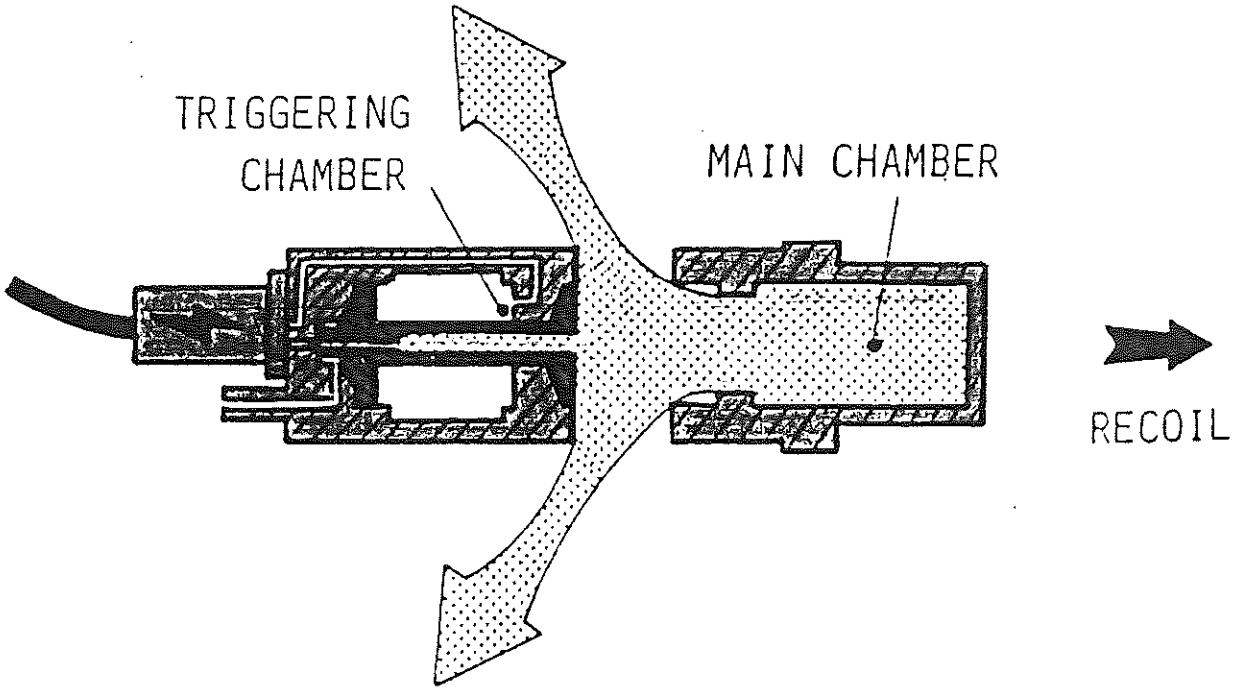
-Amélioration du rapport signal sur bruit
- Elimination des artéfacts

Infographie: Yves Descatoire Juin 1998 UMR Géosciences Azur

"AIR GUN" type Bolt



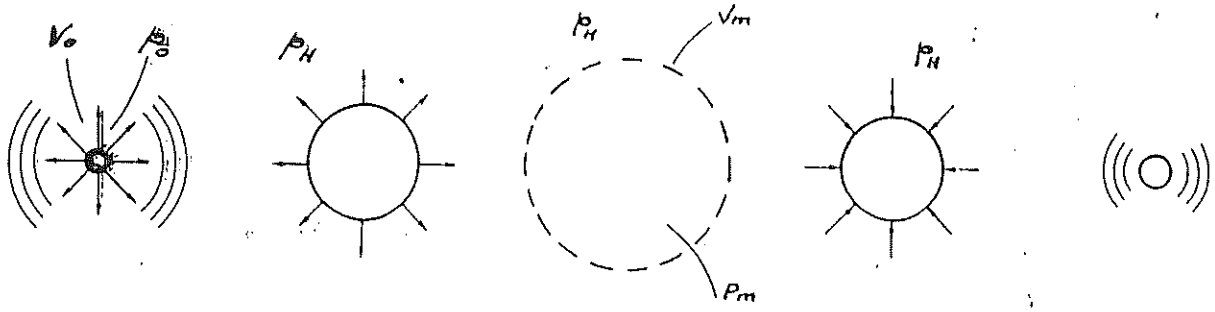
PREFIRED



FIRED

Courtesy: SODERA

BEHAVIOUR OF A BUBBLE OF HIGH PRESSURE GAS
(AIR GUN)



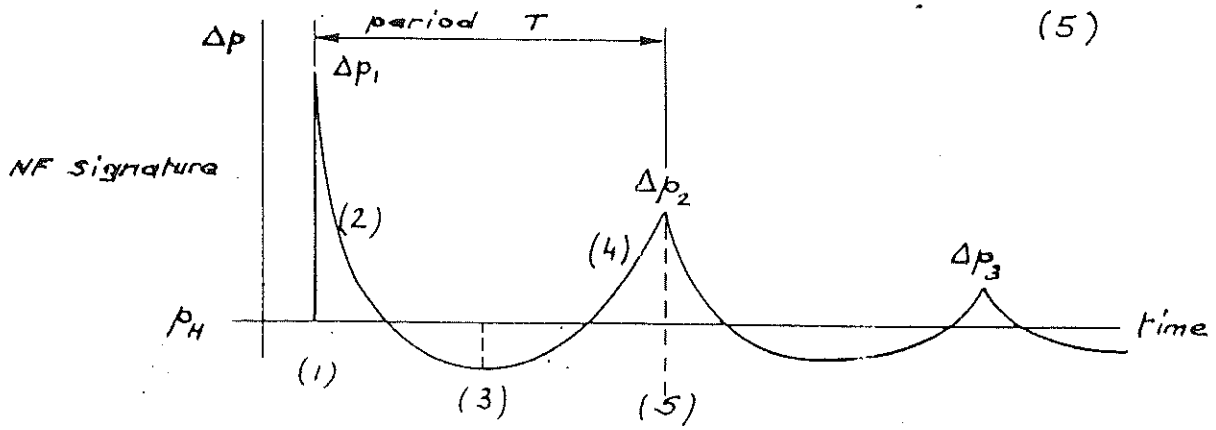
PRESSURE WAVE GENERATED (1)

BUBBLE EXPENDS (2)

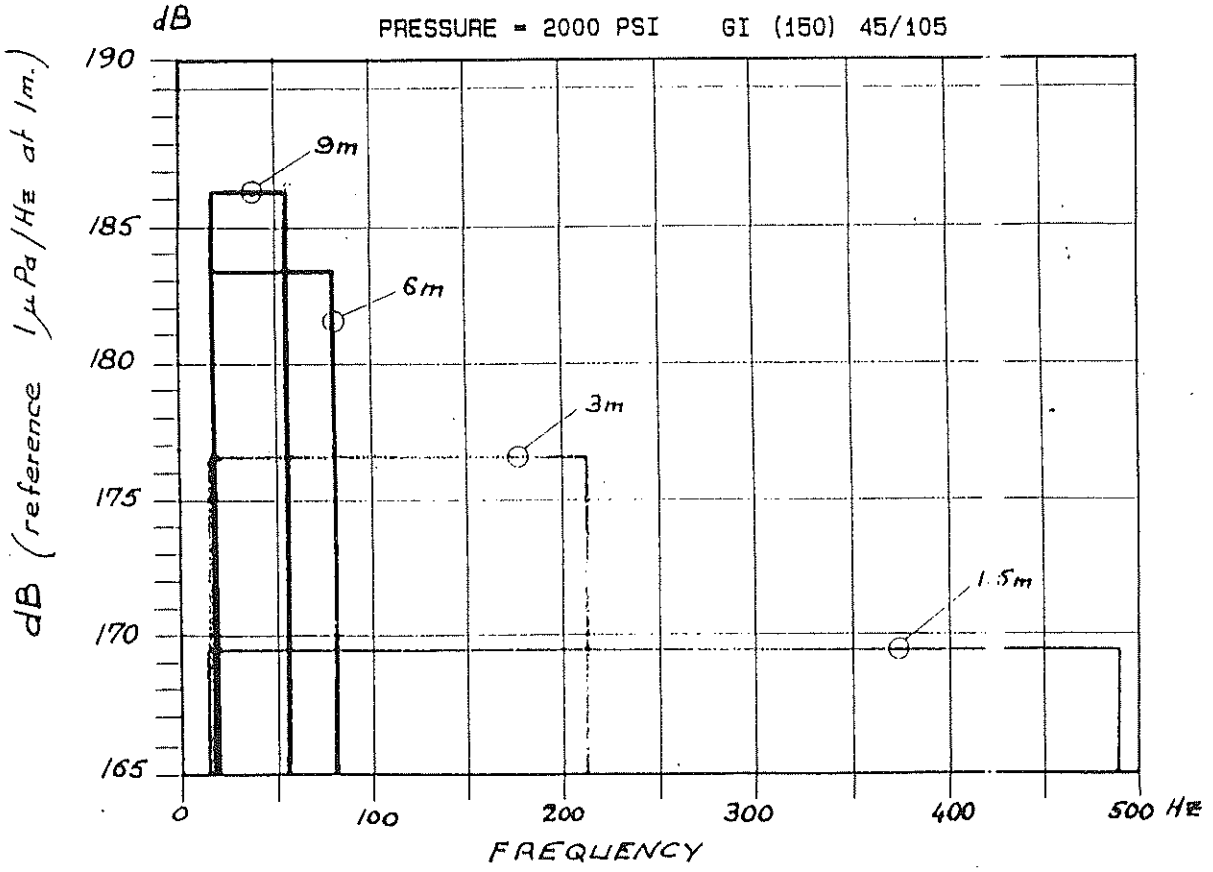
BUBBLE REACHES ITS MAXIMUM SIZE (3)

BUBBLE COLLAPSES (4)

BUBBLE AT MINIMUM SIZE EMITS SECONDARY PRESSURE WAVE (5)



DIAGRAMMATIC F.F AMP. SPECTRA VERSUS GUN DEPTH

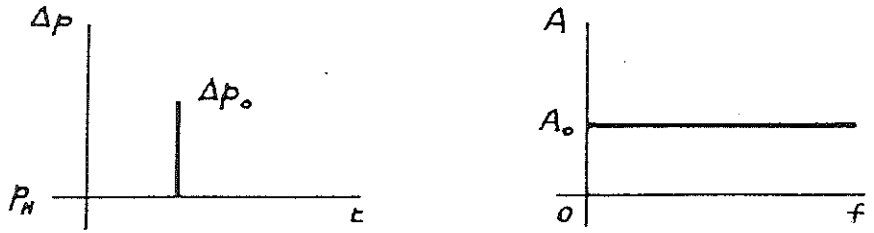


Courtesy: SODERA

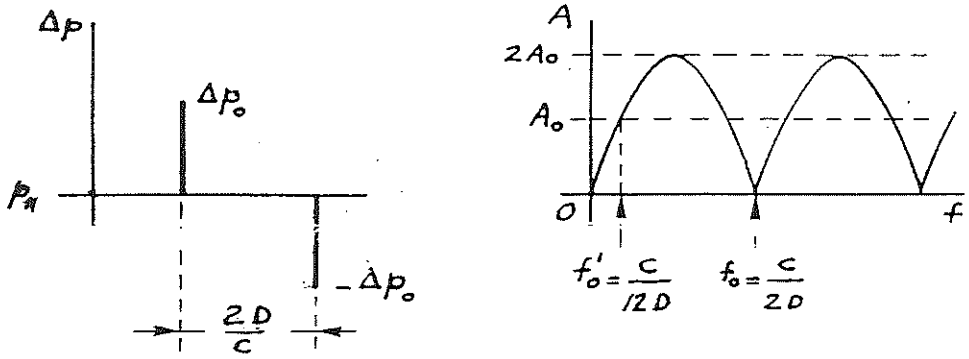
NEAR FIELD / FAR FIELD SIGNATURES AND SPECTRUM

SIGNATURE SPECTRUM

NEAR FIELD



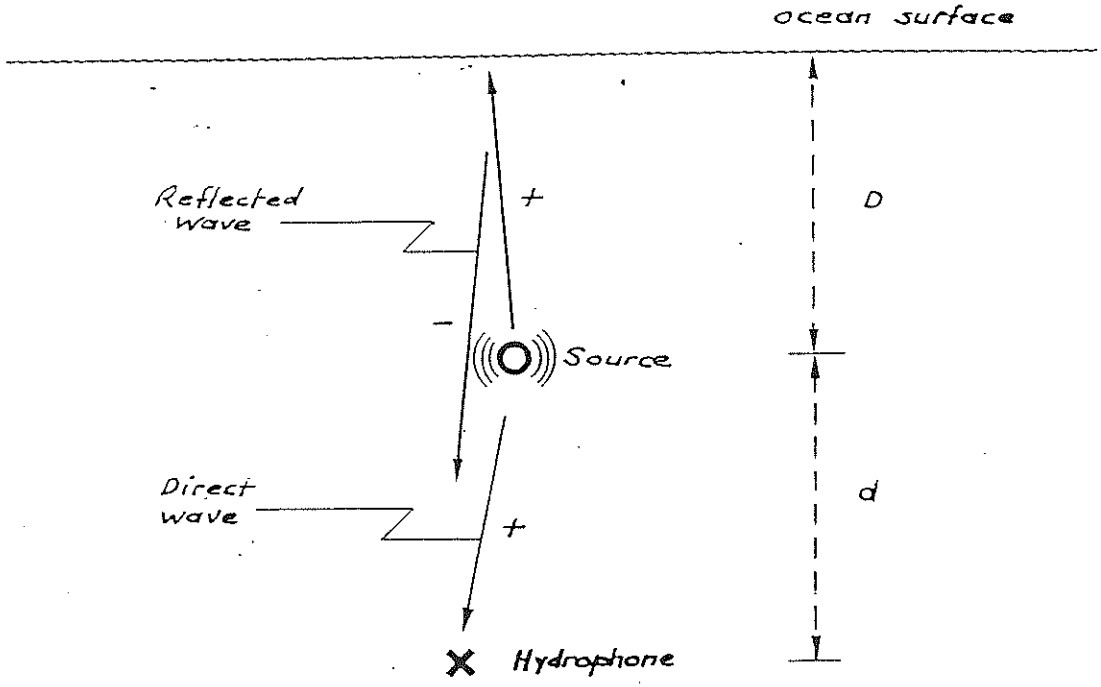
FAR FIELD



Example D = 1.5m C = 1500 m/s

f_0 = 500Hz f'_0 = 83.3Hz

NEAR FIELD / FAR FIELD SIGNATURES



Direct wave amplitude : Δp (over p_H)

Reflected wave amplitude : $\Delta p' = -\Delta p \times \frac{d}{2D+d}$

Near field : d = 1 meter

Far field : d such that $\Delta p' \simeq -\Delta p$

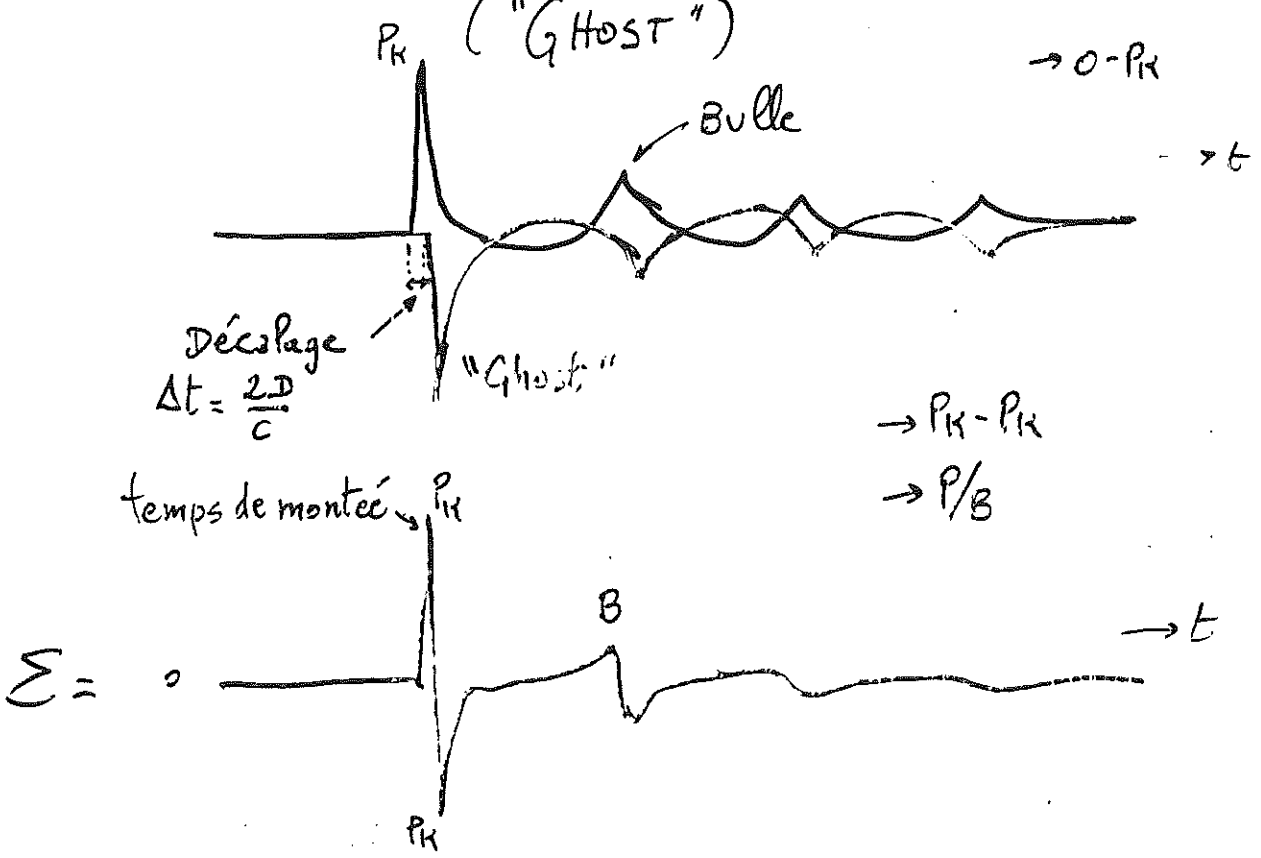
Example : D = 3 m

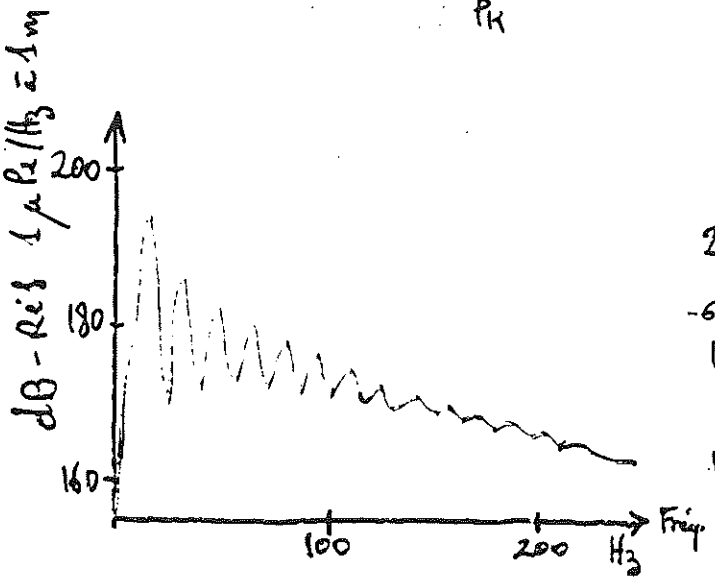
$\Delta p' \geq -0.9\,\Delta p$ if $d \geq 54$ m

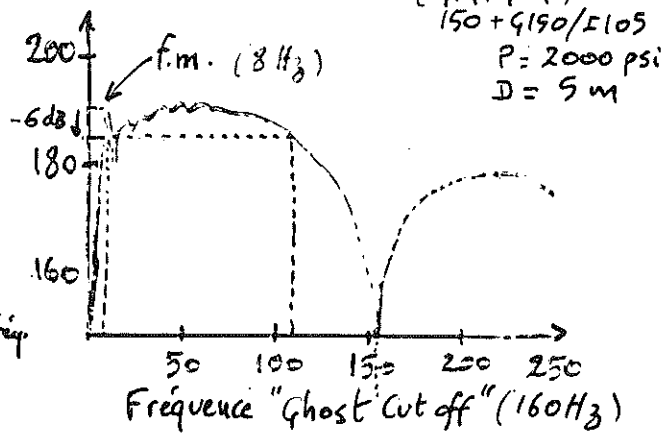
Courtesy : SODERA

Canon à air

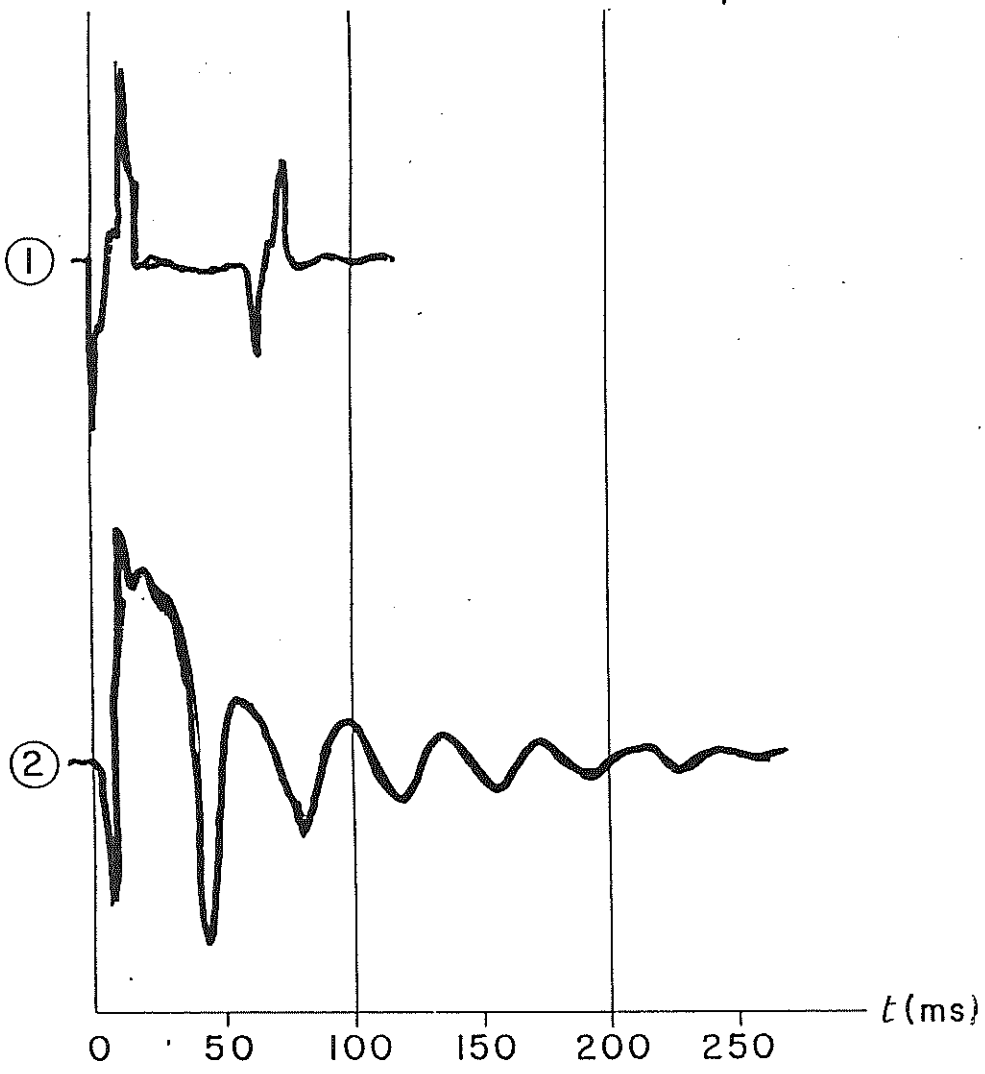
L'APPORT DU REBOND À LA SURFACE ("GHOST")



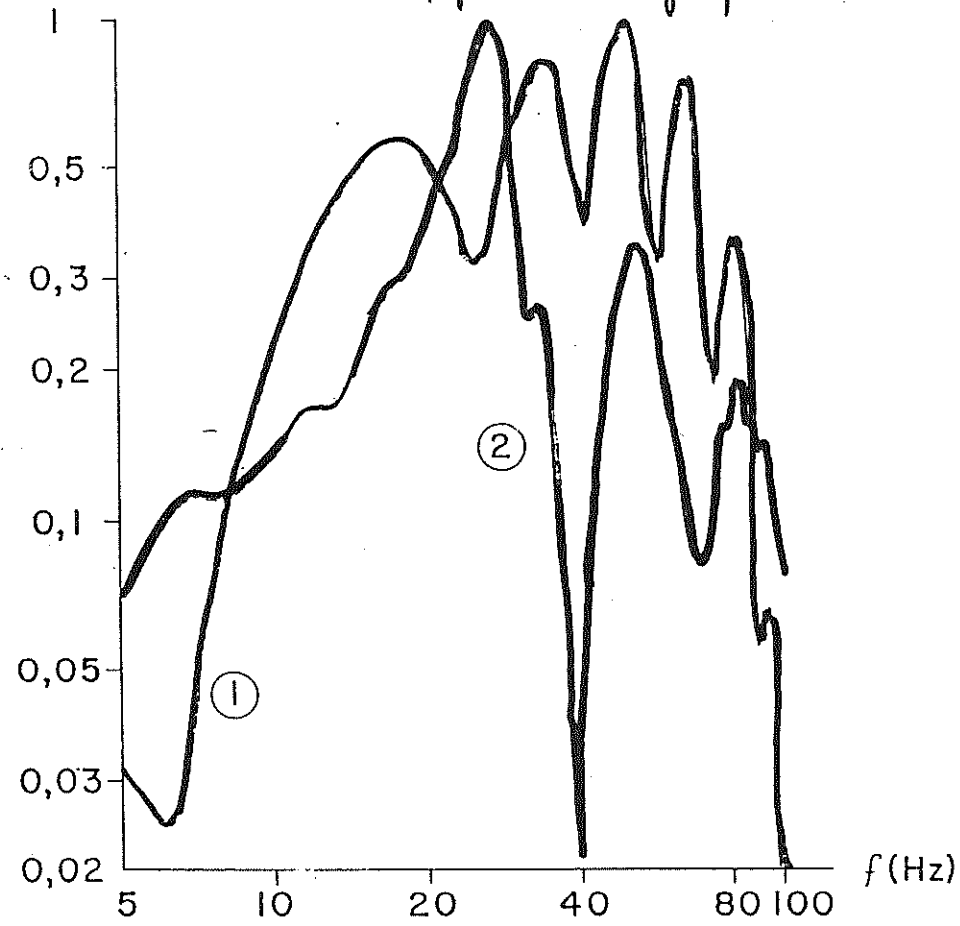




Réponse dans le temps



Réponse en fréquence



1) EXPLOSIF
50g
7m prof.

2) CANON A AIR
V = 160 cm³
P = 110 bars
7m prof.

TUNED AIR-GUN ARRAYS

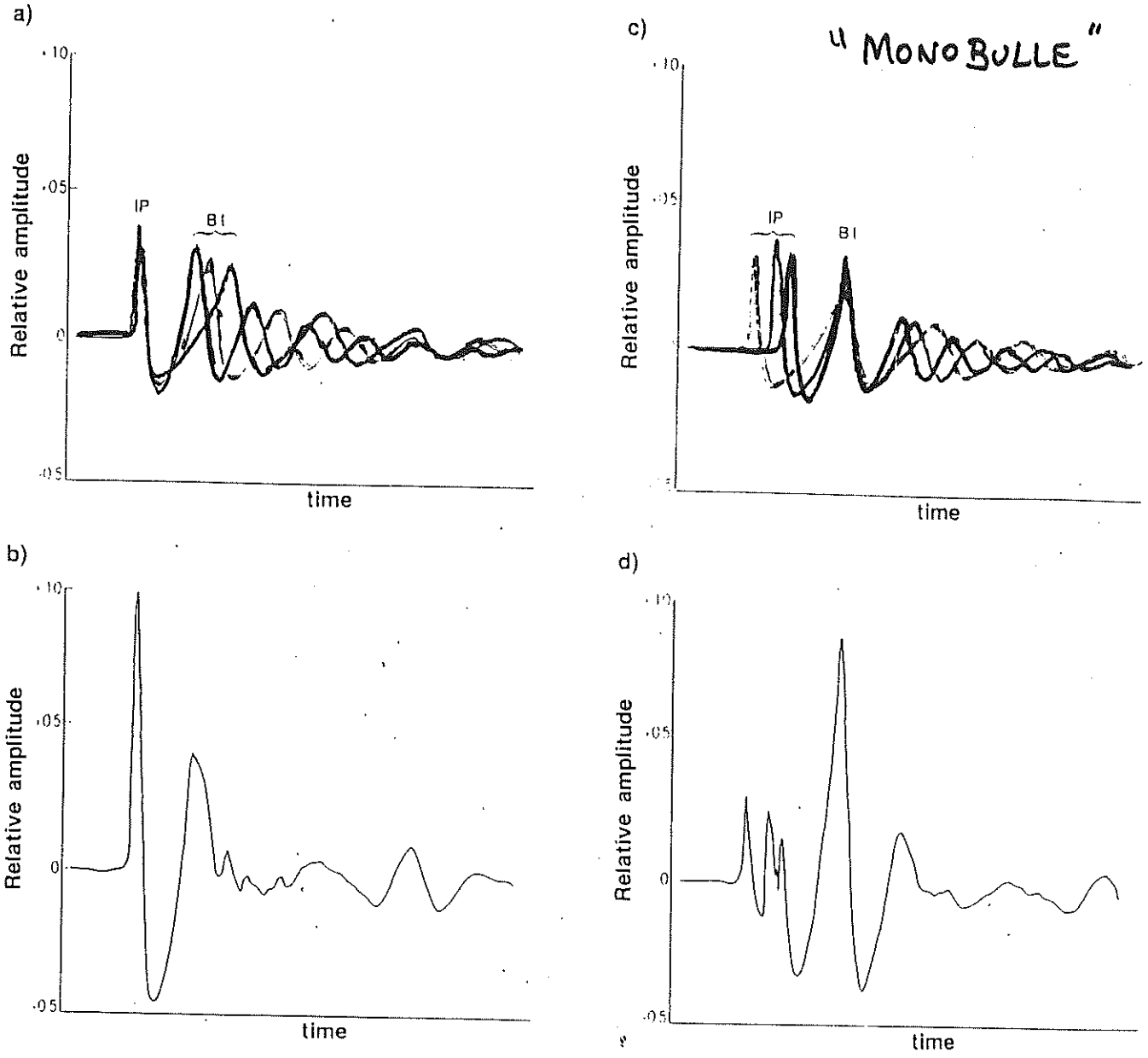


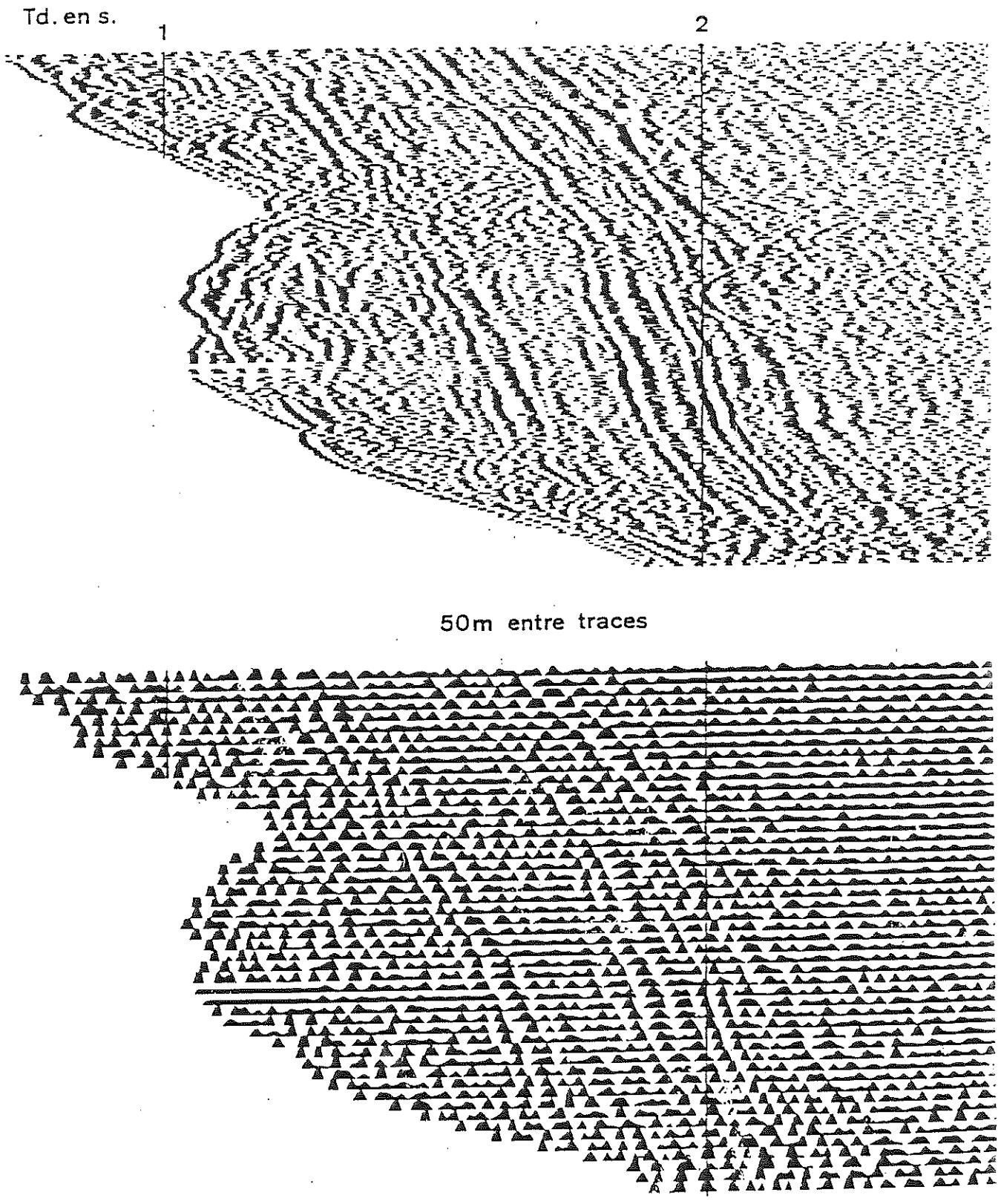
FIG. 6. (a) (b) Illustration of the working principle of tuned air-gun arrays: the superposition of the output of different-sized guns is used to reinforce the initial pulse (IP) and to reduce or cancel the bubble pulse train (B1, . . .). (c) (d) Graphs showing the principle of low-frequency pulse generation: the output of different-sized guns (or the same size guns working at different air pressures) is now synchronized to the first bubble pulse (B1). Their superposition is used to generate a short, low-frequency pulse by reinforcing the first bubble pulse (B1) and reducing the other components of the pressure signatures.

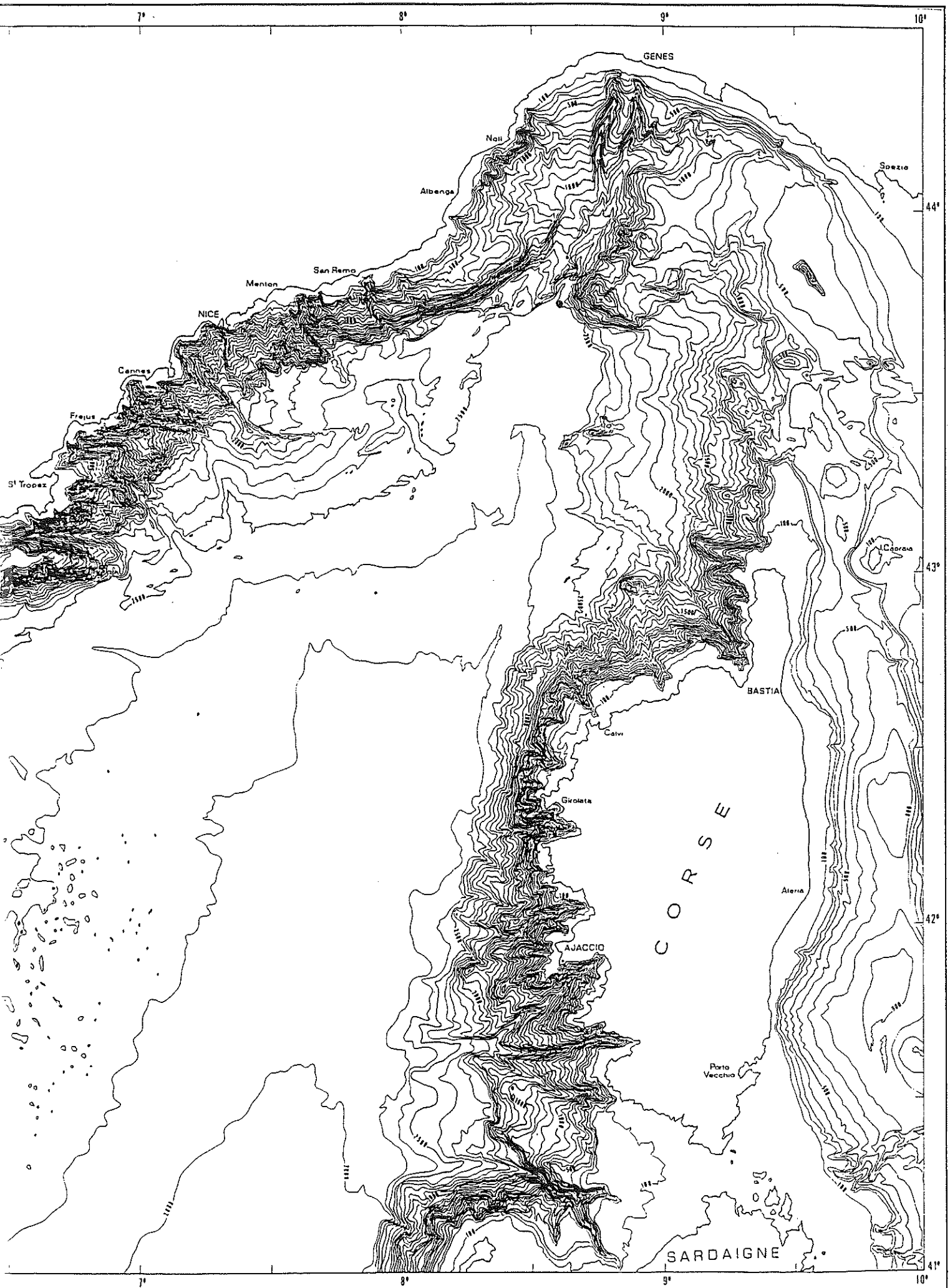
3 canons
(ou V≠,
ou P≠)

from Avedik et al, 1993

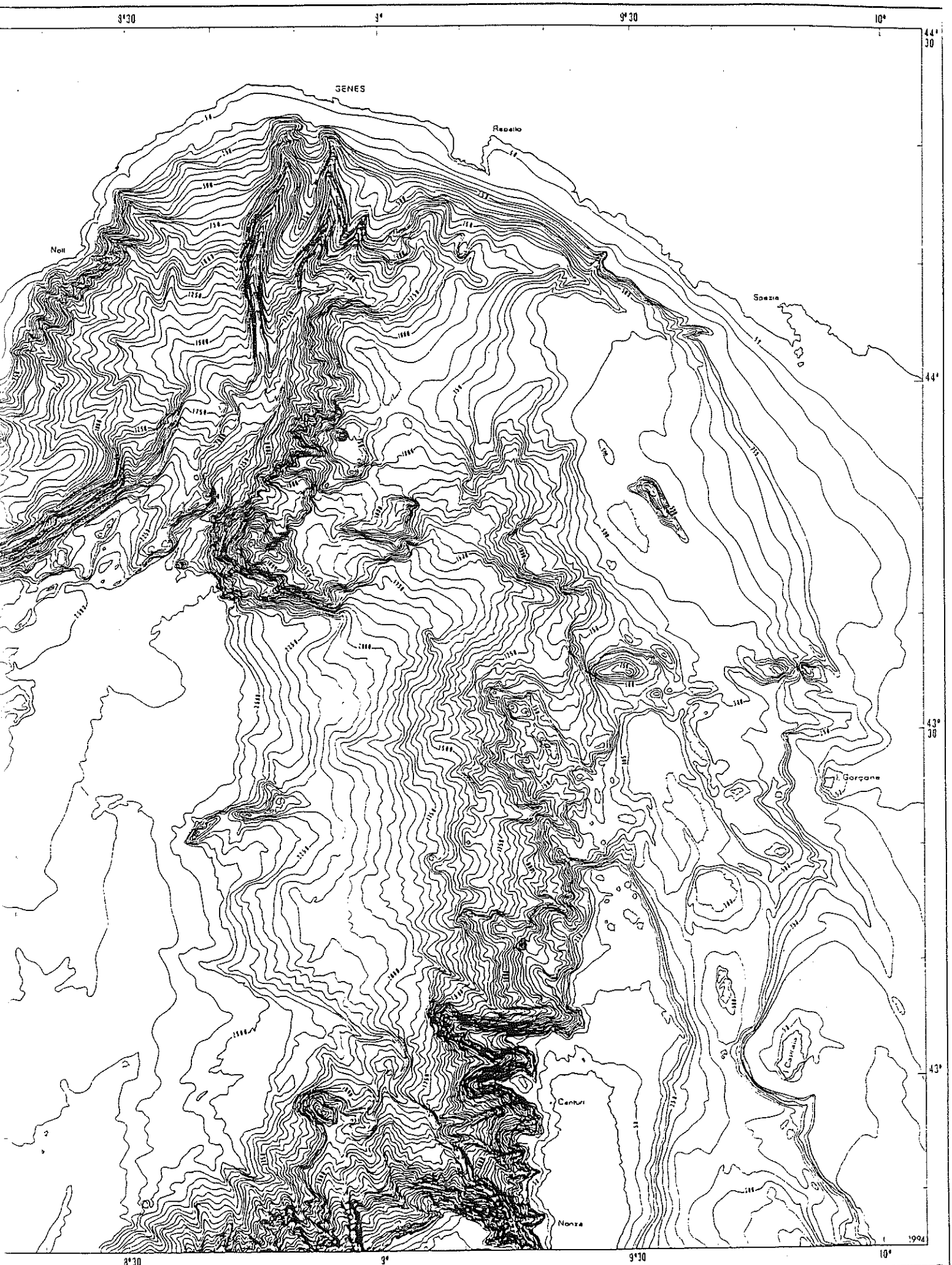
IFP

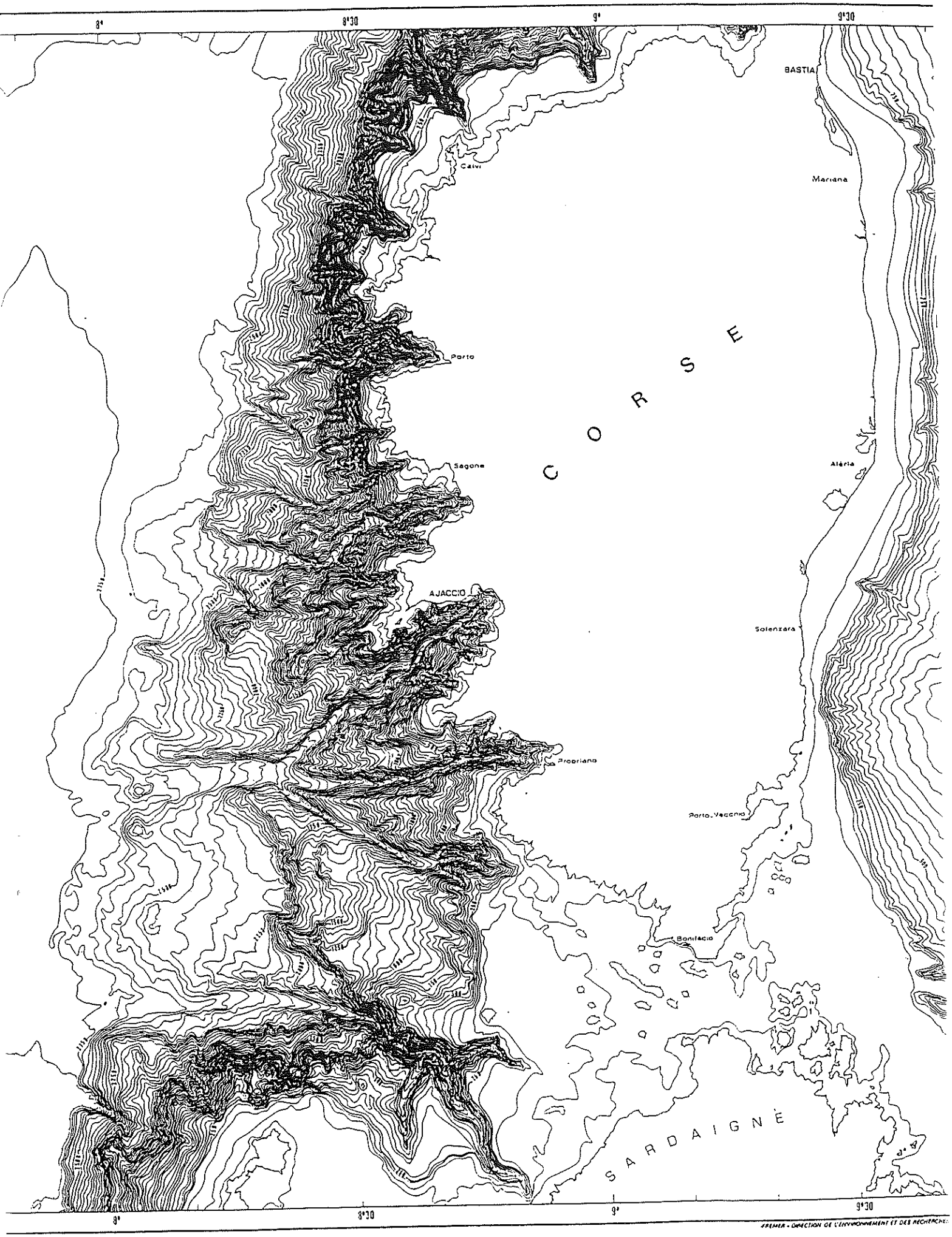
Fig.5b





IFREMER - DIRECTION DE L'ENVIRONNEMENT ET DES RECHERCHES OCEANIQUES DEPARTEMENT DES GEOSCIENCES MARINES 1992.

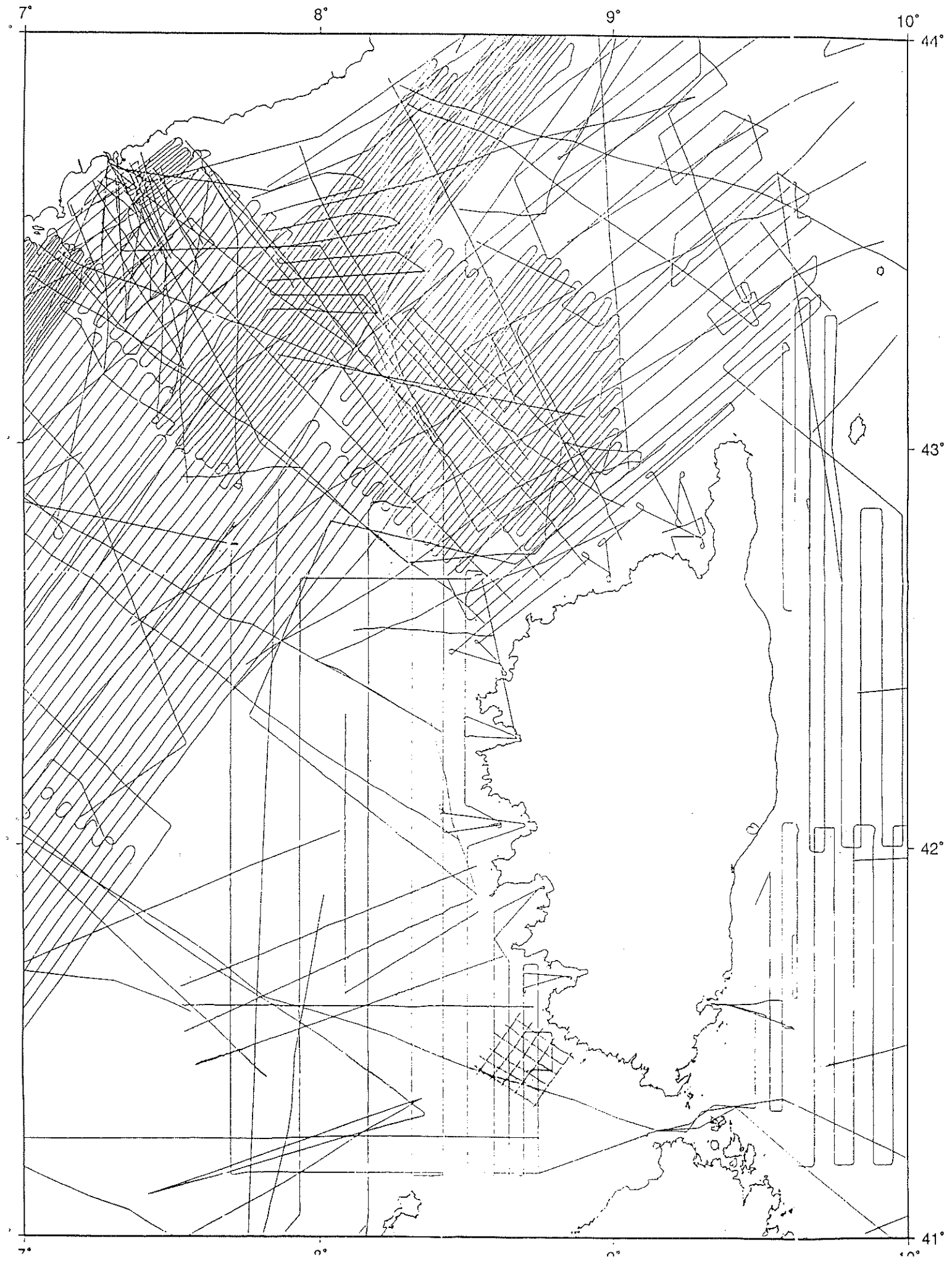

8°30
9°
9°30
10°
44°30
44°
43°30
43°
GENES
Rapallo
Noli
Spezia
I. Gorgona
I. Capraia
Centuri
Nonza
1994

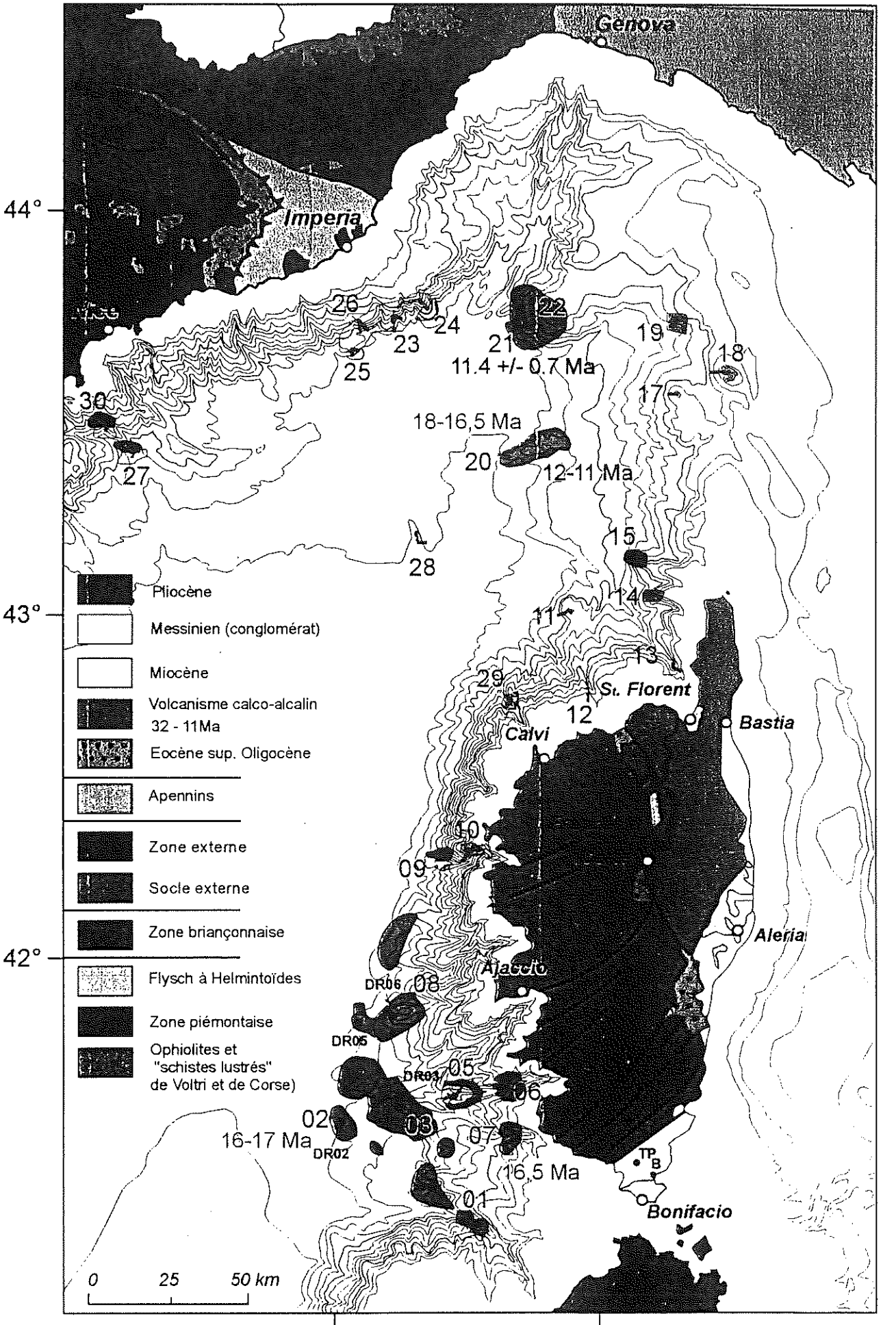

8°
8°30
9°
9°30
BASTIA
Calvi
Mariana
Porto
CORSE
Sagone
Aléria
AJACCIO
Solenzara
Propriano
Porto-Vecchio
Bonifacio
SARDAIGNE
41°30
8°
8°30
9°
9°30
IFREMER - DIRECTION DE L'ENVIRONNEMENT ET DES RECHERCHES

sismique med. occid.

1/500.000 à 38 N

Monochannel lines





(from CYLICE dives, and Synthesis)
(Rossi, Guennoc, Sosson)

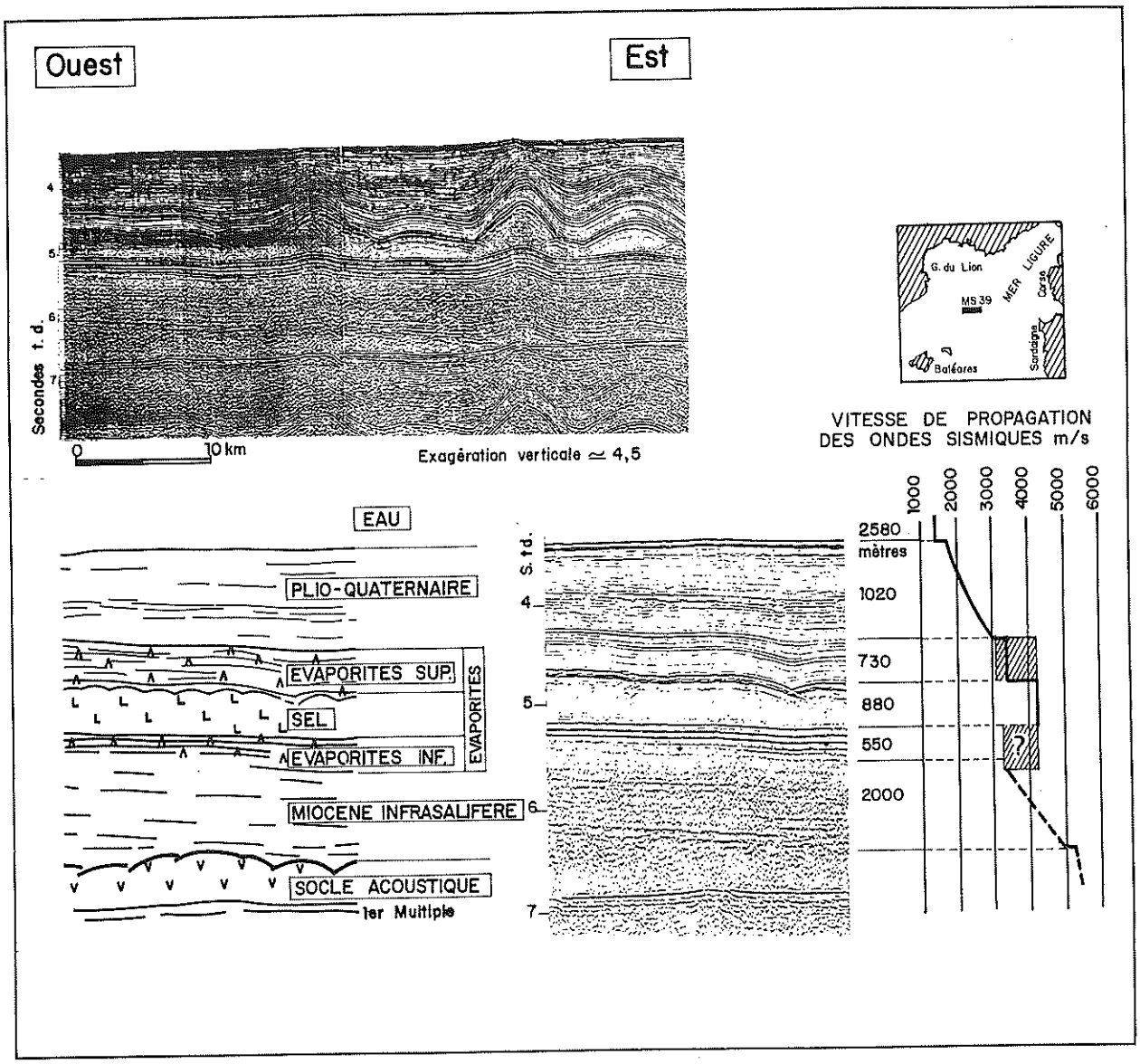
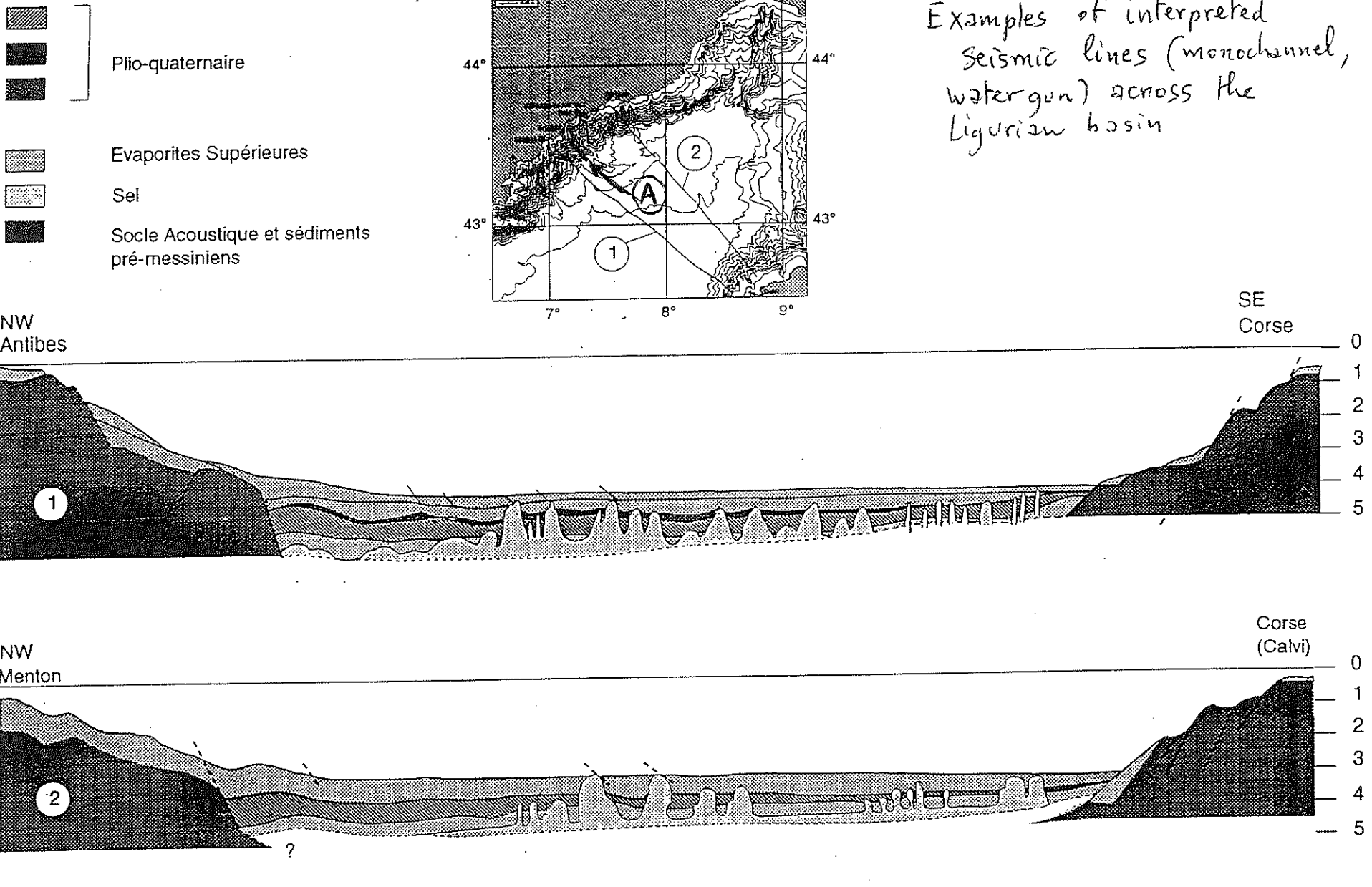
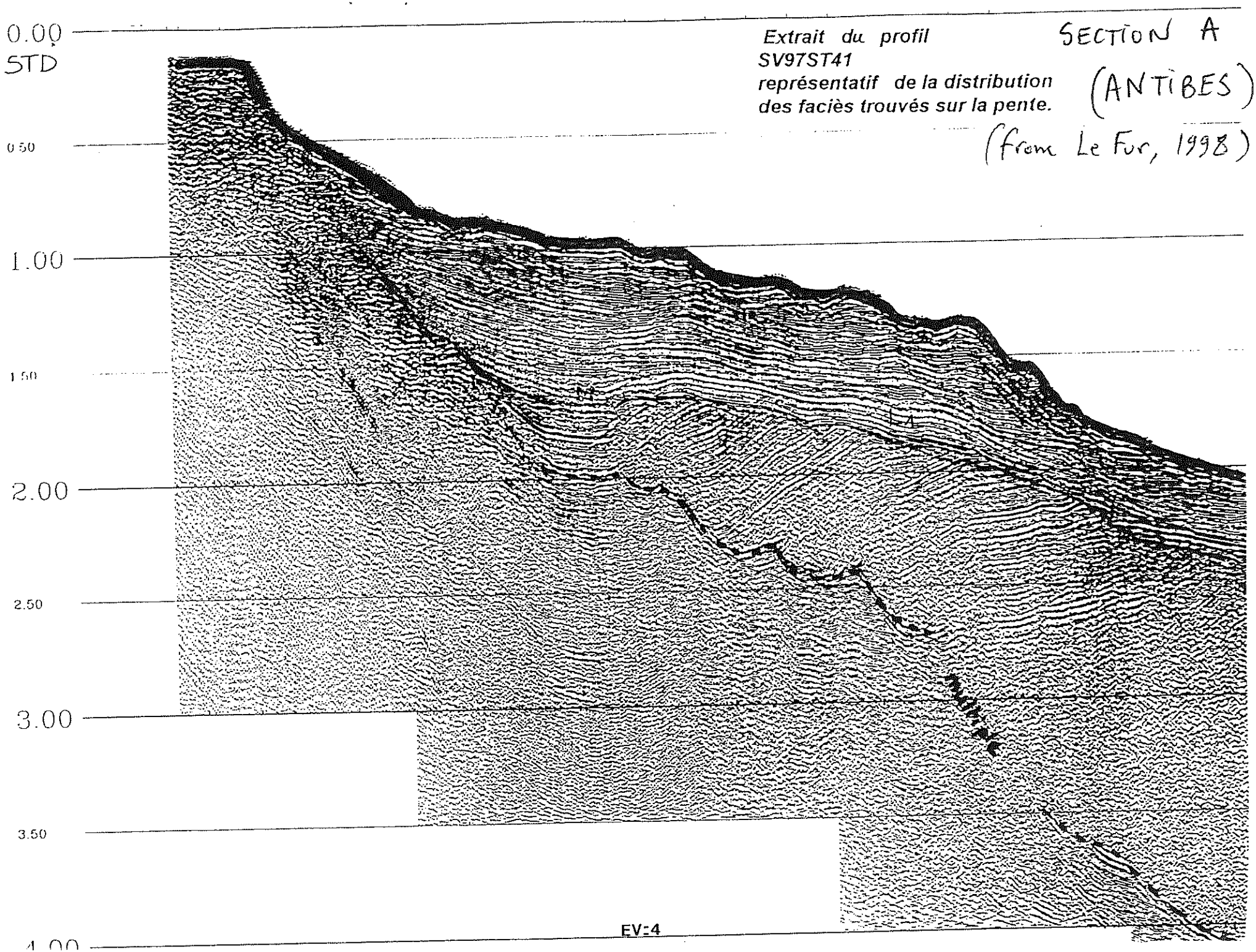


FIG.II-1 Stratigraphie acoustique de la couverture sédimentaire du Bassin Ligure profond. Le profil sismique reproduit (MS.39) a été enregistré par l'Osservatorio Geofisicale Sperimentale de Trieste (MORELLI et FINETTI, 1973). Les vitesses sismiques ont été déterminées par cet organisme et l'Institut Français du Pétrole (MONTADERT *et al.*, 1973).

Examples of interpreted seismic lines (monochannel, watergun) across the Ligurian basin



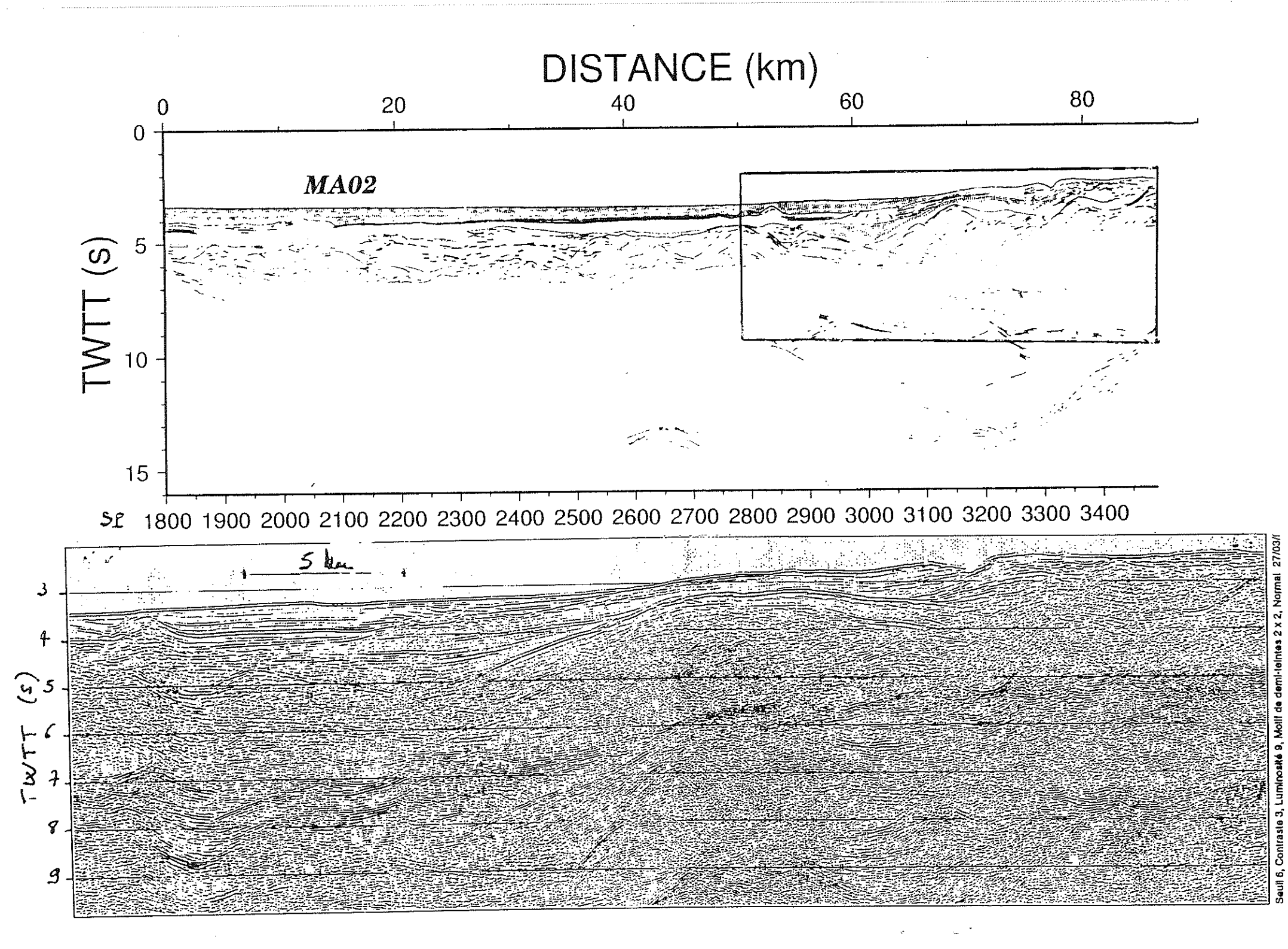
DAO: YD 01.94

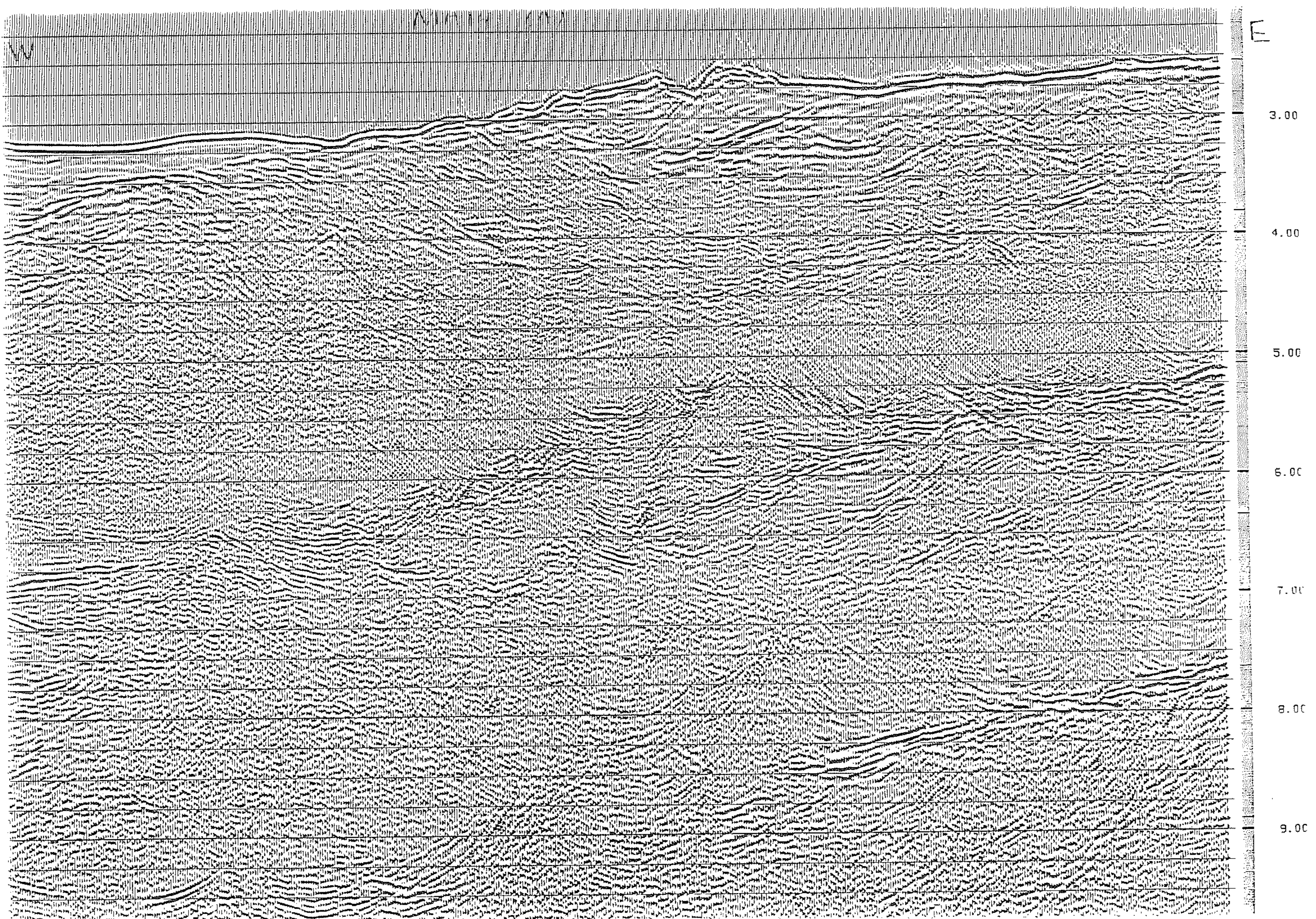


Extrait du profil SV97ST41 représentatif de la distribution des faciès trouvés sur la pente.

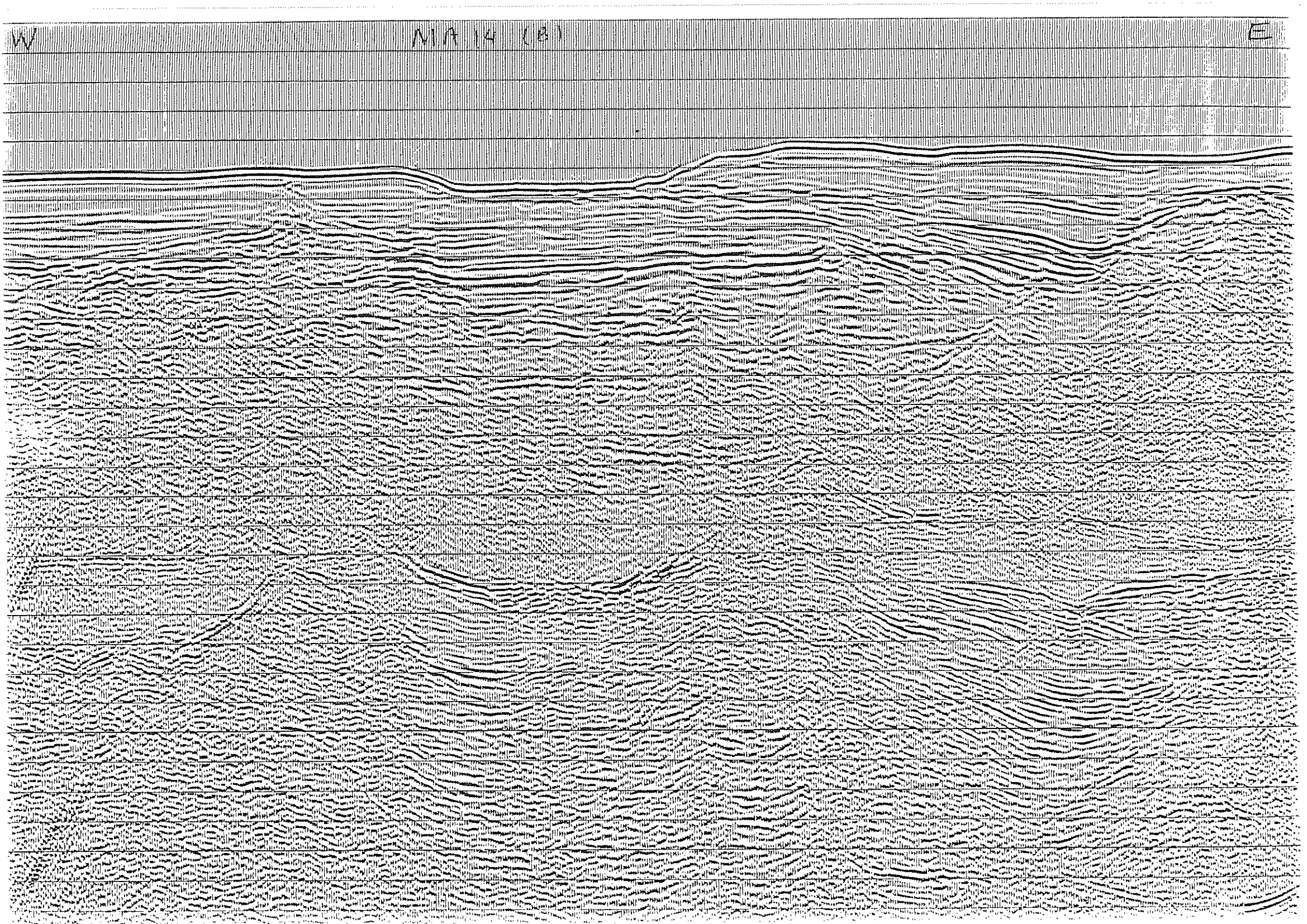
SECTION A (ANTIBES)

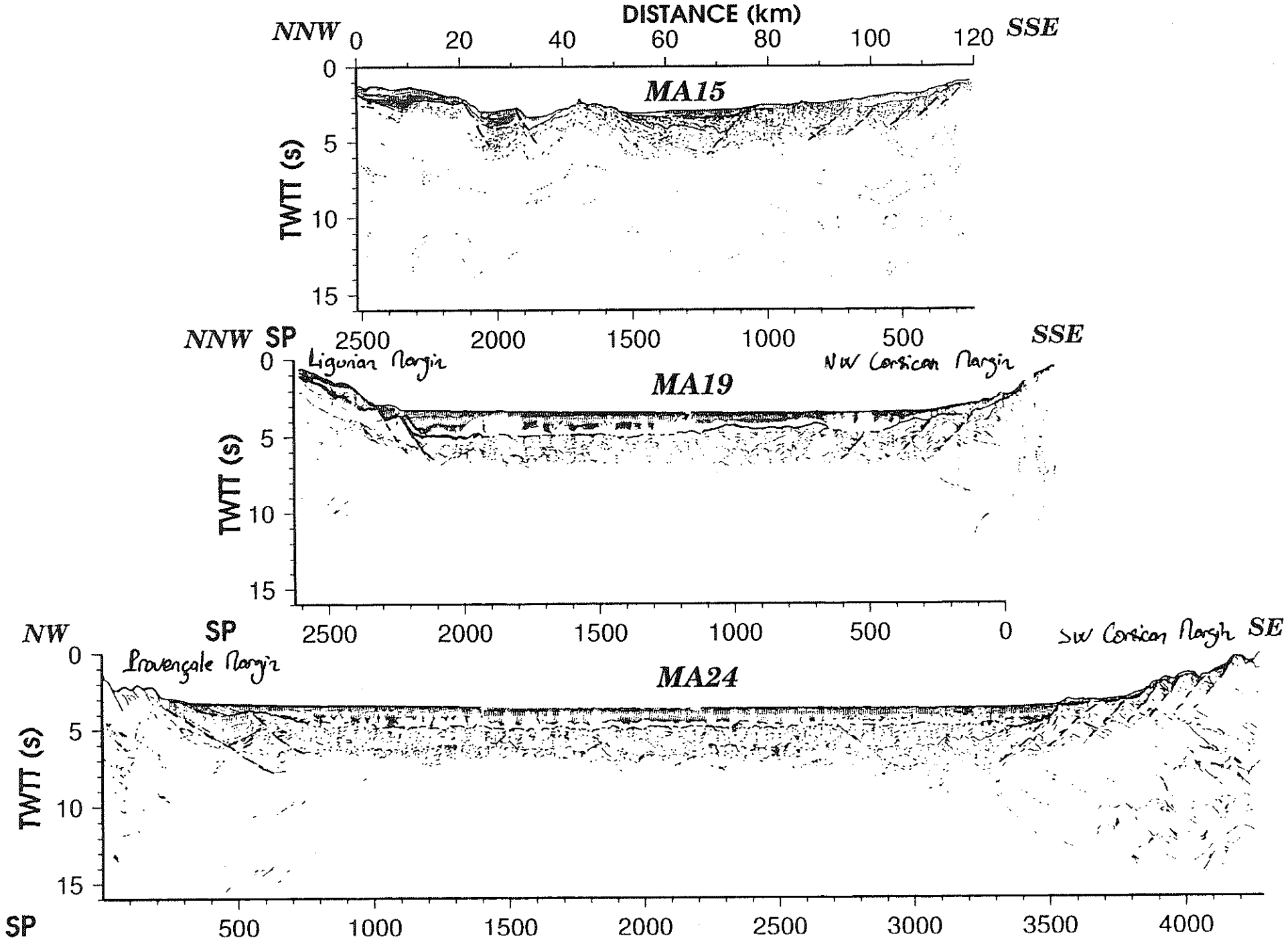
(from Le Fur, 1998)

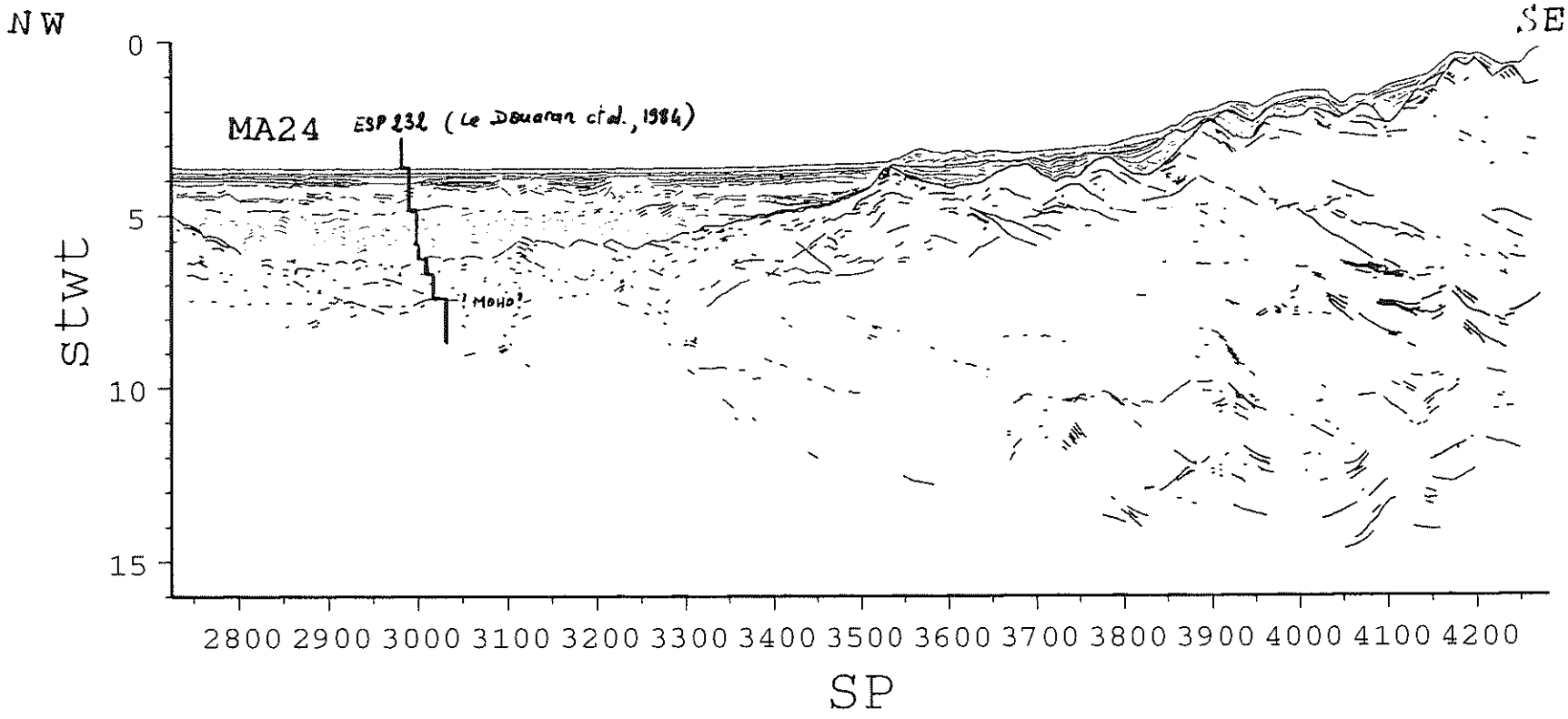

DISTANCE (km)
0
20
40
60
80
MA02
TWTT (s)
0
5
10
15
SE
1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400
5 km
TWTT (s)
3
4
5
6
7
8
9
Seuil 6, Contraste 3, Luminosité 9, Motif de demi-teintes 2 x 2, Normal 27/03/

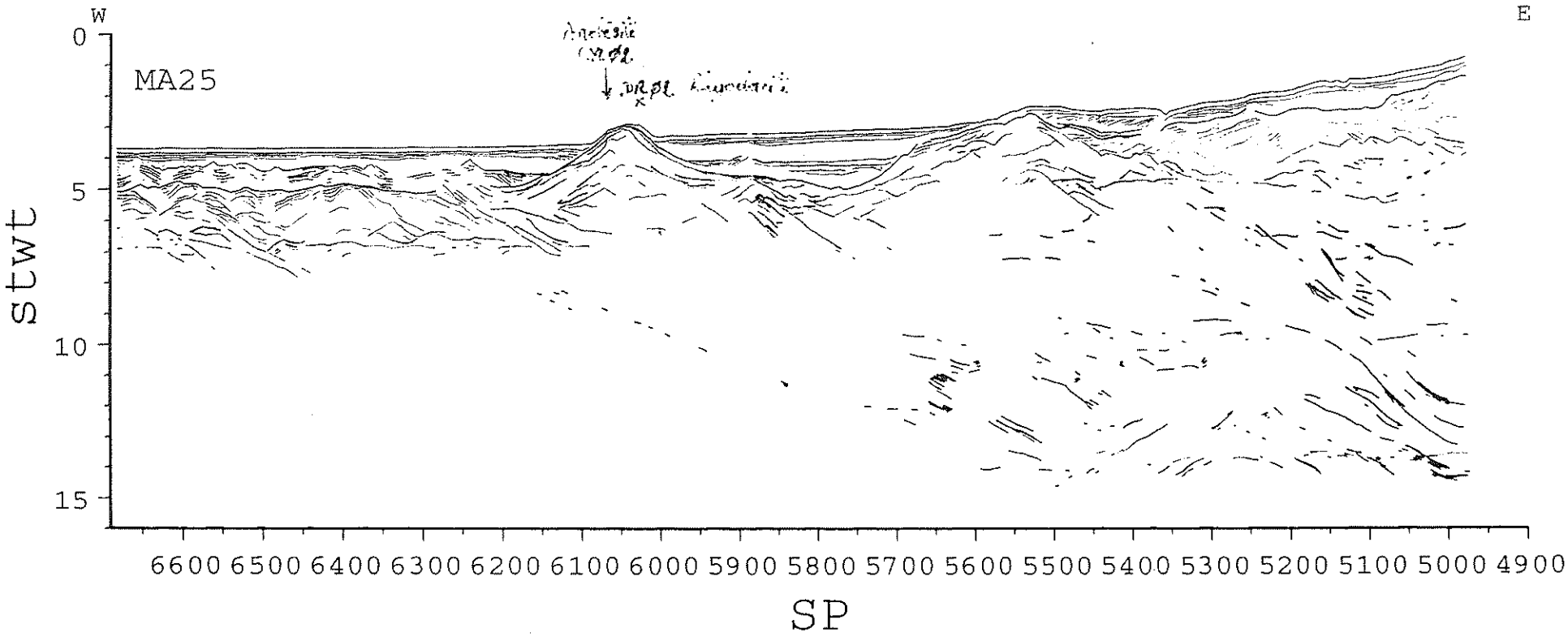


W
E
3.00
4.00
5.00
6.00
7.00
8.00
9.00


W
MA 14 (B)
E


NNW
DISTANCE (km)
0
20
40
60
80
100
120
SSE
MA15
TWTT (s)
0
5
10
15
NNW
SP
2500
2000
1500
1000
500
SSE
Ligurian Margin
NW Corsican Margin
MA19
TWTT (s)
0
5
10
15
NW
SP
2500
2000
1500
1000
500
0
SW Corsican Margin
SE
Provençale Margin
MA24
TWTT (s)
0
5
10
15
SP
500
1000
1500
2000
2500
3000
3500
4000


NW
SE
MA24
ESP 232 (Le Douaran et al., 1984)
! Moho !
0
5
10
15
stwt
2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200
SP


W
E
MA25
0
5
10
15
stwt
6600 6500 6400 6300 6200 6100 6000 5900 5800 5700 5600 5500 5400 5300 5200 5100 5000 4900
SP

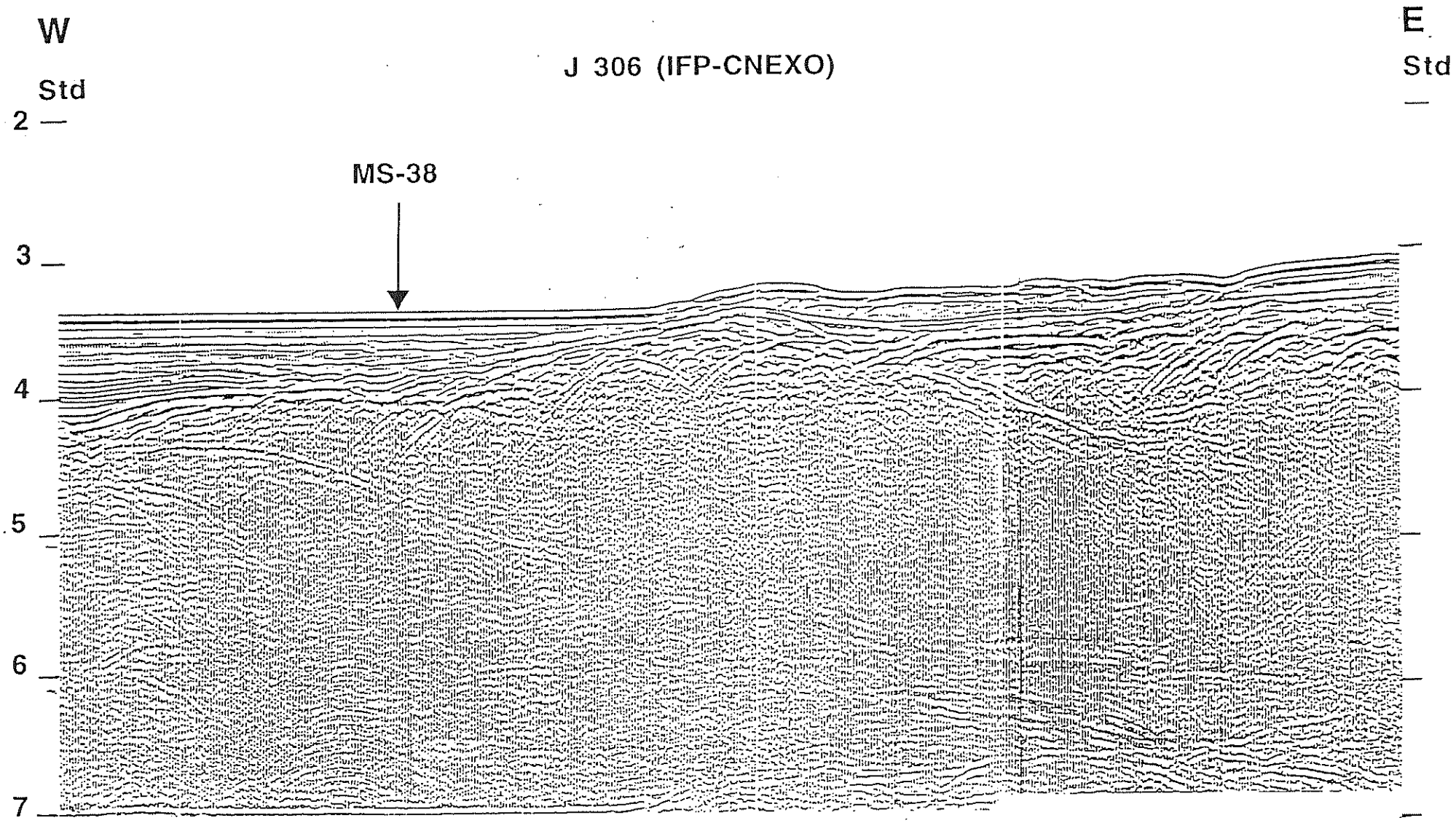


Fig. 12 Profil J-306 (voir position sur Fig.8).

(Gennesseaux et al., 1989)

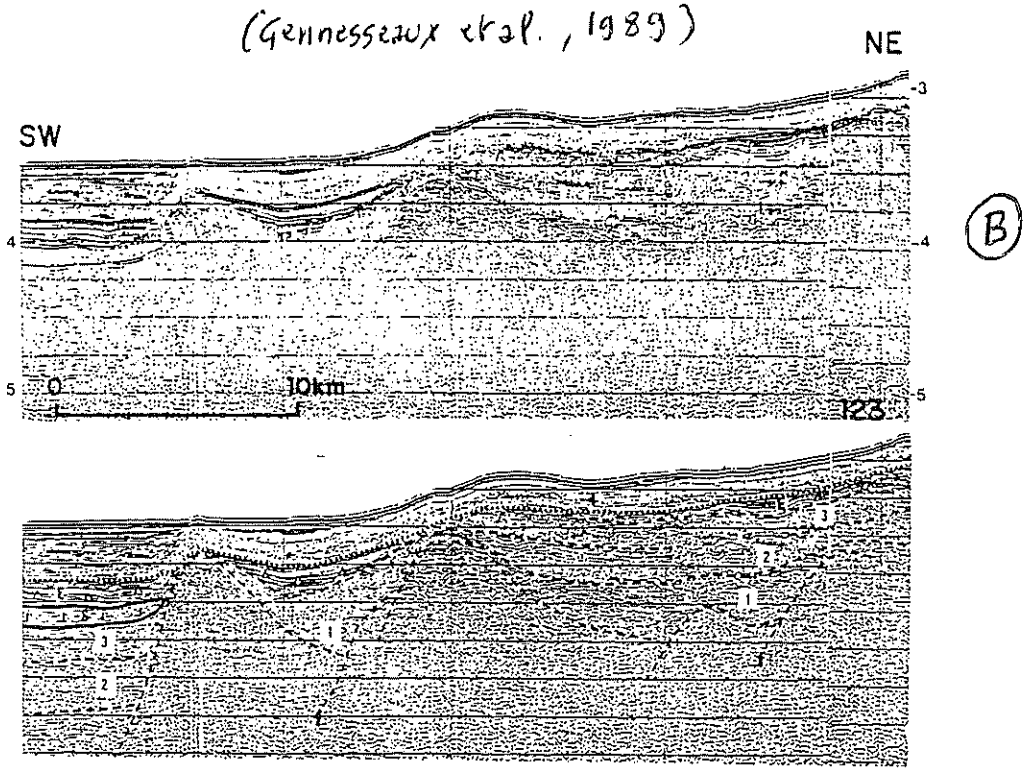


FIG. 7. — Coupe de sismique réflexion monotrace sur le glacis de la marge continentale au N de la Corse. Blocs basculés (rifting miocène basal), remobilisés pendant le Miocène inférieur et moyen; dépôts synrift; 2-3 : dépôts postrift; 4 : Plio-Quaternaire; S : sel messinien; E : évaporites supérieures.

FIG. 7. — *Single channel seismic line 123 (water-gun) on the northwestern continental margin. Tilted blocks (early Miocene rifting phase) have been reactivated during Lower and Middle times.* 1 : *syn-rift series;* 2-3 : *post-rift series ;* 4 : *Plio-Quaternary formations;* S : *Messinian salt : E : upper evaporites.*

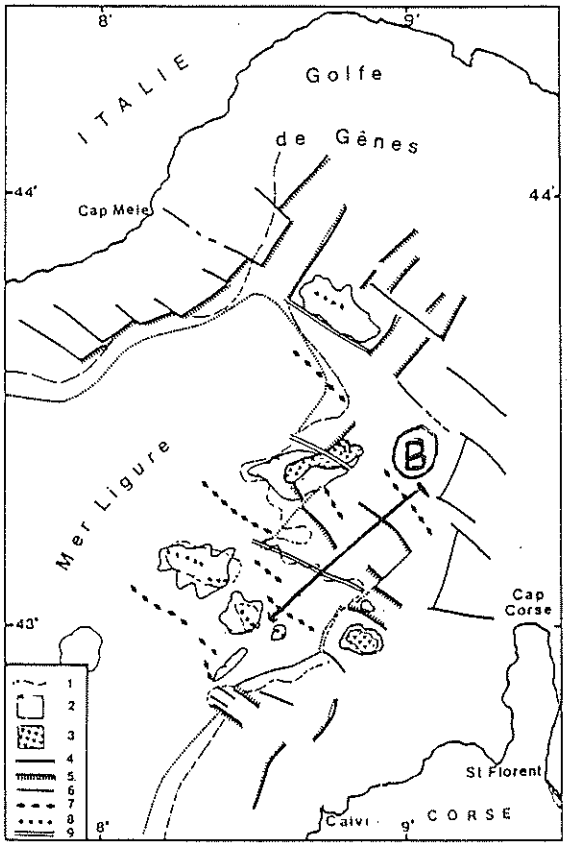
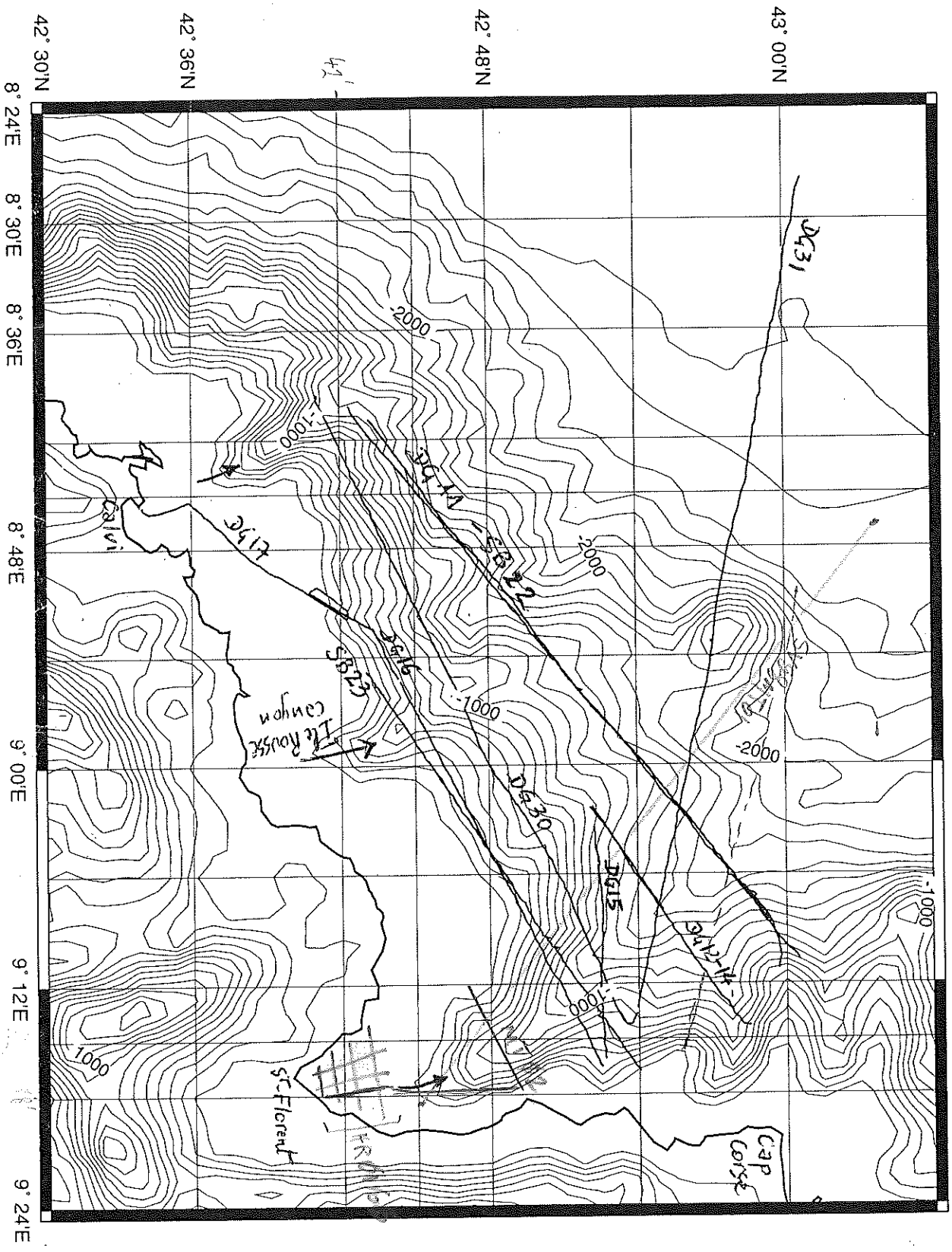


FIG. 8. — Schéma structural du Bassin ligure et de la marge Corse. 1 : limite du sel messinien; 2 : substratum volcanique basaltique; 3 : affleurements volcaniques; 4 : failles normales; 5 : failles normales de type listrique; 6 : limite croûte continentale-croûte de type océanique; 7 : axes de bassin; 8 : rides volcaniques; 9 : faille normale coulissante.

FIG. 8. — *Structural sketch of the Ligurian basin and Corsican margin.* 1 : *Messinian salt limit;* 2 : *basaltic volcanic substratum;* 3 : *volcanic outcrops;* 4 : *normal faults;* 5 : *listric type normal faults;* 6 : *continent-oceanic type crust boundary;* 7 : *basin axis;* 8 : *volcanic ridges;* 9 : *transtensional fault.*

MAST '98
Previous lines (monochannel) offshore NW Corsica



Profils DEA 97
Essais mini-GI

N° profil	Configuration mini GI	Cadence de tir	Pression	Im. canon	Im. flûte	Fenêtre enreg.	Remarques
SV97DG10	30/30	12s	180b	1,5m	~15m	2sec	Idem début SI97DG02 (S80)
DG11	30/30	10s	150b	1,5m	~15m	2sec	Idem Siboni 22 (40ci+WSK)
DG12	G 30	10s	180b	1,5m	~15m	2sec	
DG13	15/15	5s	125b	1,5m	~15m	1sec	Géné.et Inject. inversés!!! Idem DG12
DG14	20/20	3sec	60b	1,5m	~15m	1sec	Idem DG12 et 13
DG 15,16 et 17	20/20	5sec	100b	1,5m	~15m	1sec	Idem Siboni 23 (40ci+WSK)
DG 20 à 28	20/20	5sec	100b	1,5m	~3m	1sec	Quadrillage S-E Corse
DG 29	15/30	5sec	100b	1,5m	~3m	1sec	Essai sur portion DG26 et DG28
DG 30	20/20	10sec	190b	1,5m	~3m	2sec	
DG31	20/20	8sec	150b	1,5m	~3m	2sec	Vitesse 6nds
DG32 à DG34	30+30	10sec	150b	~3m	~7m	2sec	Profils sur OBS
DG35 à DG37	30/30	8sec	120b	~3m	~7m	2sec	Vitesse 6nds
DG38	15/30	2sec	50b	~1,5m	~1m	0,5sec	Profil de référence Ste Hospice
DG39	20/20	4 sec	90b	~1,5m	~1m	0,5sec	Profil de référence Ste Hospice

Autres paramètres: * filtrage 40 à 160Hz pour 2sec et 150 à 300Hz pour 1sec
* vitesse 5nds (sauf qd spécifié)