ANEXO I

Libro de reconocimiento

del trayecto del Perfil Sísmico IBERSEIS

(véase aparte)

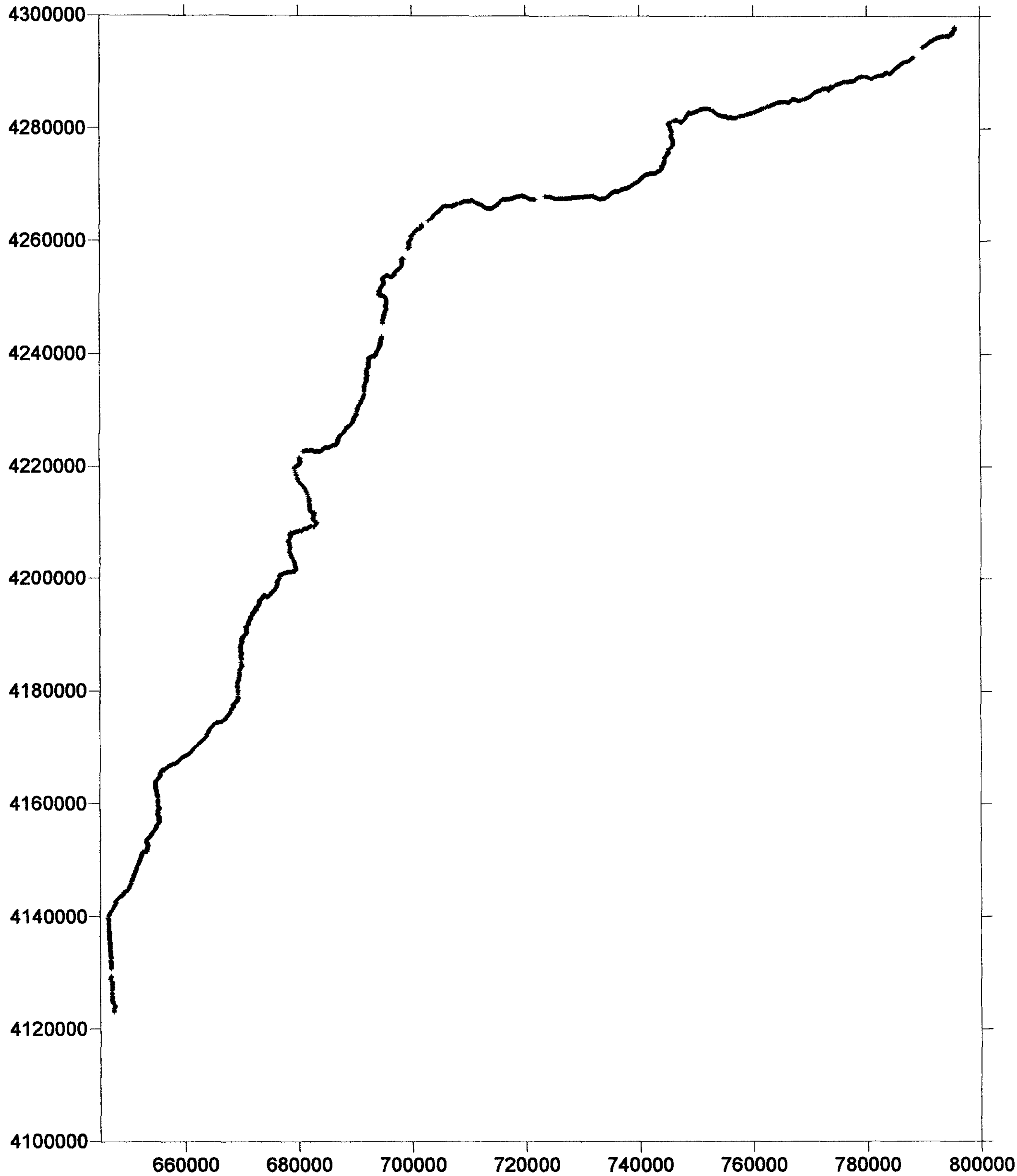
fichero estacado.xls en CD ANEXO VIII

ANEXO II

Informe sobre la toma de datos topográficos

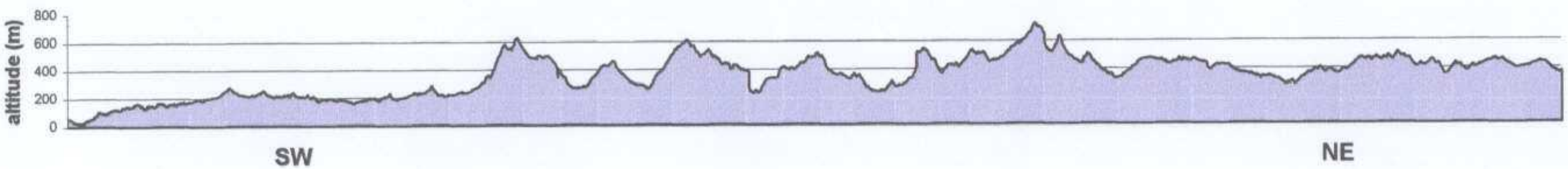
(véase aparte)

Ficheros UTM(29) y ... xxs en CD ANEXO VIII



fichero UTM(29) escala 1/1.000.000

IBERSEIS: topographic profile



ANEXO III

C.D. fotografías trabajo de campo

(conformadas el fichero plano itg (poster)

ANEXO IV

Disquetes de geometría

- Formato ASCII

* . PAG* incidencias de superficie [Pag137 (7 mayo) a Pg185 (4 julio)]

* . SPSS dispositivo utilizado en cada SP [SPSS137 a 185]

* . SPSX " de disparo [SPSX 137 a 185]

LAS 21 CINTAS DAT HAN SIDO SUSTITUIDAS POR 10 DVD:

DVD 1 shot 1-396
DVD 2 shot 397-739
DVD 3 shot 740-1189
DVD 4 shot 1190-1585
DVD 5 shot 1586-1981
DVD 6 shot 1982-2377
DVD 7 shot 2378-2773
DVD 8 shot 2774-3169
DVD 9 shot 3170-3565
DVD 10 shot 3566-3961

2 agosto 2004

ANEXO VI

Atlas de Puntos de Vibración

(véase aparte)

ANEXO VII

Stack completo del Perfil IBERSEIS

ANEXO V

Cintas magnéticas en formato SEGY (+ GEO en cabecera de cada traza)

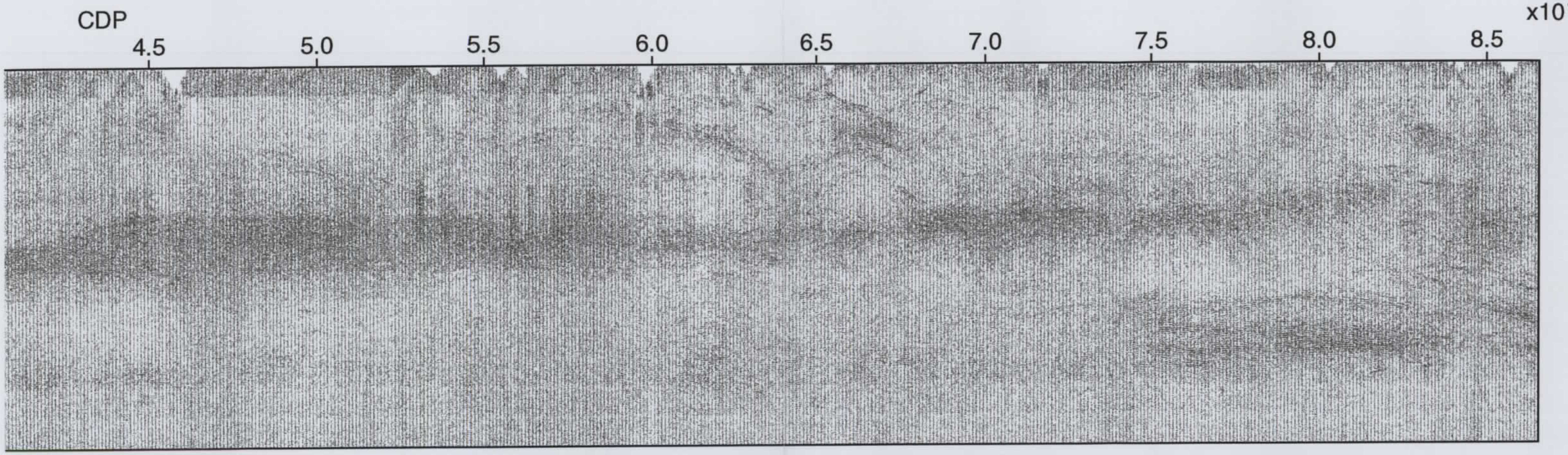
21 cinta DAT

FFID — nº de registro

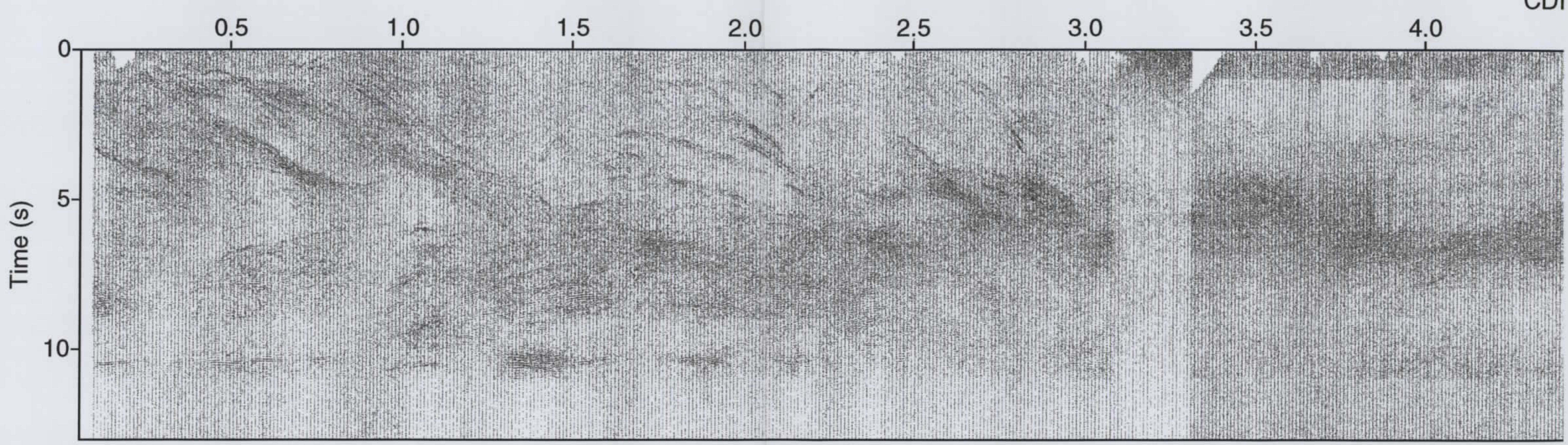
DT - intervalo muestreo (0,002 s)

MS - nº muestras por traza (10.001 = 20 s)

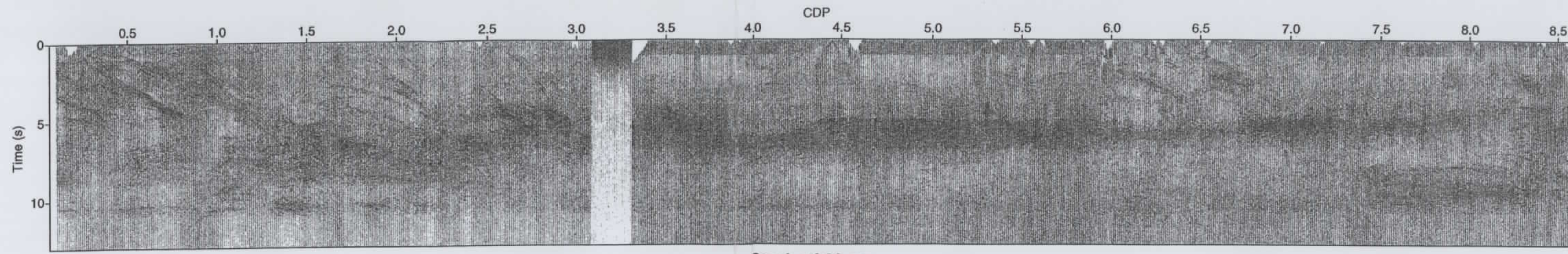
(véase aparte)



:ack STK02.su



Stack STI



Stack stk02.su

ANEXO VIII

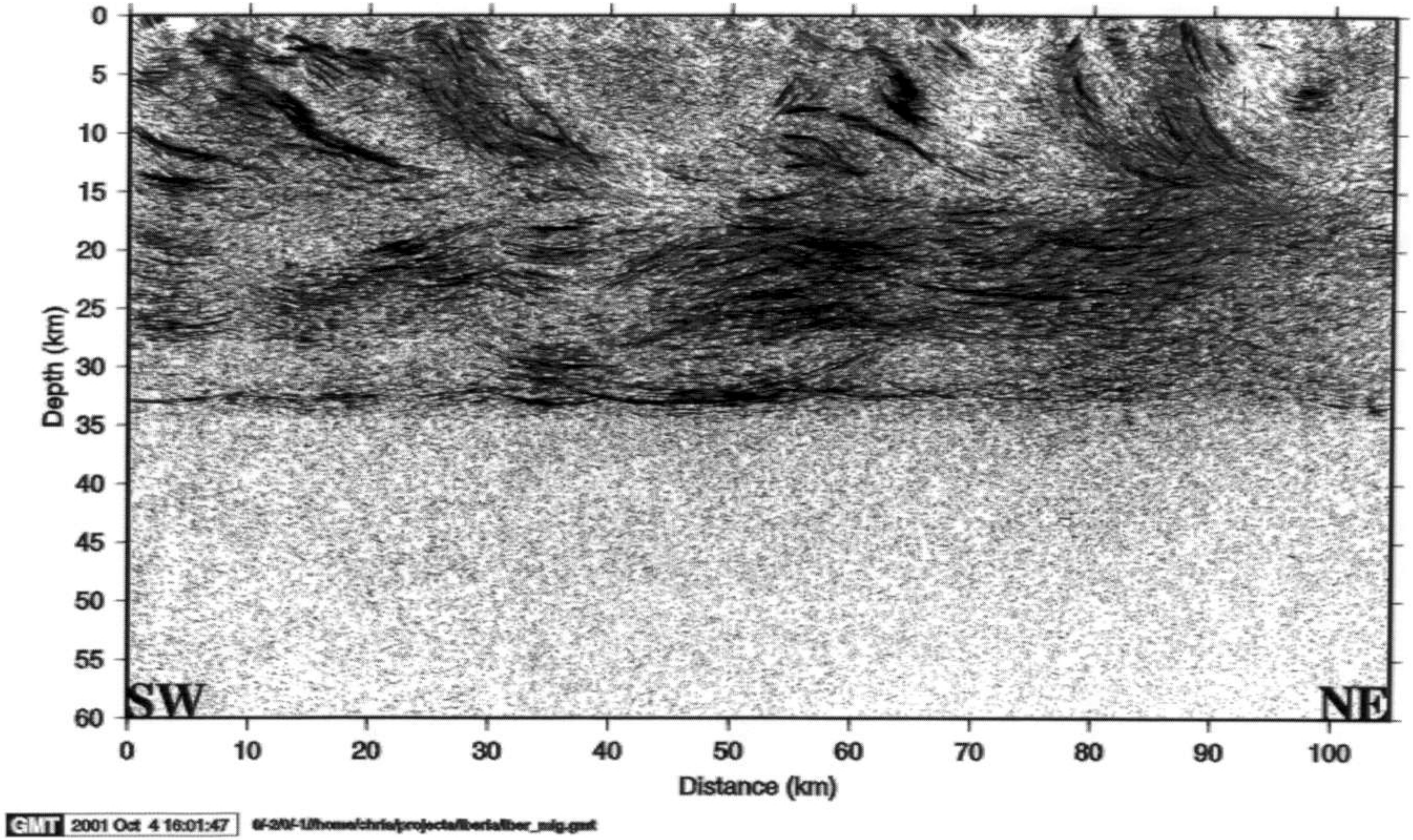
Perfil migrado de la

mitad meridional de IBERSEIS

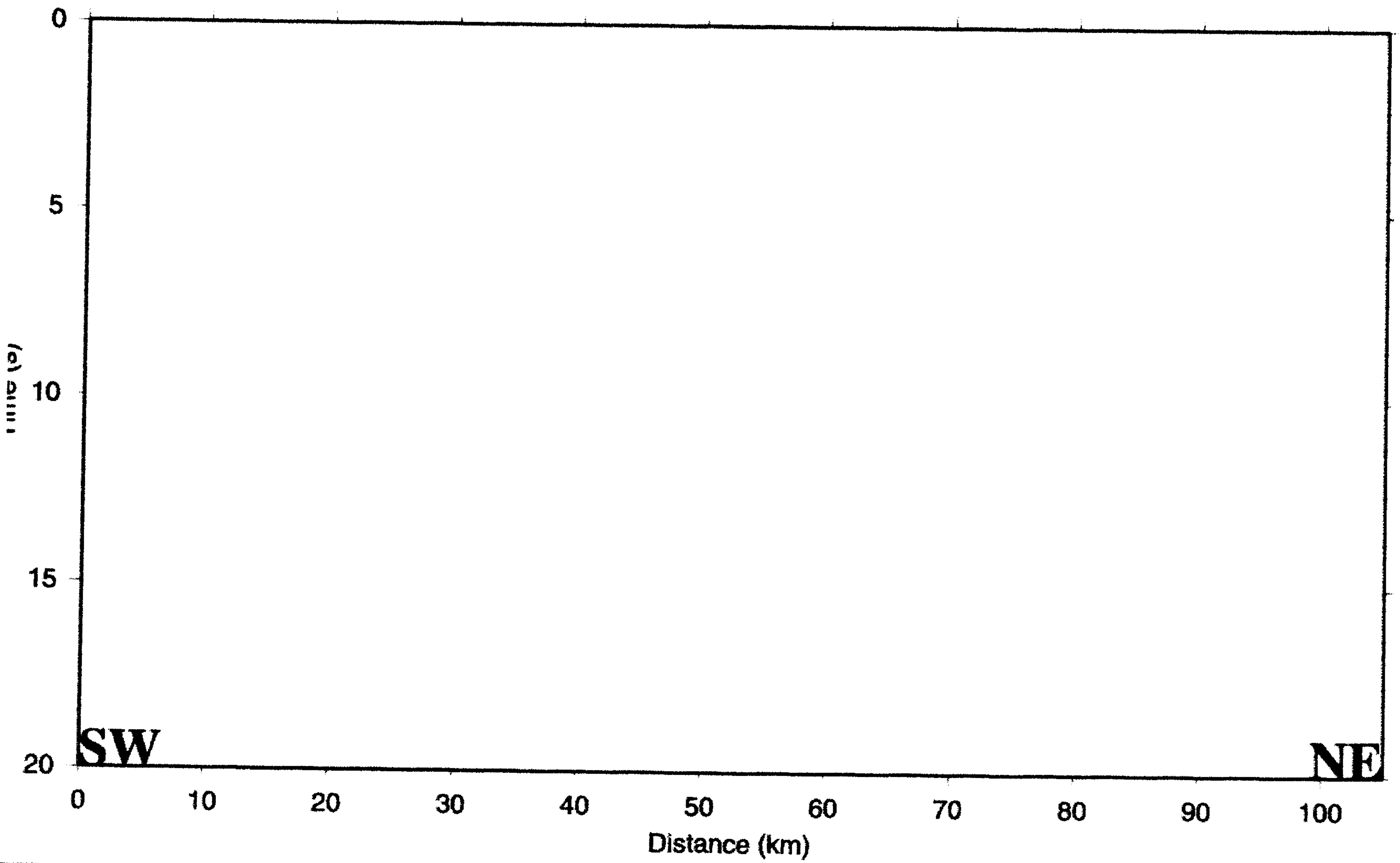
(Villablanca-Encinasola)

CD Fichero IBER_MIG_LINE.cpt
IBER_MIG_LINE.ps
IBER_time_Line.ps

Contiene además el Anexo I en fichero Estacab.xls
y el Anexo II " UTM(29)y.....xls


Depth (km)
Distance (km)
SW
NE
0
5
10
15
20
25
30
35
40
45
50
55
60
0
10
20
30
40
50
60
70
80
90
100
GMT 2001 Oct 4 16:01:47

c'bor_time_line.ps



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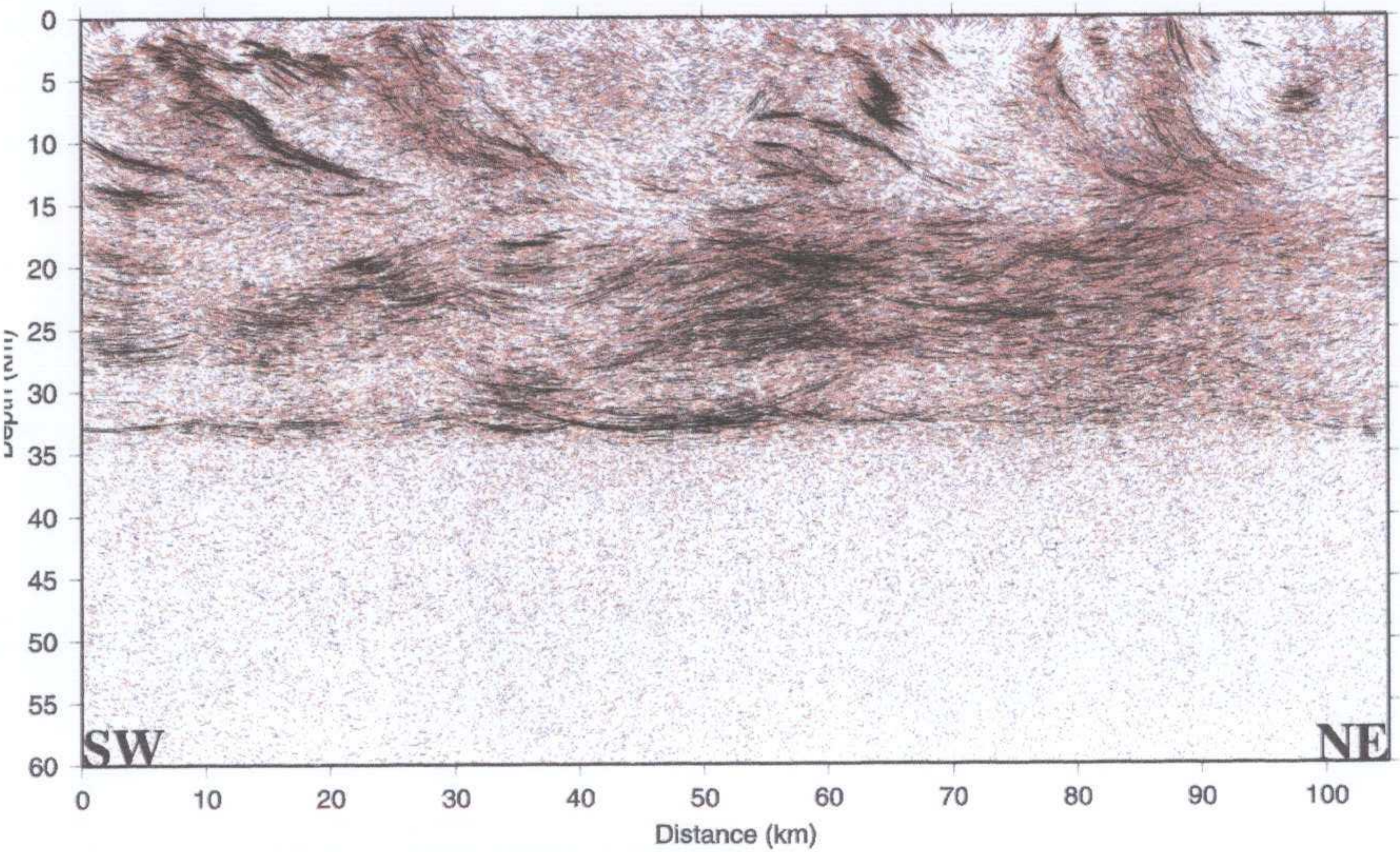
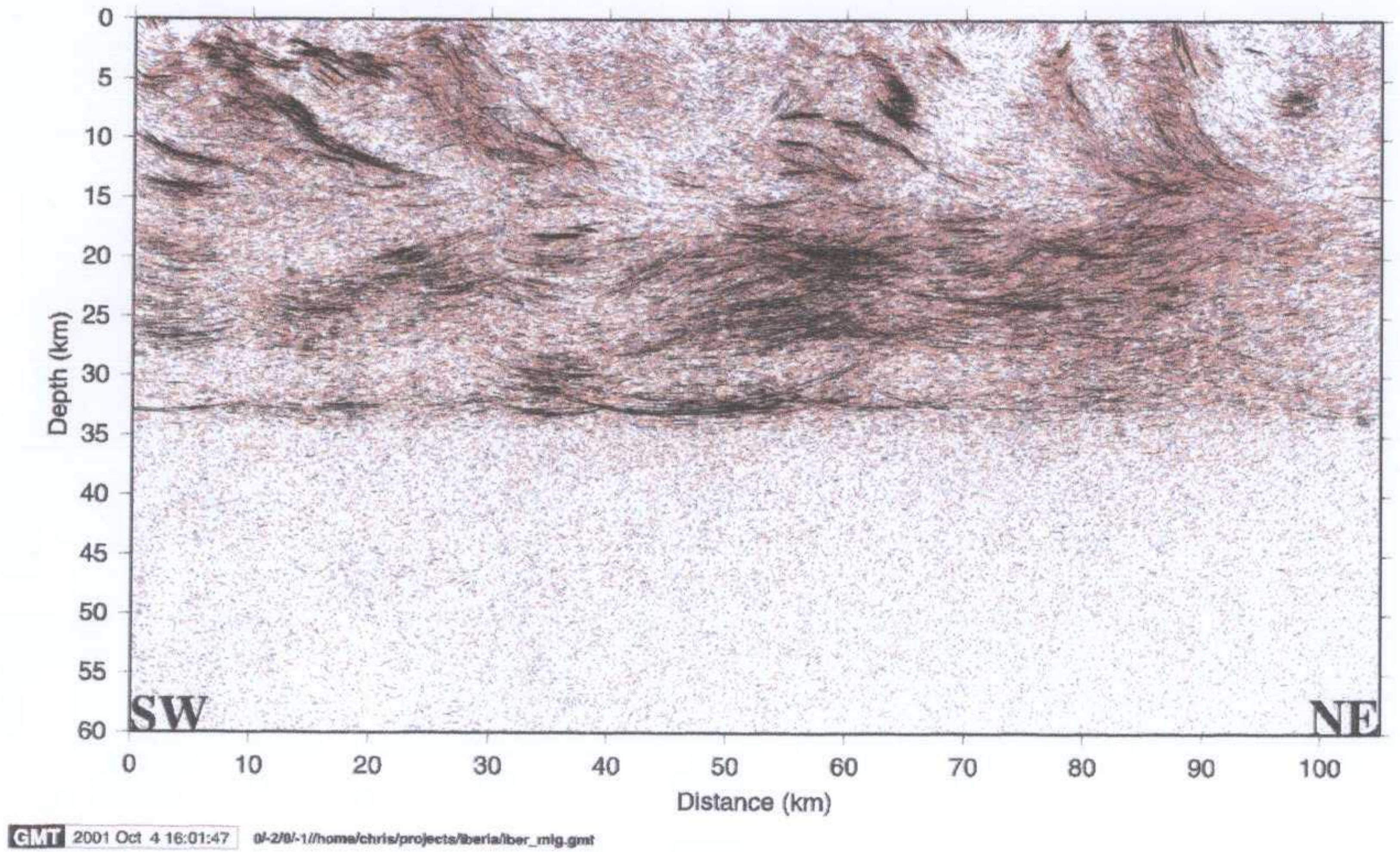


2001 Oct 4 16:01:47 0/-2/0/-1//home/chris/projects/iberia/iber_mig.gmt ibor_mig_line.ps

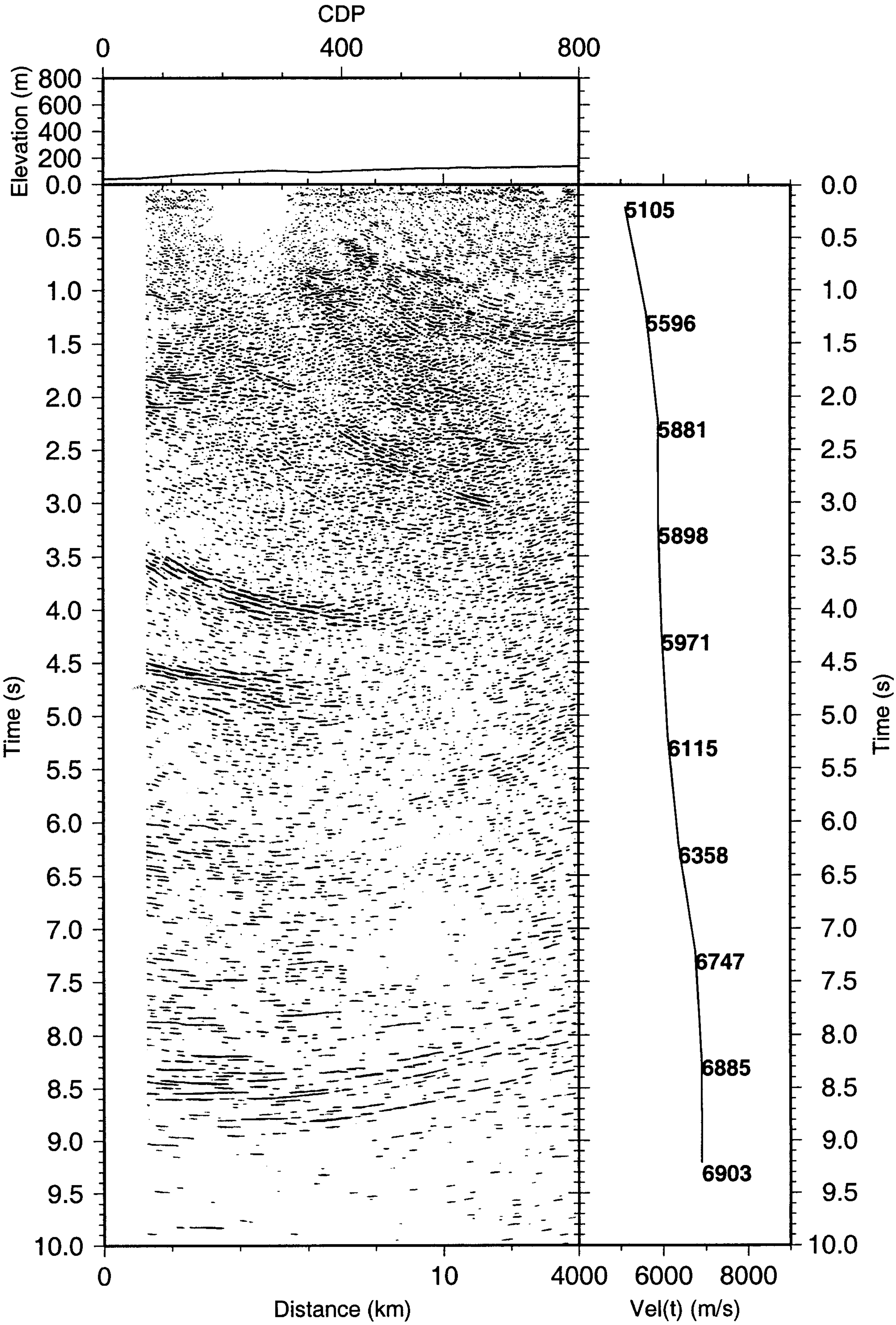


ANEXO IX

Primeros procesados de detalle

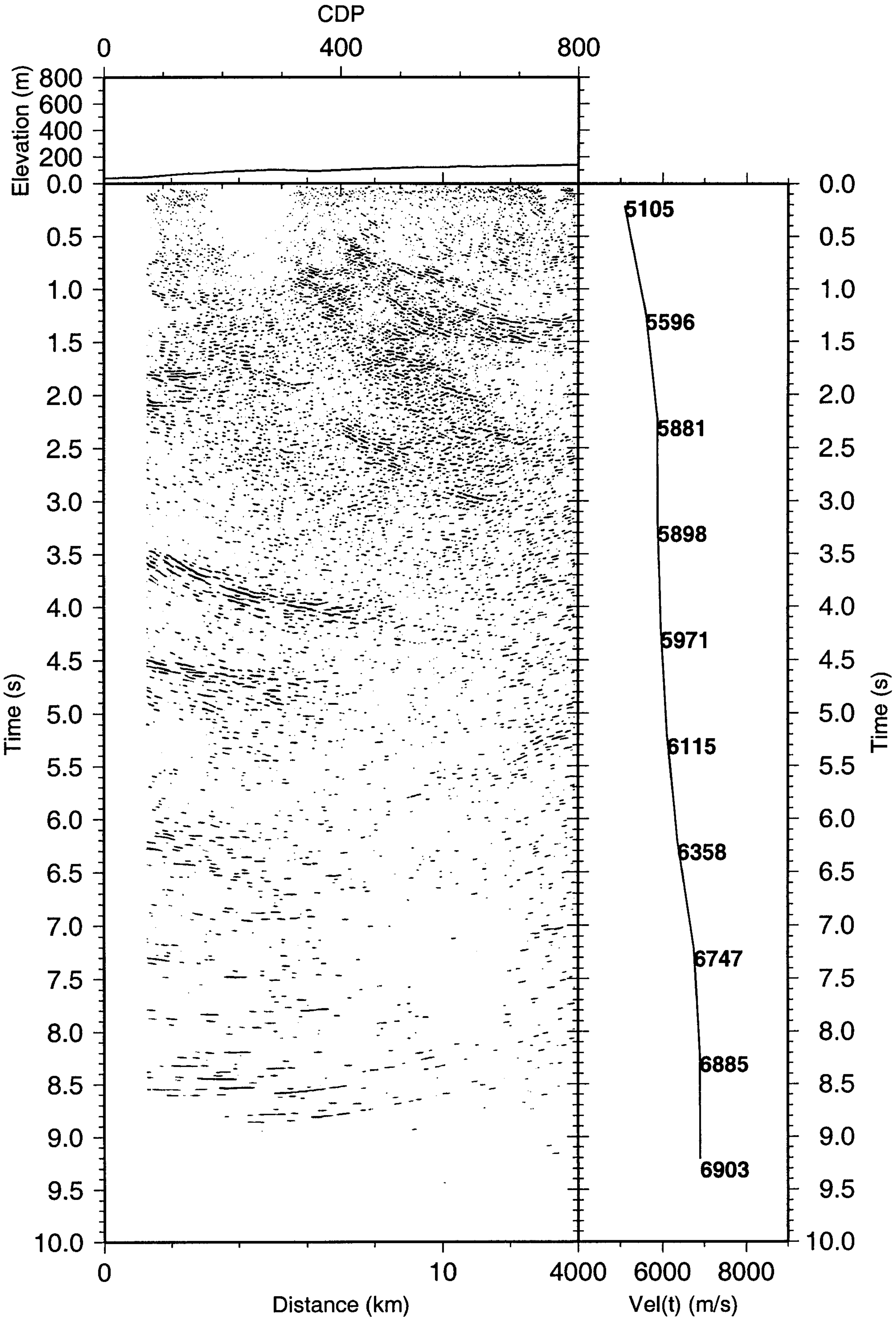
(Villablanca-San Silvestre de Guzmán)

NO DMO Kirchhoff mig 60-dip vel-dmo2



GMT 2001 Nov 16 15:55:57 /seis/diskB/ak/iberseis/./part_a4.gmt

Kirchhoff mig 60-dip vel-dmo2



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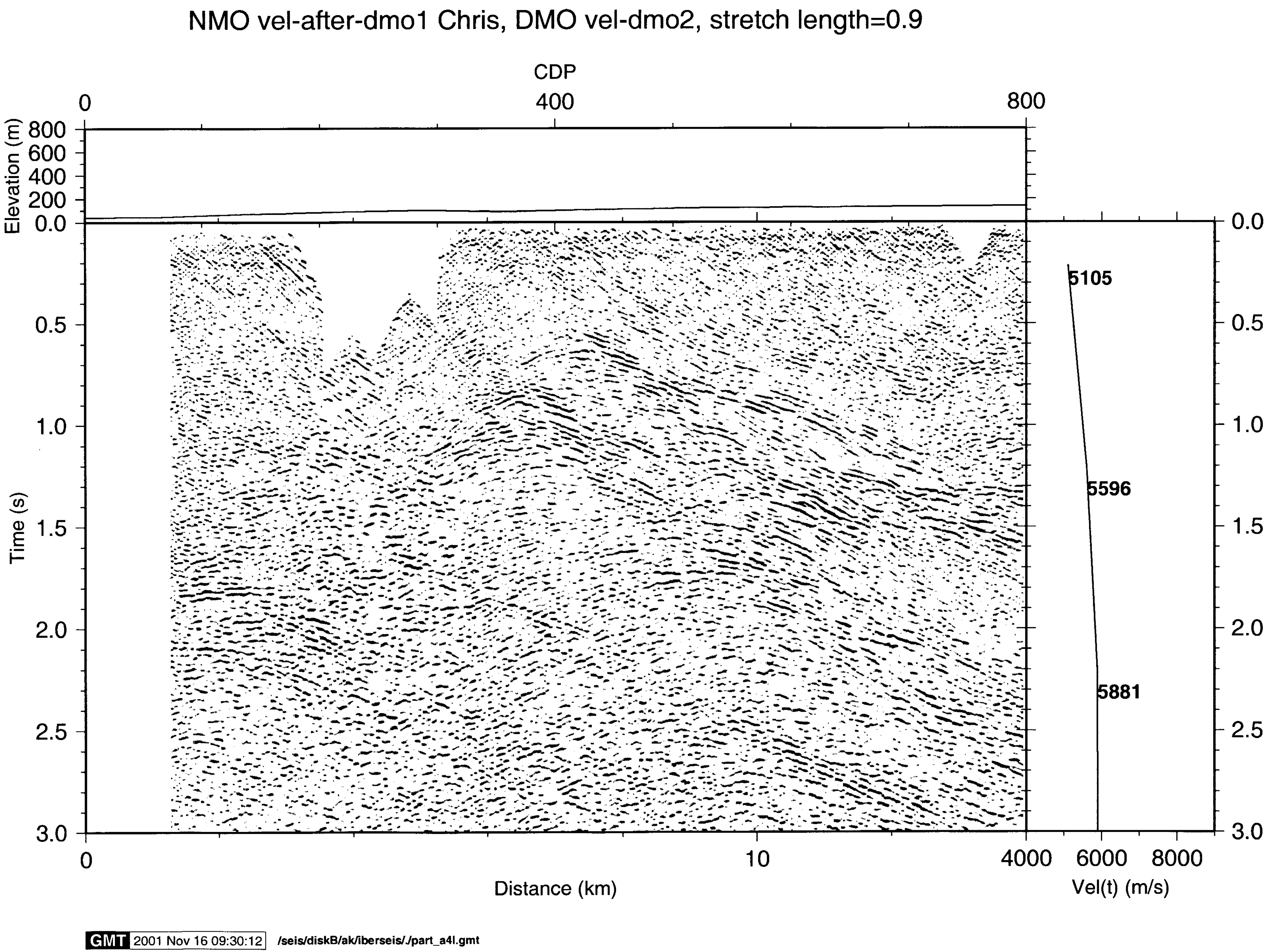
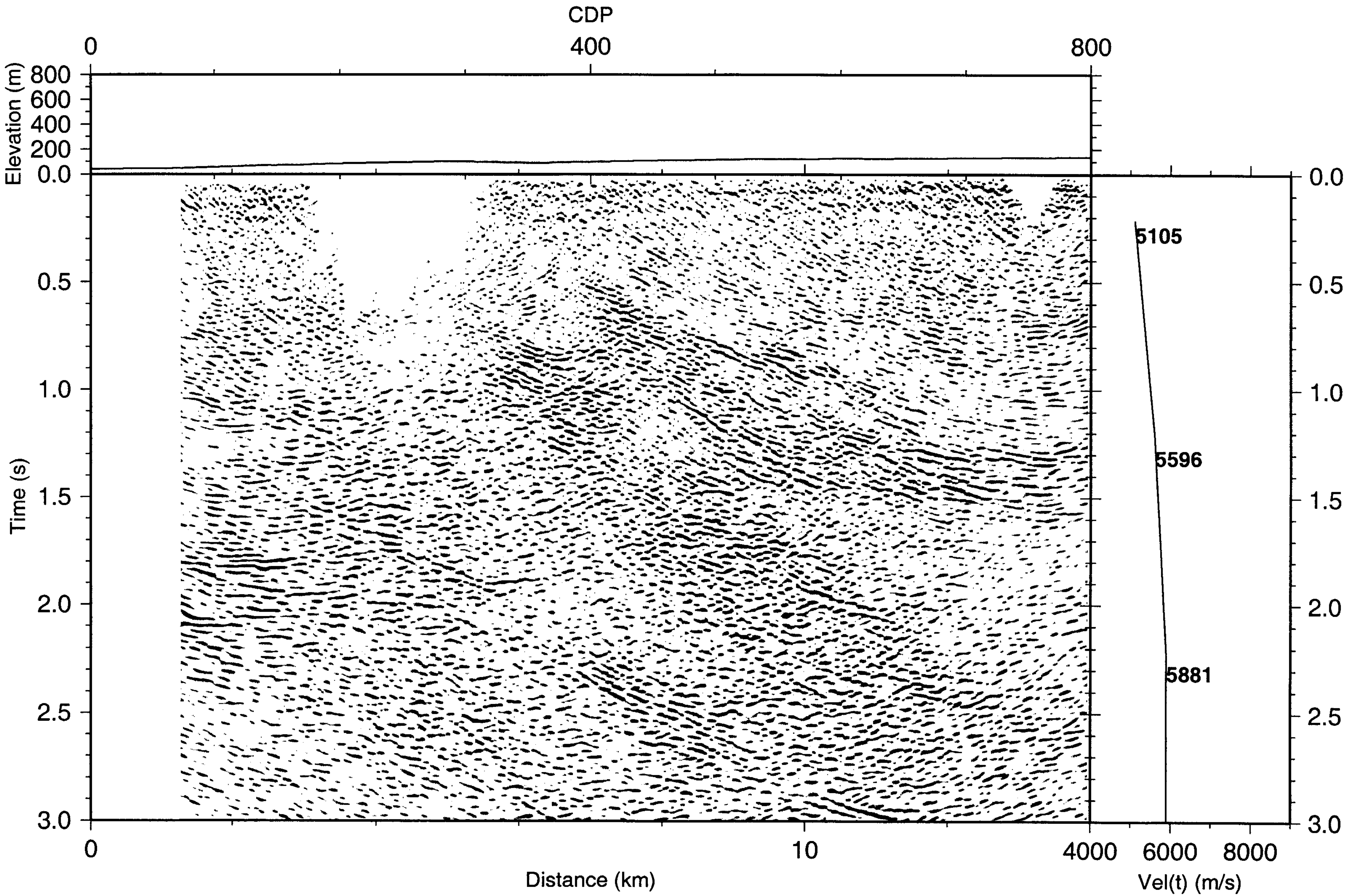


NMO vel-after-dmo1 Chris, DMO vel-dmo2, stretch length=0.9
CDP
0
400
800
Elevation (m)
800
600
400
200
0.0
Time (s)
0.5
1.0
1.5
2.0
2.5
3.0
0
10
Distance (km)
5105
5596
5881
4000
6000
8000
Vel(t) (m/s)
GMT 2001 Nov 16 09:30:12
/seis/diskB/ak/iberseis/./part_a4l.gmt

Migrated vel-dmo2 Kirchhoff 60



GMT 2001 Nov 16 14:08:25 /seis/diskB/ak/iberseis/./part_a4l.gmt

The Architecture of a Variscan Collisional Crust, as revealed by the IBERSEIS Seismic Reflection Profile in southwest Iberia

Simancas, J.F.[1], Carbonell, R.[2], González Lodeiro, F.[1], Pérez Estaún, A.[2], Ayarza, P.[3], Juhlin, C.[4], Azor, A.[1], Sáez, R.[5], Martínez Poyatos, D.[1], Pascual, E.[5] and the IBERSEIS Group

(1) University of Granada, Spain; (2) Inst. Earth Sciences Jaume Almera, CSIC, Barcelona, Spain; (3) University of Salamanca, Spain; (4) University of Uppsala, Sweden; (5) University of Huelva, Spain

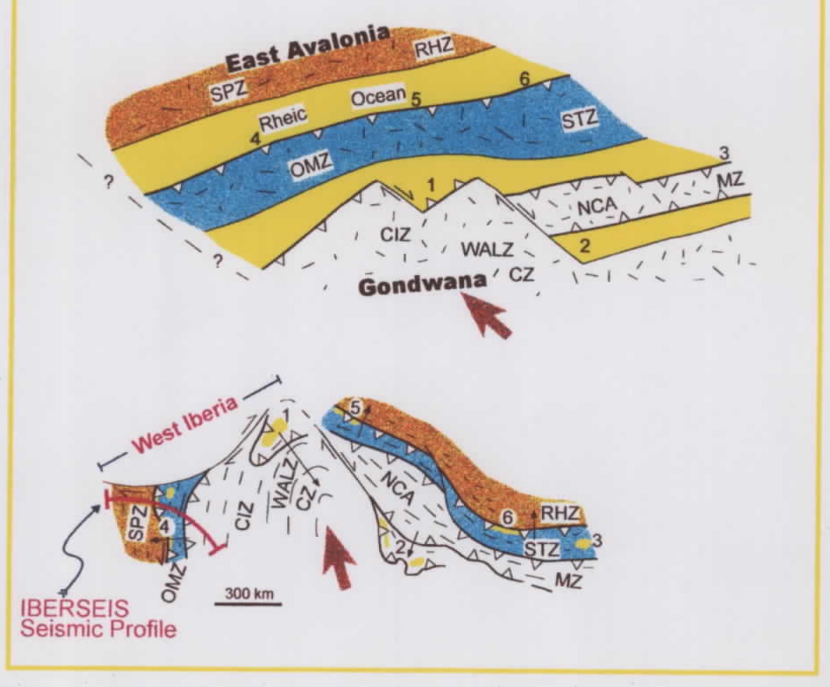


Figure 1

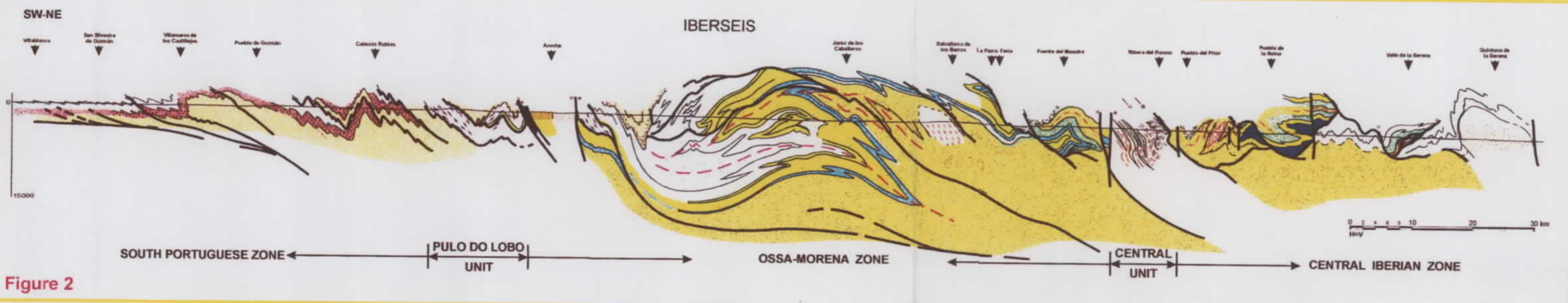


Figure 2

I - THE GEOLOGICAL CONTEXT

The western part of the Iberian Peninsula is made up by crust almost undeformed since Late Paleozoic, which conserves the record of Variscan orogenic processes affecting most of Europe.

Collision involving the continents of Gondwana and Laurussia plus a number of Gondwana-derived terranes is the plate tectonic framework for the Late Paleozoic Variscan Orogeny developed between 380 and 300 Ma. In the building up of southwest Iberia, the following continental components of that puzzle are involved (Fig. 1): a) the eastern part of Avalonia (in Iberia called **South Portuguese Zone**), a Gondwana-derived terrane accreted very early to Laurussia and, since then, making the border against which other fragments of Gondwana collided in Variscan time; b) an intermediate terrane (the **Ossa-Morena Zone**) whose degree of independence from Gondwana is being discussed; and c) the front of the Gondwana continent itself (the **Central Iberian Zone** and other zones of the Iberian Massif). The IBERSEIS Deep Seismic Reflection Profile cut across these three amalgamated continental pieces (Fig 1).

The structure of the upper crust along the IBERSEIS transect, as it was known just before the seismic acquisition, is shown in Fig. 2. The three main zones referred above are indicated; the boundaries between these zones being sutures marked by oceanic and/or high-pressure rocks. Kinematic data indicate that collision was oblique (left-lateral). The way in which oblique shortening has been accommodated in the whole crust and the crustal architecture of this transpressional orogenic region are the main goals of the IBERSEIS deep seismic research.

Figure 3a

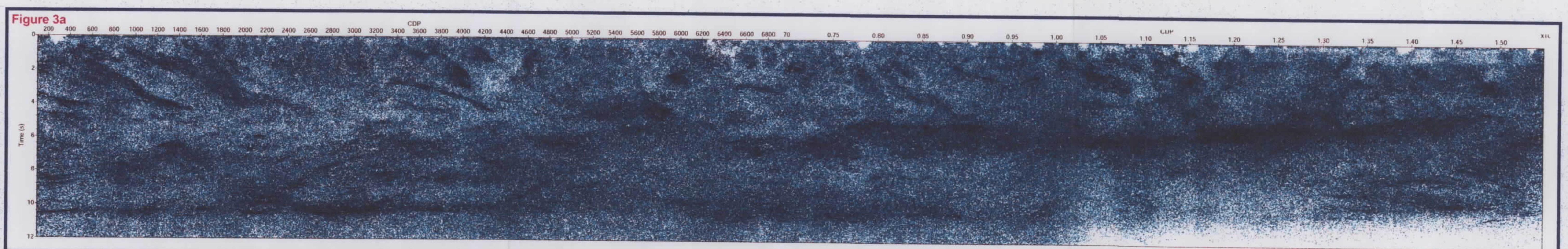



Figure 3b

II - THE IBERSEIS SEISMIC PROFILE

A migrated section of the 300 km long IBERSEIS seismic profile is shown in Fig. 3a. Hand drawing of conspicuous reflections (Fig. 3b) provides a first structural framework of the crust of southwest Iberia, and a more detailed account of the crustal structure is given in the following sections. A flat subhorizontal seismic Moho is seen all along the profile, so that remnants of orogenic roots inferred to have been formed during Variscan collision no longer exist. Thus, present Moho is postorogenic, probably latest Carboniferous to Permian.

Figure 4a

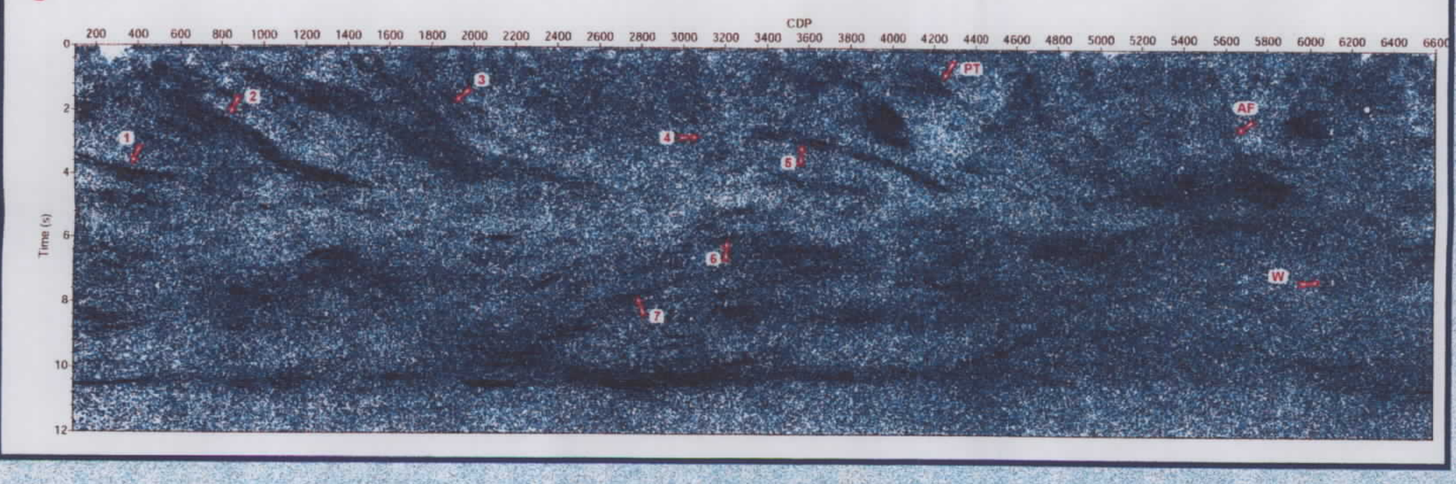
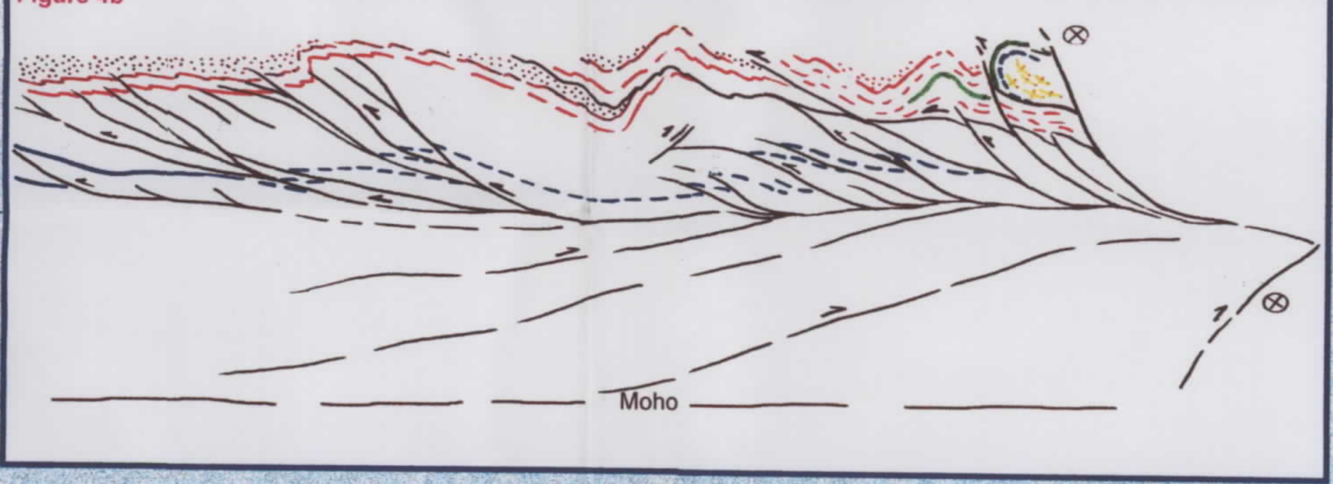


Figure 4b



III. THE STRUCTURE OF THE SOUTH PORTUGUESE ZONE (SPZ)

The SPZ is an external zone of this orogen announcing the proximity of the undeformed foreland, but the very front of the Variscan Orogen does not outcrop in southwest Iberia. The structure of the SPZ is shown in Figs. 4a (uninterpreted seismic data) and 4b (geological interpretation), and basically consists in an imbricated fan of southward-vergent thrusts affecting all of the upper crust. The detachment level for this thrusts is located in the middle of the crust. Under the detachment, the lower crust is broken by a number of back-thrusts that merge upwards in the mid-crustal detachment and downwards in the Moho. From this structure, the inferred rheological behavior of the SPZ crust is that of a body composed by two thick high-strength layers (upper and lower crust) and two thin low-strength layers (in the middle and at the base of the crust).

IV. THE SUTURE BETWEEN THE SOUTH PORTUGUESE ZONE (SPZ) AND THE OSSA-MORENA ZONE (OMZ)

At surface, the boundary between these two zones is marked by the Beja-Acebuches Oceanic Amphibolites and the Pulo do Lobo Unit (Fig. 2), the latter considered being a subduction-related accretionary prism.

In Fig. 5, the wedge of subduction-related rocks is labeled "PL". The strip of the Beja-Acebuches Oceanic Amphibolites ("BAA") has no seismic expression, suggesting that the amphibolites do not have downwards continuity. It is not clear where the suture continues in the lower crust, but it could be in reflections located under the OMZ and dipping to the north ("S" in Fig. 5).

The present geometry of the suture is strongly influenced by late-collision displacements. The Beja-Acebuches Oceanic Amphibolites first emplaced to the north, above continental rocks of the OMZ (obduction), being later inverted and transported to the southwest. Left-lateral faults ("AF", "B" in Fig. 5) produced important out-of-section displacements and impinged a wedge of SPZ lower crust upon the OMZ crust.

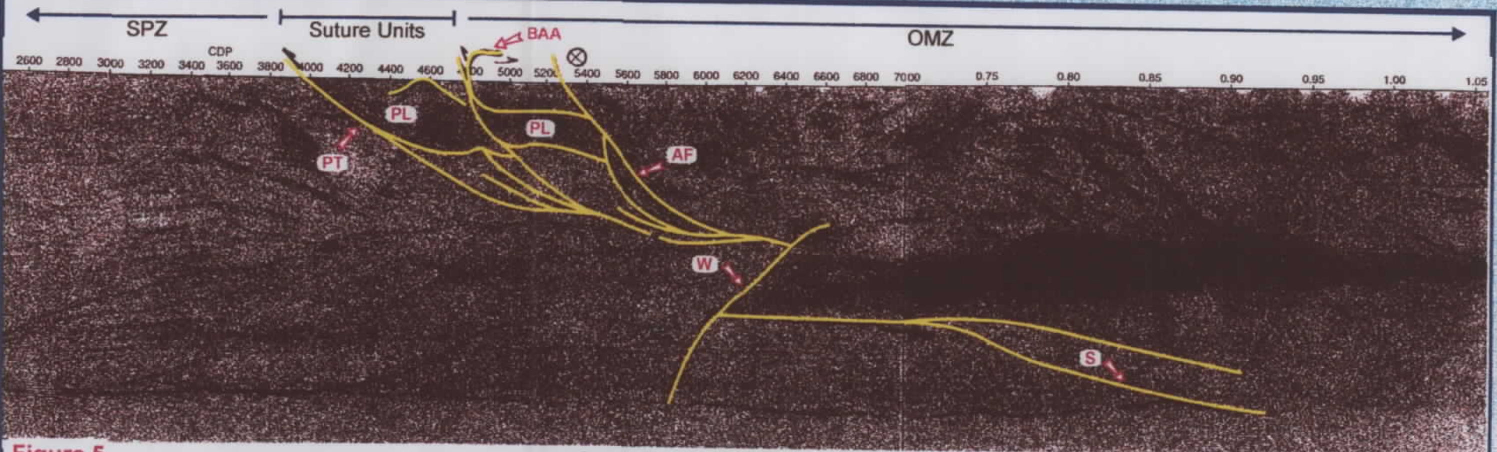
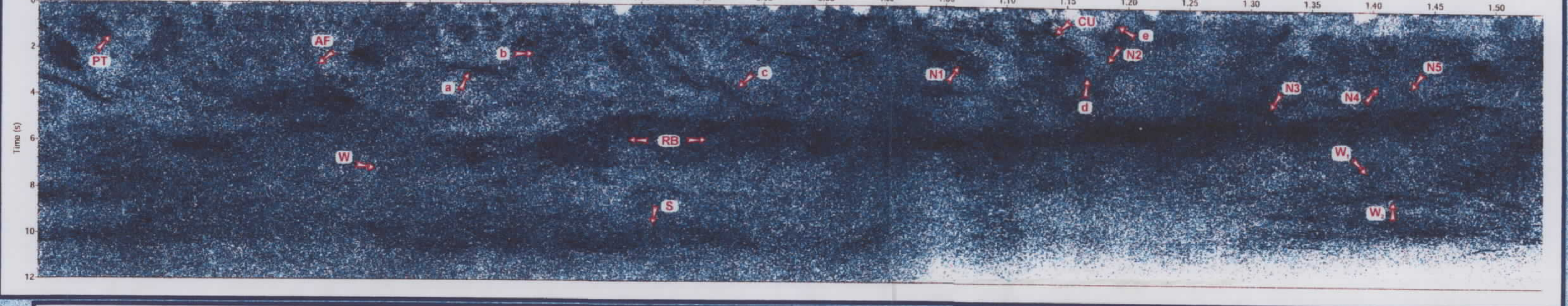


Figure 5

Suture between OMZ and SPZ

Figure 6a



V. THE STRUCTURE OF THE OSSA-MORENA (OMZ) AND CENTRAL IBERIAN (CIZ) ZONES, AND THE SUTURE BETWEEN THEM

The structure of the upper crust of OMZ, dominated by recumbent folds and thrust, has been firmly established from geological and seismic data (Figs. 6a and 6b). The Central Unit, made up by strongly-deformed high-metamorphic rocks and marking the boundary between OMZ and CIZ, is imaged as a band of reflections dipping northward ("CU"). Deformation in and at the borders of the Central Unit includes important left-lateral out-of-section displacements. The high-grade metamorphic rocks are cut and displaced by a normal fault ("N2") which belongs to a system ("N1", "N2", "N3", "N4", etc) thinning the upper crust of the CIZ in Early Carboniferous times. The lower crust of the OMZ is mostly transparent, but to the north, under the upper crust of the CIZ, a wedge structure is clearly imaged ("W1", "W2"). Wedging in the lower crust may have developed simultaneously with late shortening (folding) in the upper crust of CIZ.

The most conspicuous feature of the OMZ crust is a subhorizontal band of strong reflectivity located in the middle crust ("RB"in Figs. 6a and 6b). This band coincides with the detachment level in which upper-crustal structures merge, but clearly it is not a simple detachment level.


Figure 6b

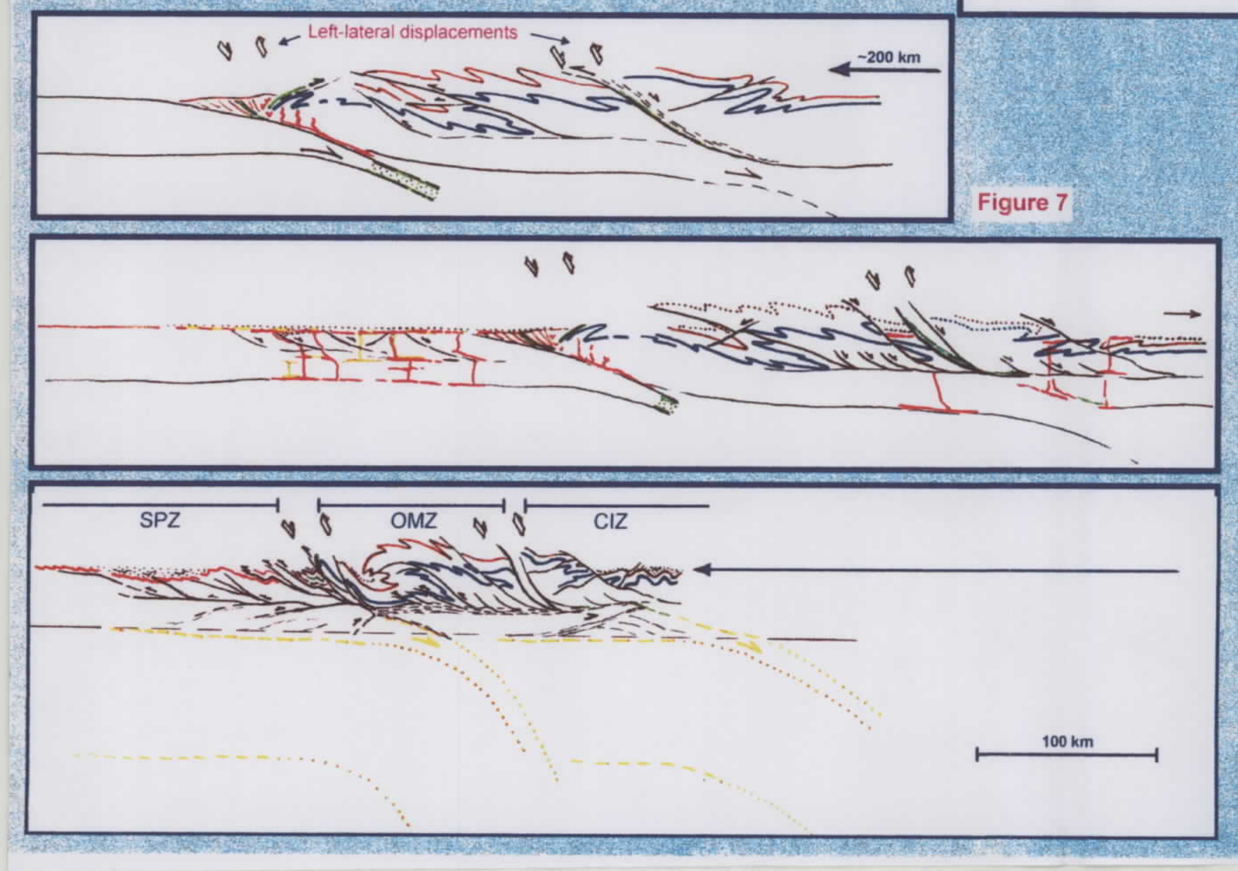


Figure 7

VI. EVOLUTION OF THE COLLISION IN SOUTHWEST IBERIA

The IBERSEIS seismic image gives a snapshot of the Variscan crust of southwest Iberia at the end of the Variscan collision. However, the crustal structure imaged accumulates displacements and structures produced along a history of continental collision (380 300 Ma), which is summarized in Fig. 7:

a) In Middle to Late Devonian (380-360 Ma), the OMZ and the CIZ collided, and recumbent folds in the upper crust of the OMZ and CIZ were produced. In the boundary OMZ/SPZ deformation in the Pulo do Lobo accretionary prism and obduction of oceanic rocks occurred, but no important deformation seems to penetrate in the SPZ crust.

b) Earliest Carboniferous (360- 340 Ma) was a transient time of oblique extension. Extrusion of volcanic rocks developed mainly in the SPZ (Iberian Pyritic Belt), and normal faults responsible for thinning of northernmost OMZ and CIZ are mapped at surface and seen in the seismic image.

c) Oblique convergence is detected again since Visean until the orogenic blockade (340 300 Ma). Contractive deformation in the SPZ was entirely produced in this period, as well as a second stage of shortening in the OMZ and the CIZ. Left-lateral strike-slip faulting was conspicuous at the end of the collision.

CONCLUSION

The IBERSEIS Deep Seismic Reflection Profile provides a detailed image of the architecture of the crust in southwest Iberia. This frozen image corresponds to the end of the Variscan Orogeny. The combination of seismic and geological data provides a deep knowledge about crustal evolution during collision.

ACKNOWLEDMENTS

This project has been funded by CICYT-FEDER, Junta de Andalucia, ENRESA, Swedish Reasearch Council and IGME. Special thanks are given to the field crew and CGG.

A X

Ficheros:

Stack: IBER6–stk.sgy
Migración: IBER6–mig.sgy
Fichero de velocidades de stack: VRMST.sgy

Processing Sequence

Read SEGY Tapes
Anti-alias filtering 0 60 Hz
Time resample 0.004 s
Trace editing
Frequency Filters

Time (s)	Filters (hz)
0-4	16-60
4-8	12-60
8-12	8-50
12-20	8-40

Trace balancing
Time scaling
Geometrical Spreading
Static Corrections
First arrival time picking
Elevation Statics
Refraction Statics
CDP Sorting
Velocity analysis
Normal moveout correction
Residual Statics
Stacks
Trace balancing
Time migration: Stolt

Time (s)	Vel (m/s)
0.0	5000
1.0	5250
2.0	5500
4.0	5750
6.0	6000
10.0	6250