CRUISE REPORT

SHIP UTILIZATION DATA

UNOL
Rev. -/83

SHIP NAME ROBERT D. CONRAD	OPERATING INST. LDGO OF COL. UNIV.	
CRUISE (LEG) NO. 29-11	DATES Nov. 2-29-1988	
AREA OF OPERATIONS: MEDITERRANIAN	PORT CALLS: PLACE / DATES	
	Barcelona / 11-2-88	
	Cadiz / 11-29-88	
DAYS AT SEA 27 / DAYS IN PORT 10		

PARTICIPATING PERSONNEL

CODE	NAME	TITLE	AFFILIATION
1.	A. Watts	Co-chief Scientist	LDGO
2.	J. Mutter	Co-chief Scientist	LDGO
3.	U. ten Brink	Scientist	LDGO
4.	J. Bott	Scientist	Oxford

Use Reverse If Additional Space Required. (see over)

WAS RESEARCH CONDUCTED IN FOREIGN WATERS? YES COUNTRY: SPAIN, MOROCCO & ALGERIA

PRIMARY PROJECTS (those which govern the principal operations, area and movements of the ship)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)
PROJECT VALSIS	NSF	OCE 86-14958	
DISCIPLINE MCS			

ANCILLARY PROJECTS (which are accomplished on a not-to-interfere basis and contribute to the overall effectiveness of the cruise)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)

SIGNATURE A. Watts DATE 10-13-89
CHIEF SCIENTIST

TOTAL SCIENTISTS 7 TOTAL TECHNICIANS 9
TOTAL GRAD STUDENTS 1 TOTAL STUDENTS/OBSERVERS

ATTACH PAGE SIZE CRUISE TRACK

COST ALLOCATION DATA

DAYS CHARGED	AGENCY OR ACTIVITY CHARGED	GRANT OR CONTRACT NO.
37	NSF	OCE-86-16405

SIGNATURE [signature] DATE 10/17/89
Institution Official

5.	B. Pinet	Scientist	IFP
6.	M. Torne	Scientist	Spain
7.	C. Zehnder	Scientist	LDGO
8.	J. Stennett	Technician	LDGO
9.	P. Bennett	Technician	LDGO
10.	J. DiBernardo	Technician	LDGO
11.	B. Francis	Technician	LDGO
12.	M. Iltzsche	Technician	LDGO
13.	R. Maiwiriwiri	Technician	LDGO
14.	T. Nolan	Technician	LDGO
15.	F. Robinson	Technician	LDGO
16.	W. Robinson	Technician	LDGO

cc: Cruise file
Gulf of Valencia file
Joyce Alsop

PROJECT VALSIS

R/V Conrad Cruise 29-11 Report

Barcelona - Cadiz, Spain

November 2nd - 20th, 1988

Background

Project VALSIS is a two-ship multichannel seismic reflection and refraction profile study of the Valencia Trough in the western mediterranean. The project is a joint one between Lamont-Doherty, the Institut Francaise de Petrole (IFP) and the University of Paris 6. The main objective of the project is to determine the detailed velocity-depth structure of the crust and the depth to the Moho beneath the Valencia Trough, western mediteranean. The Valencia Trough is believed to be a rift that extended during the Oligocene and then failed. The comparitively thin post-Oligocene sedimentary cover make it an ideal locality for the study of extensional features in rifted continental margins.

The joint project involved two ships: the Lamont-Doherty operated vessel "Robert D. Conrad" and the IFREMER (Brest, France) operated vessel "Jean Charcot". The cruise of Conrad began in Barcelona, Spain on November 2nd and ended in Cadiz, Spain on November 29th. The cruise of Charcot began at the same time in Barcelona but ended in Palma, Mallorca on November 20th. There was an exchange of personnel and equipment between the two ships on November 20th. This narrative refers mainly to operations on the Conrad although some reference is made to activities on the Charcot.

Personnel

The personnel on the two ships included representatives from each of the institutions involved in the joint project. In addition, three scientists from Spain participated in the project. They included:

Robert D. Conrad

A. Watts (LDGO)	Co-chief scientist
J. Mutter (LDGO)	Co-chief scientist
U. ten Brink (Stanford/LDGO)	
B. Pinet (IFP)	
M. Torne (Geol. Surv. Catelonia)	
C. Zehnder (LDGO)	
J. Bott (Oxford)	
J. Stennett (LDGO)	Chief Science Officer
B. Francis (LDGO)	
P. Bennett (LDGO)	
J. Dibernardo (LDGO)	
M. Ilitche (LDGO)	

Jean Charcot

A. Mauffret (Univ. Paris)	Chief scientist

P. Buhl (LDGO)

D. Odin (IFP) Chief Science Officer
P. Ricarte (IFP)
G. Pascal (IFP)
J. Mueller (IFP)
G. Lartigaux (IFP)

M. Gennesseaux (Univ.Paris)
G. Ciais (Univ.Paris)
F. Ortigosa (Inst. Jaime Almera, Barcelona)
M. Jurado (Inst. de Ciencias, Barcelona)

Equipment

The equipment on board the Lamont-Doherty operated vessel R/V Robert D. Conrad included the following items:

* DIGICON 2.4 km streamer with 96 traces and 25 m group spacings
* Tuned 10 element BOLT airgun array (total volume 5821 cu.in)
* DIGICON DSS 240 recording system
* 4 PRICE Air Gun Master and 1 DC drive air compressors.
* RAYDIST Model RA-89 receiver and antenna
* Motorola Mini-Ranger and antenna
* Decca/Trisponder and antenna (from NERC)
* Bell Aerospace BGM-3 sea-gravity meter system
* Varian proton magnetometer
* Loran-C, transit and GPS positioning systems
* Single-Side-Band ship to ship radio (from IFREMER)
* VHF "Sailor" ship to ship radio (from IFREMER)
* Sobrelec clock (from IFP)
* Input/output encoder system (from IFP)

The IFREMER operated vessel R/V Jean Charcot was equipped with:

* AMG 2.4 km streamer with 96 traces and 25 m group spacings (from IFP)

* SERCEL SN-348 96 channel recording system (from IFP)

* Lacoste-Romberg sea gravity meter system

* Loran-C, transit and GPS positioning systems

* Sobrelec clock (from IFP)

* RAYDIST Model RA - 89 receiver and antenna

* VHF "Sailor" ship to ship radio

* BLU long-range ship to ship radio

* SEABEAM

Narrative

The Conrad departed from Barcelona at 1430 hours on November 2nd and headed for a point in deep water about 120 km east of the port. At 0930 on November 3rd the DIGICON streamer was deployed in moderate sea conditions and work begun on attaching the cannisters, adapters, transducers and floats. Charcot departed Barcelona at a similar time but shortly after departure found a problem with the onboard seismic data processing system. Since the demultiplexing of seismic data at sea was an important objective of the IFP group, Charcot decided to head for the nearest French port to pick up spare parts. We agreed to rendez-vous with the Charcot later in the day and if the streamers on both vessels were successfully deployed to begin the survey at ESP 1 in the deep Valencia gulf. By about the late afternoon the weather had turned noticeably for the worse and sea states of 5 to 6 were encountered. The poor weather was centered to the north over the Gulf of Lion where there were gale force winds. We decided therefore to pull in the streamer and transit with the Charcot to the southeast away from the storm center and begin the survey at ESP 2 (note that in this narrative ESP 2 is the first ESP - ESP was cancelled because of rough sea conditions) off the north coast of Mallorca instead. On November 5th we began deploying the streamer again in calm seas in the lee of the island where we had hoped to begin the first COP traverse of the trough. By about mid-day it became clear that we could not begin the profiling because of telemetry problems with the streamer.

The first of the problems concerned faults in the digitising cannisters between the active sections of the streamer. One of the cannisters had been replaced earlier and now it was necessary to replace cannister # 7. At 2040 hours on November 5th, the connector to cannister # 14 was opened and it was found that it was missing the O-ring that prevents water seepage. The O-ring was replaced but the power problems continued. By 2145, the connector to cannister # 11 was opened and again it was found to be missing an O-ring. The problems continued through the night and it was not until 1800 the next day that the work on the streamer was complete. By this time more missing O-rings were found and two more cannisters had to be replaced.

After deployment of the streamer and a successful test of the airguns we were able to begin the first COP profile at 2302 hours on November 6th. Since the Conrad was the ship equipped with air-guns it was decided to let the Charcot lead the Conrad during the COP. The range between the two ships was chosen to be 5.4 km so as to give a near offset of 0.27 to 2.67 km and a far offset of 2.67 to 5.07 km for the wide aperture data. The range between the two ships was monitored on a Decca Trisponder on loan from NERC

(Barry, UK) and the RAYDIST. The Trisponder provided a digital read out of the range (in meters) in the main lab, but the bridge had an analogue display of the difference in lanes between the two ships from the RAYDIST. The bridge of the two vessels were in touch every hour and the appropriate adjustments were made in the speed to maintain the 5.4 km offset distance. During the COP the bearing of the Charcot and its tailbuoy were logged by the bridge every half-hour.

The main objective of the COP was to profile the deep crustal layers on a profile of the trough from the shelf off Mallorca to the northern part of the trough to the south of Tarragona. The 108.6 nm long line was completed at 2106 hours on November 7th. Two major basement highs were crossed on the transect which appear to be part of a NE - SW trending structure. Since the next line was to the east it was decided to do a large turn first to the north and then to the south and west. Unfortunately, several fishing boats were encountered and the turn was delayed. By the time both vessels were at the new start point 6 hours had elapsed. The next COP (COP # 2) was run between this point and the mid-point of ESP 2 along the axis of the Valencia trough where previous studies indicate the thickness of the Neogene is about 4 km and at a relatively constant depth. The end of the line was reached at 0630 hours on November 9th at which time the Conrad continued to the end of the ESP aquiring CDP data while the Charcot made a transit to the western end-point of the ESP.

The rendez-vous for the first shot of the ESP was first set for 0900 but was then delayed while the Charcot re-positioned. ESP 2 began at 1103 hours when Conrad's guns were at the end-point and the mid-point of Charcot's streamer was at the other end-point. To save time ESP 2 was shot as a "half ESP": the two ship's passing each other at 1441 hours and then breaking the line. During the crossing of the vessels the bearing of the Charcot was recorded and both channels of the trisponder were read every minute.

After the ESP, both ships headed for a position north of the ESP mid-point to start the third COP profile from the margin off Barcelona to the Balearic islands ridge via the ESP 2 mid-point. On the way to the COP start point it was decided to recover the streamer to correct a telemetry problem. Several large fishing nets were removed from the streamer and one of the cannisters needed to be replaced. By 0418 hours on November 10th we were ready to begin COP 3 between the center of the basin and the Balearic ridge. The COP ended at 2215 hours after which time Conrad continued south between Mallorca and Menorca aquiring CDP data while the Charcot began its transit to the western end-point of ESP 3. At 0400 on November 11th it was decided to end the CDP and pull the streamer in to correct for possible snagging by fishing lines. Two additional cannisters were replaced (# 15, #16) because they were suspected of giving noisy traces.

By 1115 hours the two ships were positioned for ESP 3 - the first "full" ESP shot on the cruise. The ESP was located on the narrow shelf to the north of Mallorca where the basement (?Betic) appears to outcrop. Conrad passed from the east while Charcot completed the track from the west. The mid-point of the ESP was at 1422 hours and was located about 5 km off Mallorca. At 1436 hours during the ESP a telemetry fault occured with the streamer and CDP data was lost. By 1720 hours near the mid-point (both vessels abeam) power had been restored. At 2154 hours the telemetry failed again and the recording system had to be shut down - about 1 hr before the end of the ESP. Due to streamer problems only 50% of the northern part of the CDP profile was recorded and about 80% of the southern part.

After completing the ESP at 0040 on November 12th, we decided to retrieve the streamer to correct possible bad cannisters and other faults. Several attempts were made to build the streamer but it continued to fail near cannister # 13. Other telemetry problems

occured with the streamer and despite much effort to repair it by Joe and his team, it was still not possible to record. In order not to loose any further time we decided to make the transit to the end-point of ESP 4 and work on the streamer on the way.

ESP 4 began at 1225 on November 12th and ended at 0012 hours on the 13th after a 52.9 nm long profile. This ESP was located in the center of the trough along COP 2. The line had already been shot as 30 sec CDP by Conrad along the COP and so it was not really that critical that we were unable to record CDP data during the ESP. During the transit between the end-points of ESP 4 and 5 it was decided to continue shooting at 60 sec intervals so that the Spanish scientists manning the land seismic stations in Spain could also record our shots.

ESP 5 was the first ESP off Barcelona and Tarragona and it introduced us to some of the difficulties of carrying out seismic work on the continental shelf. A great help on this ESP was the guard boat M/V Cataluna who had been assigned to protect Conrad's streamer since the morning of November 11th. It was agreed that the boat should keep its distance and follow the tailbuoy to ward off boats attempting to cross astern of the Conrad. Occasionally it was necessary for the guard boat to steam up alongside the streamer or to the front of Conrad to ward off any fishing trawlers that ignored our radio warnings.

This ESP, like that of ESP 4, was shot "full". The ESP was located on the shelf where the Neogene sedimentary cover was believed to be relatively thin. Conrad reached the eastern end-point at 1301 hours on November 13th and was ready to begin shooting to the Charcot shortly after. The ESP was 52.9 nm in length and last shot was at 0018 on November 14th.

At 0300 hours the streamer, which had been in water more or less for the past 3 days, was retrieved one more time to test the possibility of a fault in the leader at the head section. The streamer had two leaders: a DIGICON one and one of Lamont's spares. It was found that after the DIGICON leader was removed the streamer could be built completely. This leader was therefore suspected of causing many of the unexplained telemetry problems earlier in the cruise and it was with some relief that Joe had found the fault. By 0400 the streamer had been put back in the water and it was floating well. The only problem was a noisy trace near cannister # 4, but it was decided not to go ahead and repair that now. At 0538 we began recording CDP (30 sec) data after a data "gap" of more than 3 days.

By the time streamer was built we were about half-way along the transit between the end-point of ESP 5 and the start of ESP 6. We reached the start point of ESP 6 at 1314 hours on November 14th and completed the ESP by 0119 hours the next day. While shooting the CDP we passed to the west of a drilling platform - a reminder that this area of the Valencia trough is an important petroleum province.

ESP 6 was located on the shelf south of Tarragona and was aligned NE - SW. According to well data the ESP is located over the axis of a deep shelf basin which exceeds 5 km in thickness at its center near the ESP mid-point. The basin is relatively narrow (~ 25 km) and has been drilled in a number of locations.

At the end of ESP 6 we made a transit from the end-point of ESP 5 to the end-point of ESP 7 via the western end-point of ESP 3. CDP data was aquired along the entire length of the 97.2 nm transit. Charcot travelled a similar distance and collected SEABEAM data over the edge of the continental shelf. We reached the ESP 7 end-point at 0010 on November 16th and completed the profile by 1126 hours the same day. Since we had enough

time, it was decided to shoot this ESP as "full". This ESP was located at the head of the Valencia gulf on a site where existing data indicate that up to 3 km of sediments are located.

After successfully completing ESP 7, we decided on an extended transit to the south to a point on the Balearic islands ridge near Ibiza. The purpose of this line was to make sure that the final COP profile crossed the seaward extension of the Betic mountain front. It was while we on our final turn at the end of profile that we ran into streamer problems again. The turn had not been an excessively steep one and although there were a number of fishing boats in the area none were suspected of damaging the streamer.

Joe was unclear of the cause of this telemetry failure at first. He checked the suspect cannister # 15 which had been giving some noisy channels and found it in order. An adapter section in front of one of the cannisters was found to have a faulty O-ring and this was replaced. Finally, an O-ring was found to be missing from the tail of the compass section. After these faults were repaired the streamer built successfully and we were ready to shoot the final COP line by 1223 hours on November 16th.

We had lost a total of about 6 hours at the start point to the COP because of streamer problems and some of the scientists on the Charcot were getting concerned that they may not be able to make the agreed rendez-vous off Mallorca on November 19th. They proposed to run the COP over the deep water in the trough: an idea that did not receive much support on the Conrad. After much debate we agreed to continue the COP onto the shelf and try to connect the ESP mid-points.

The COP was run across the shelf between Valencia and the Isles Columbretes and north to off Tarragona. On several occasions the passage of the two ships was interupted by fishing trawlers but the captain and officers of both ships ensured the safe passage of both vessels. The mid-point of ESP 6 was reached at 2220 on November 18th and ESP 5 at 0348 on November 19th. Since both mid-points were on the shelf it was decided to make gentle turns and not carry out any loops or other manauevours. The final part of the program was the COP run between Barcelona and Mallorca. This COP connected the mid-points of ESP 3, 4 and 5. Since there was enough time we decided to continue the COP along half of ESP 3 (where we only obtained ~ 80% coverage before) to a point intersecting COP1.

At 0820 hours on November 20th the two vessels broke line and Charcot started to pull its streamer in while Conrad secured its airguns. By 1030 hours the Charcot had steamed abeam of Conrad and each vessel launched a zodiac for the transfer of equipment and personnel between the ships. The transfer was carried out outside Spain's terretorial limits. Pinet, ten Brink and Torne transfered to the Charcot and Mauffret to the Conrad. Conrad then began to retrieve its streamer - checking adapters on the way in for leekage - and by 1430 hours was ready to steam toward Palma harbour at full ahead. At 2000 hours Conrad arrived in Palma harbour to pick personnel and provisions and the first part of project VALSIS had been successfully completed.

Weather

The general weather conditions for the two-ship work were:

Date	Force	Line
November 3rd	3	Streamer balancing
November 4th	8	Transit

November 5th	4	Transit
November 6th	4	COP 1
November 7th	4	COP 1
November 8th	4	COP 2
November 9th	3	ESP 2, COP 2, 806, 807
November 10th	3	COP 3, 808
November 11th	3	ESP 3, 808, 809
November 12th	3	ESP 4, 810
November 13th	3	ESP 4, 810, 811, 812
November 14th	3	ESP 6, 812, 813, 814
November 15th	2	ESP 6, 814, 815
November 16th	1	ESP 7, COP 4, 816, 817
November 17th	1	COP 4, 818
November 18th	4	COP 5, 818, 819, 820
November 19th	3	COP 6, 7, 8
November 20th	2	COP 8

Results

The total line length of COP, ESP and CDP data collected (Figs. 1 to 4) during the cruise was 1135.5 nm which broke down as follows:

COP - 631.3 nm 56 %

ESP - 298.0 nm 26 %

CDP - 206.2 nm 18 % (does not include CDP during COP and ESP)

The total time available for the cruise was 17.71 days :

Transit - 1.3 days 7 %

Maneuvouring/turning - 0.8 days 0.4 %

Streamer balancing, down time, repair - 5.26 days 30 %

COP - 4.60 days 26 %

ESP - 3.95 days 22 % Total seismic - 10.35 days 58 %

CDP - 1.80 days 10 %

Clock synchronisation

During the ESP it was necessary to sychronise the clocks on each ship in order to start the recording. Charcot used a SOBRELEC clock to give the time break for the recording cycle. Conrad used its own clock to give the time break for its shooting and recording cycle. The Conrad time break occured after that of the Charcot. About once each day the two clocks were synchronised. For the period of the survey the difference between the clocks was found to be constant and of the order of a few millisecs.

Equipment

Streamer. The problems encountered with the streamer have been outlined in the

narrative above. Also, Joe Stennett will be sending a separate report on its performance at the end of the cruise. The main problems with the streamer can be summarised as a) missing O-rings in the connectors between the cannisters, compass sections and adapters and the active sections, b) electrical faults in the leader section to the streamer, c) chafing of the streamer by fishing gear, c) damage to the tail buoy, d) loss of telemetry at random times while under-way for no apparent reason.

Air-guns. The air-guns performed very well during the cruise. There were only a few occasions when Martin had to retrieve a gun for maintenance. The only problem during the cruise (when the guns could not be fired at the required rate) was towards the end when the cooling system on one of the compressors failed.

Other equipment. The BGM-3 gravity meter and PDR's worked flawlessly during the cruise. Some problems were encountered with the Varian magnetometer. The RAYDIST caused a lot of interference on the magnetometer and so data could be recorded during the COP's. The data logger and the DSS 240 successfully operated during with no apparent problems.

General comments

The cruise was successful in that all the major objectives were achieved. The overall success of the cruise can be attributed in large part to the master and officers of the Conrad and Charcot who showed considerable skill in carrying the two-ship work. We are particularily grateful on the Conrad for the helpful manner the officers on the bridge undertook to take bearings of the Charcot and its tailbuoy at regular intervals, prepare telexes to coordinate the guard boats and the Spanish recording project on land, and put up with a lot of science related telephone traffic. On the Conrad the science officer, Joe Stennett, and his team deserve the credit for the successful operation of the equipment during the cruise. The main problems encountered (as this narrative describes) were with the streamer but Joe and his team worked tirelessly on it and "downtime" was kept to a minimum.

Line	COP	ESP	CDP	Time	Date	Shot	Pitlog	Latitude	Longitude	Depth
805	1	0	0	2302	Nov 6 311	5	528.1	38 47.7	02 35.0	750
805	1	0	0	2106	Nov 7 312	2653	636.7	40 19.5	01 23.2	750
806	2	0	0	0246	Nov 8 313	2654	658.6	40 18.2	01 18.6	580
806	2	0	0	0630	Nov 9 314	5991	796.0	41 13.2	04 04.6	2520
807	0	2	0	1003	Nov 9 314	6261	811.3	41 11.4	04 01.7	2611
807	0	2	0	1601	Nov 9 314	6619	840.9	40 59.2	03 28.1	2969
808	3	0	0	0418	Nov 10 315	7469	886.5	41 29.5	03 30.2	1320
808	3	0	0	2215	Nov 10 315	9623	969.9	40 08.7	03 29.7	935
808	0	0	1	2215	Nov 10 315	9623	969.9	40 08.7	03 29.7	935
808	0	0	1	0400	Nov 11 316	10192	996.4	39 48.5	03 37.4	70
809	0	0	(2)	1042	Nov 11 316	11103	1019.3	40 01.5	03 09.7	150
809	0	0	(2)	1115	Nov 11 316	11183	1021.5	40 00.5	03 07.1	522
809	0	3	0	1115	Nov 11 316	11183	1021.5	40 00.5	03 07.1	522
809	0	3	0	2316	Nov 11 316	11777	1075.0	39 37.3	02 07.3	171
810	0	4	0	1225	Nov 12 317	N/A	1128.1	40 25.1	01 47.0	1625
810	0	4	0	0012	Nov 13 318	N/A	1181.0	40 44.9	02 54.0	2023
811	0	0	0	0234	Nov 13 318	N/A	1189.3	40 51.2	02 53.2	2019
811	0	0	0	0720	Nov 13 318	N/A	1205.6	41 05.8	02 46.1	1700
812	0	5	0	1301	Nov 13 318	14122	1230.8	41 24.9	02 35.8	131
812	0	5	0	0018	Nov 14 319	14799	1283.7	41 00.8	01 29.3	224
813	0	0	2	1538	Nov 14 319	15001	1304.3	40 44.7	01 14.7	105
813	0	0	2	1206	Nov 14 319	15777	1335.1	40 26.2	00 49.6	61
814	0	6	0	1314	Nov 14 319	15856	1339.0	40 28.1	00 48.6	55
814	0	6	0	0119	Nov 15 320	16581	1399.3	41 05.7	01 43.5	210
815	0	0	3	0207	Nov 15 320	16627	1402.9	41 05.3	01 46.1	172
815	0	0	3	2322	Nov 15 320	19184	1500.1	39 40.5	01 10.9	1384
816	0	7	0	0010	Nov 16 321	19184	1504.0	39 38.9	01 06.7	1340
816	0	7	0	1126	Nov 16 321	19868	1552.8	39 24.1	00 01.0	120
817	0	0	4	1223	Nov 16 321	19948	1556.3	39 21.7	00 02.1	120
817	0	0	4	2309	Nov 16 321	21242	1608.0	38 55.5	00 56.8	515
818	4	0	0	1118	Nov 17 322	21242	1646.0	38 58.6	00 56.9	600
818	4	0	0	0025	Nov 18 322	22815	1703.9	39 47.6	00 21.1	104
819	5	0	0	0027	Nov 18 323	22820	1704.2	39 47.6	00 21.1	91
819	5	0	0	2220	Nov 18 323	25442	1798.9	41 01.8	01 31.4	320
820	6	0	0	2224	Nov 18 323	25454	1801.2	41 01.8	01 31.4	235
820	6	0	0	0348	Nov 19 324	26102	1826.0	41 12.2	02 00.5	40
821	7	0	0	0350	Nov 19 324	26106	1826.0	41 12.2	02 00.5	60
821	7	0	0	2217	Nov 19 324	28224	1911.6	39 50.4	02 39.1	311
821	8	0	0	2252	Nov 19 324	28621	1914.6	39 49.1	02 37.5	70
822	8	0	0	0730	Nov 20 325	29288	1952.5	39 32.9	01 55.1	1228

ESP 2				
314:10:03:00.000	41	11.4716	4	1.8086
314:15:41:00.000	40	59.8301	3	30.3811
314:16:01:00.000	40	59.1467	3	28.4483
ESP 3				
316:11:15:00.000	40	0.9302	3	7.5572
316:17:22:00.000	39	49.8264	2	38.7946
316:23:16:00.000	39	37.7386	2	7.0118
ESP 4				
317:12:25:00.000	40	24.9190	1	46.2620
317:18:23:00.000	40	34.8854	2	19.9637
318:00:12:00.000	40	44.9397	2	53.9528
ESP 5				
318:13:01:00.000	41	25.1995	2	35.7971
318:18:30:00.000	41	12.5590	2	1.8908
319:00:18:00.000	41	1.1586	1	29.5138
ESP 6				
319:13:14:00.000	40	28.1000	0	48.6000
319:18:56:00.000	40	46.5697	1	16.7203
320:01:19:00.000	41	5.7805	1	43.5778
ESP 7				
321:00:10:00.000	39	39.0610	1	7.8000
321:05:50:00.000	39	31.4908	0	33.1597
321:11:26:00.000	39	24.4150	0	0.3120

Table 1. ESP mid- and end-points.

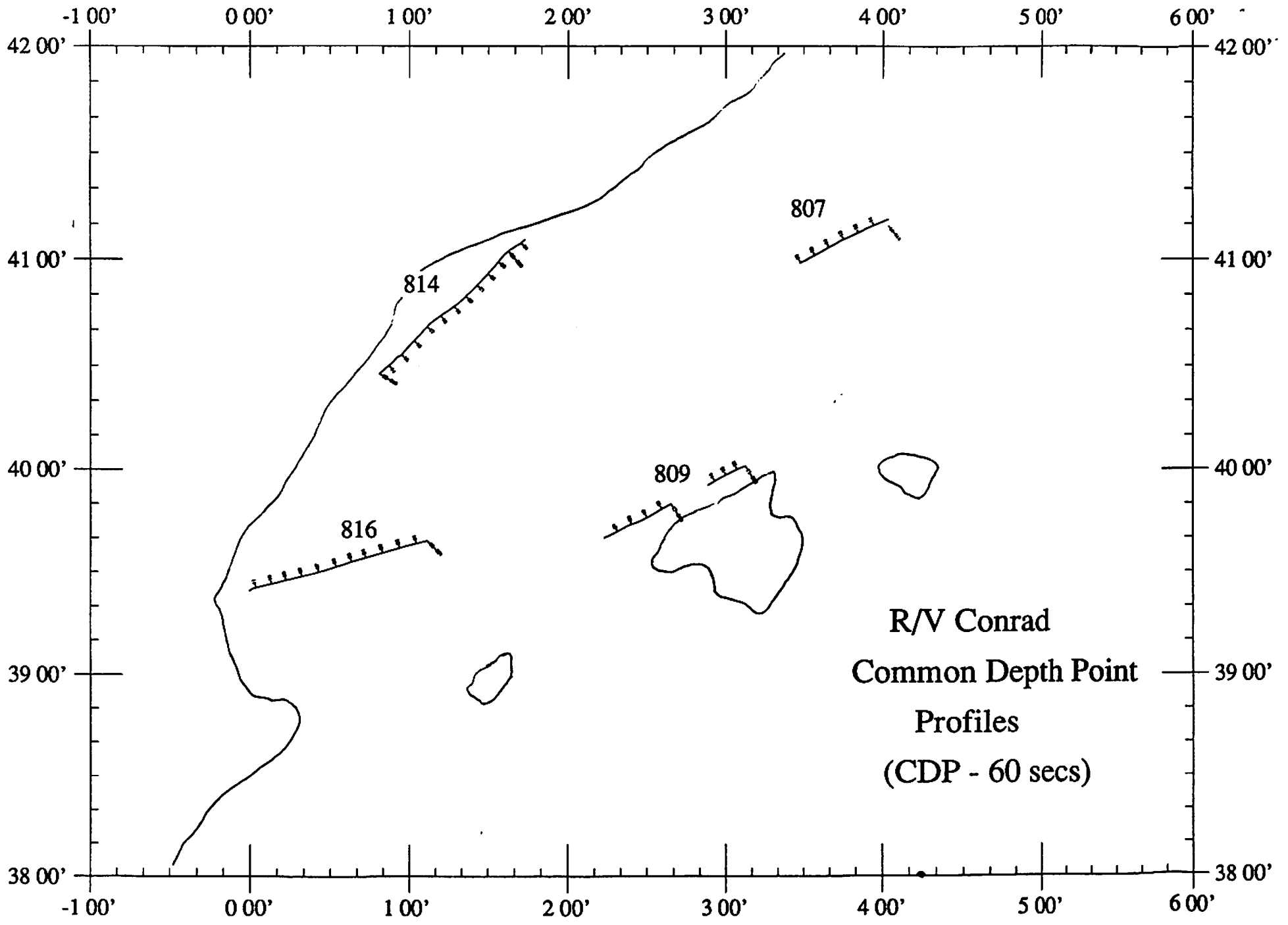

-1 00'
0 00'
1 00'
2 00'
3 00'
4 00'
5 00'
6 00'
42 00'
41 00'
40 00'
39 00'
38 00'
807
814
809
816
R/V Conrad
Common Depth Point
Profiles
(CDP - 60 secs)

Fig. 3

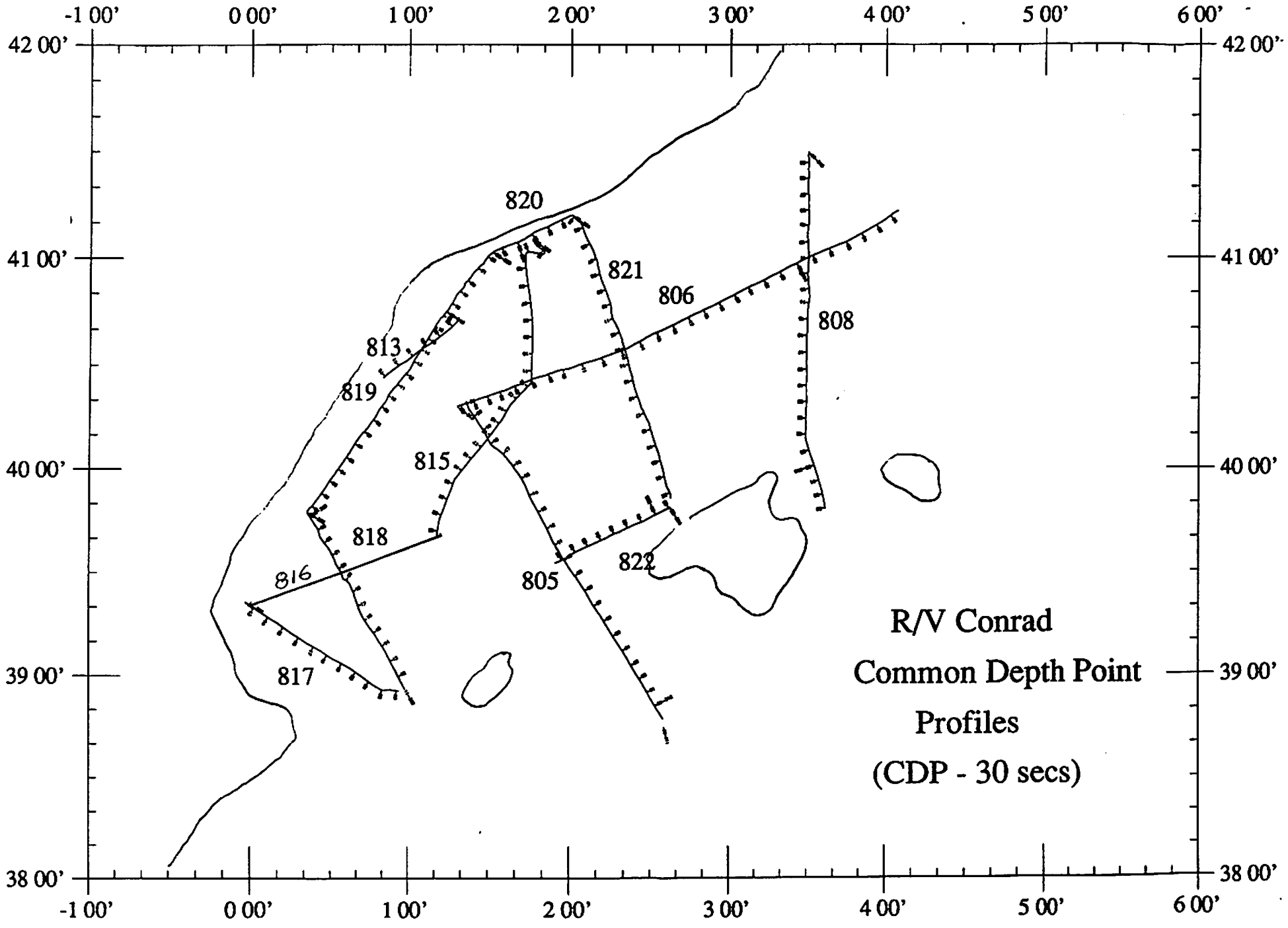

-1 00'
0 00'
1 00'
2 00'
3 00'
4 00'
5 00'
6 00'
42 00'
41 00'
40 00'
39 00'
38 00'
820
821
806
808
813
819
815
818
816
817
805
822
R/V Conrad
Common Depth Point
Profiles
(CDP - 30 secs)

Fig. 4

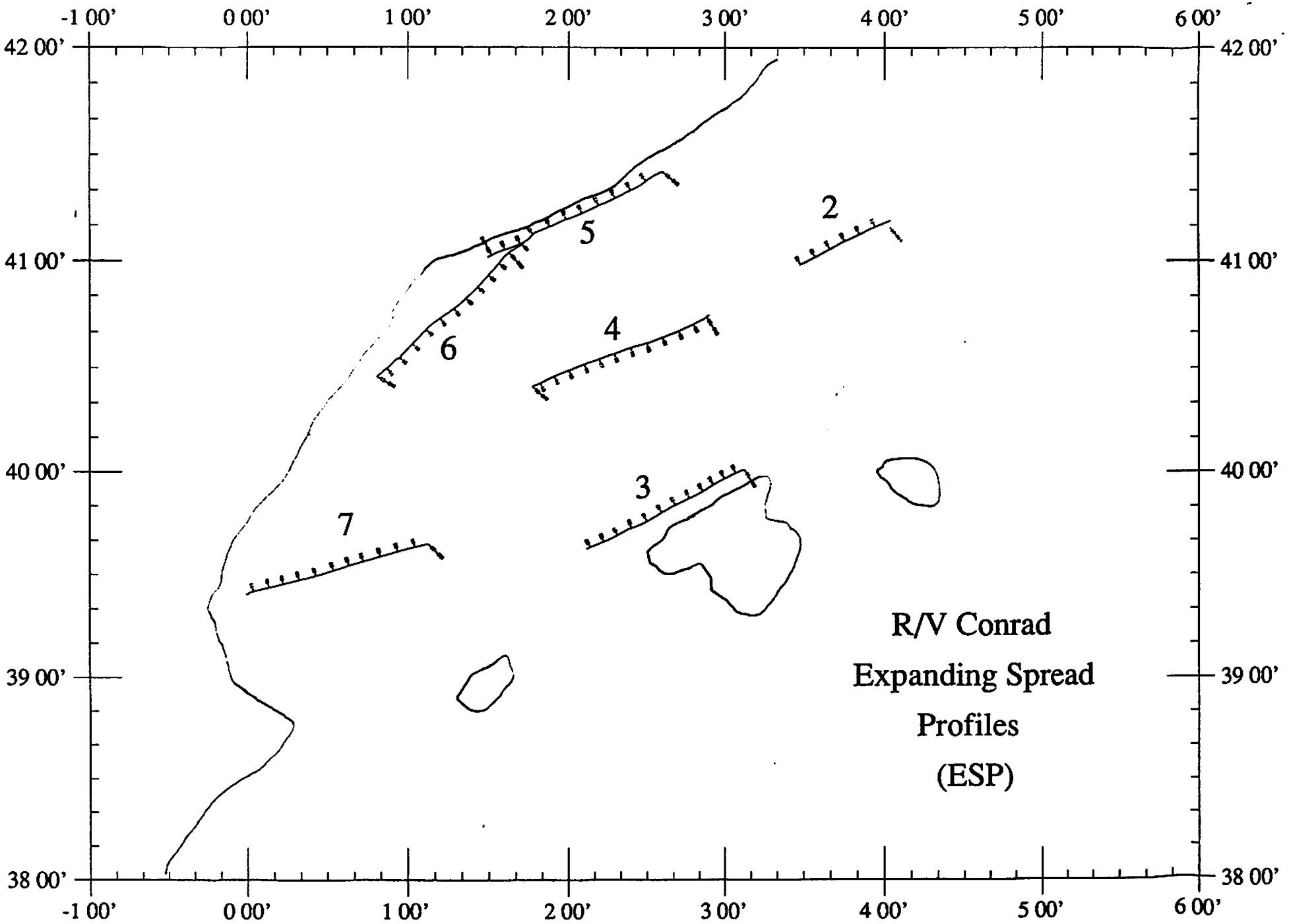

-1 00'
0 00'
1 00'
2 00'
3 00'
4 00'
5 00'
6 00'
42 00'
41 00'
40 00'
39 00'
38 00'
2
5
6
4
3
7
R/V Conrad
Expanding Spread
Profiles
(ESP)

Fig. 2

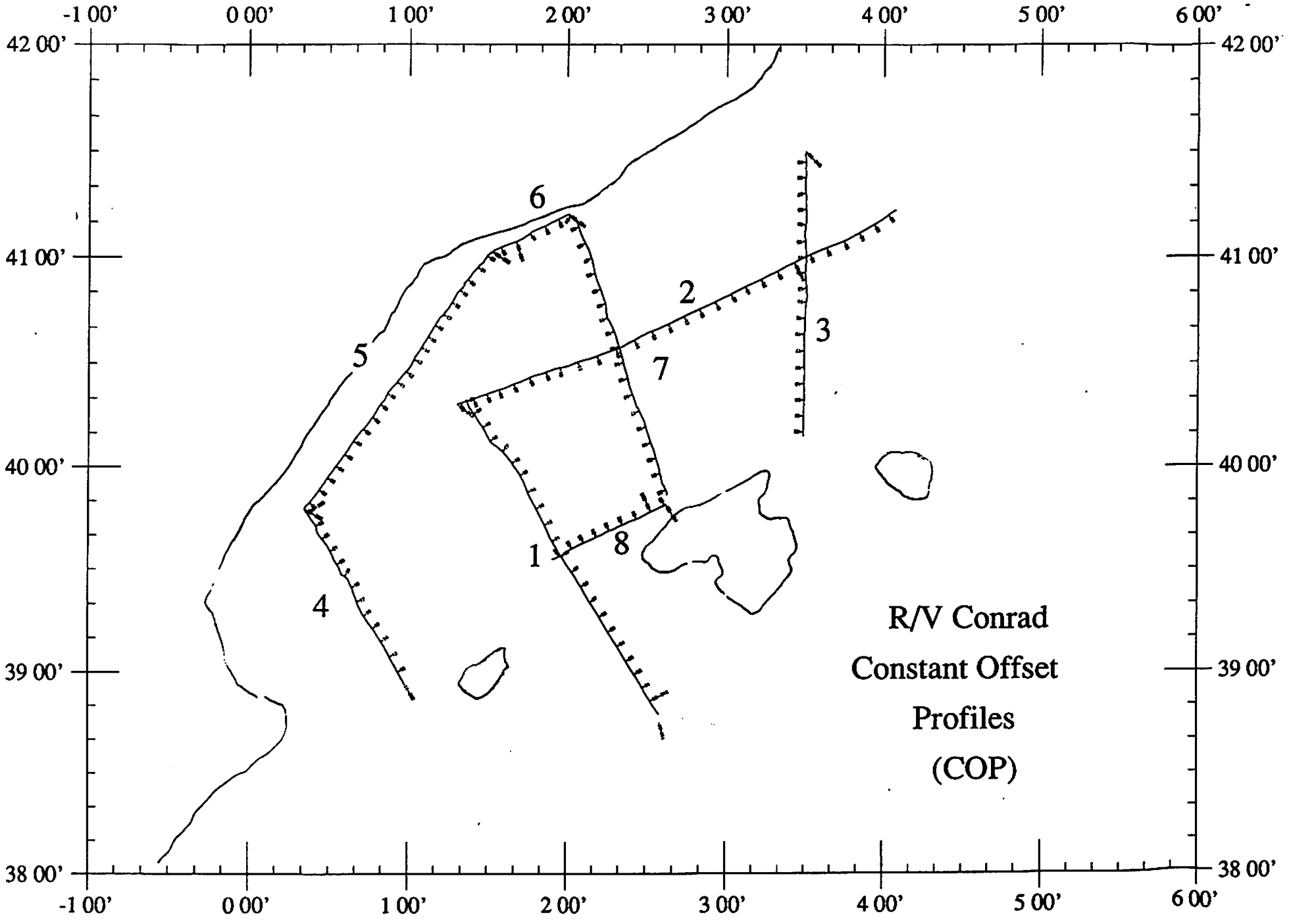

-1 00'
0 00'
1 00'
2 00'
3 00'
4 00'
5 00'
6 00'
42 00'
41 00'
40 00'
39 00'
38 00'
1
2
3
4
5
6
7
8
R/V Conrad
Constant Offset
Profiles
(COP)

Fig. 1

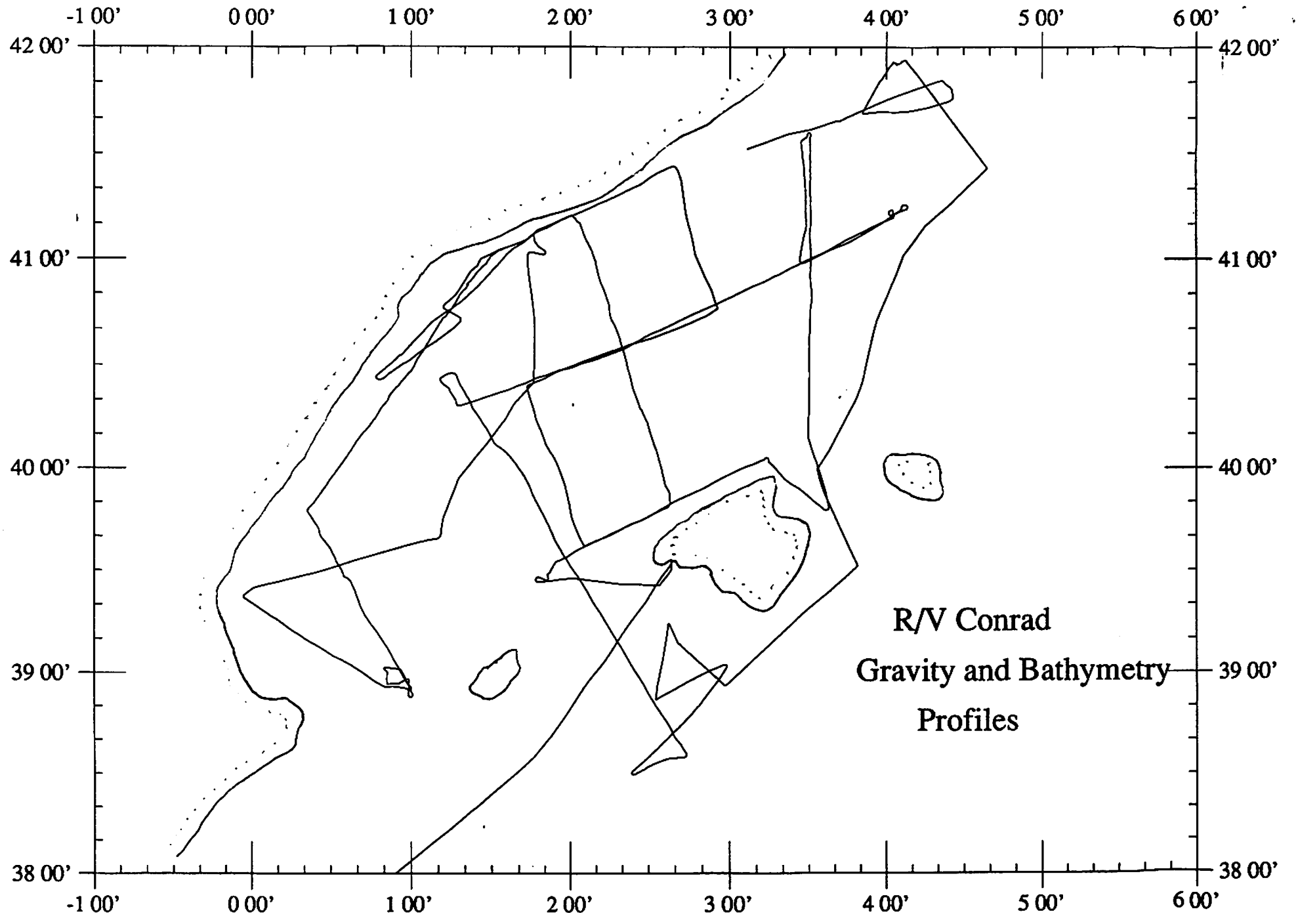

-1 00'
0 00'
1 00'
2 00'
3 00'
4 00'
5 00'
6 00'
42 00'
41 00'
40 00'
39 00'
38 00'
R/V Conrad
Gravity and Bathymetry
Profiles

Fig. 5

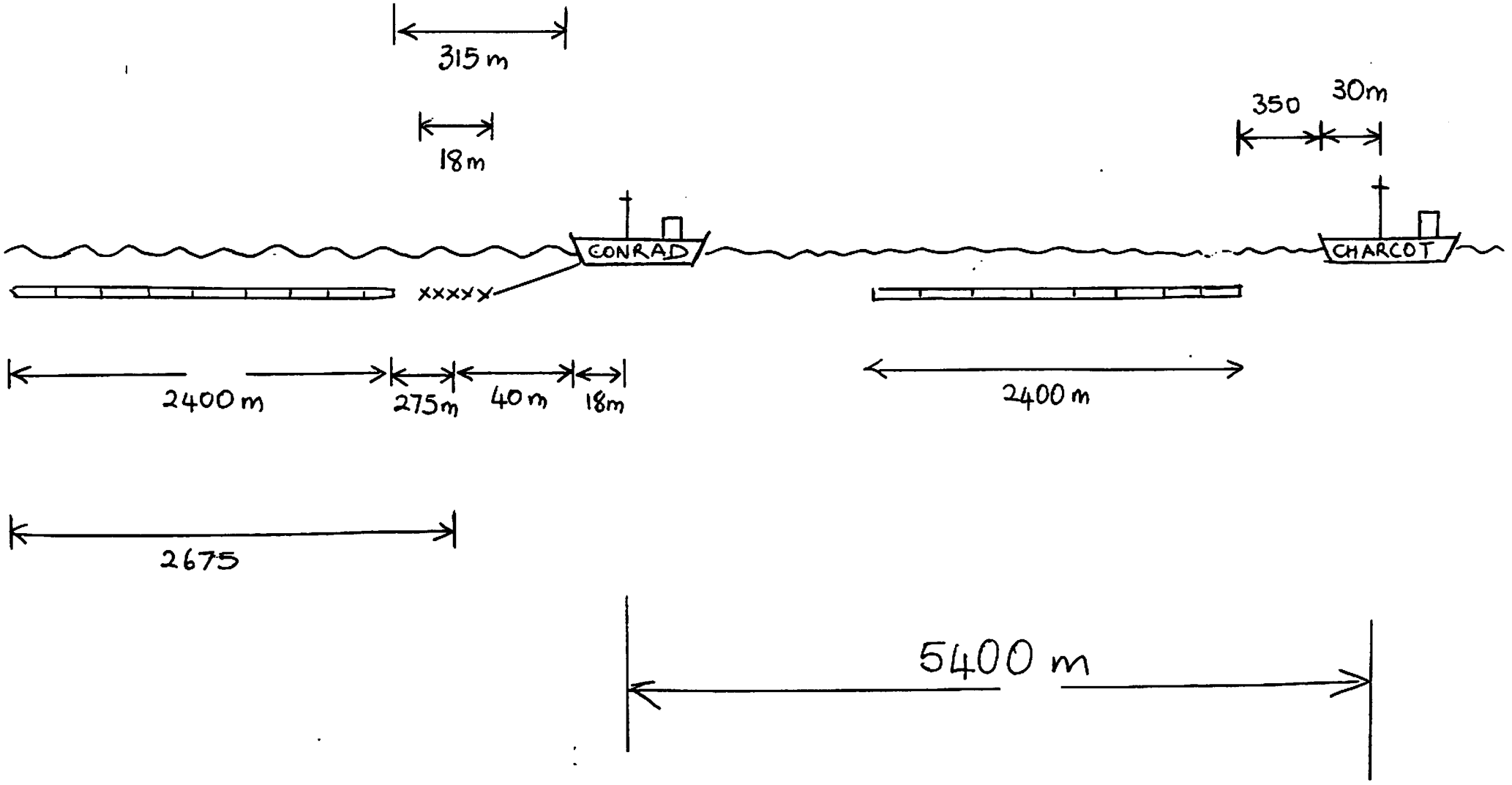


Fig. 6. Ship configuration for the COP's.

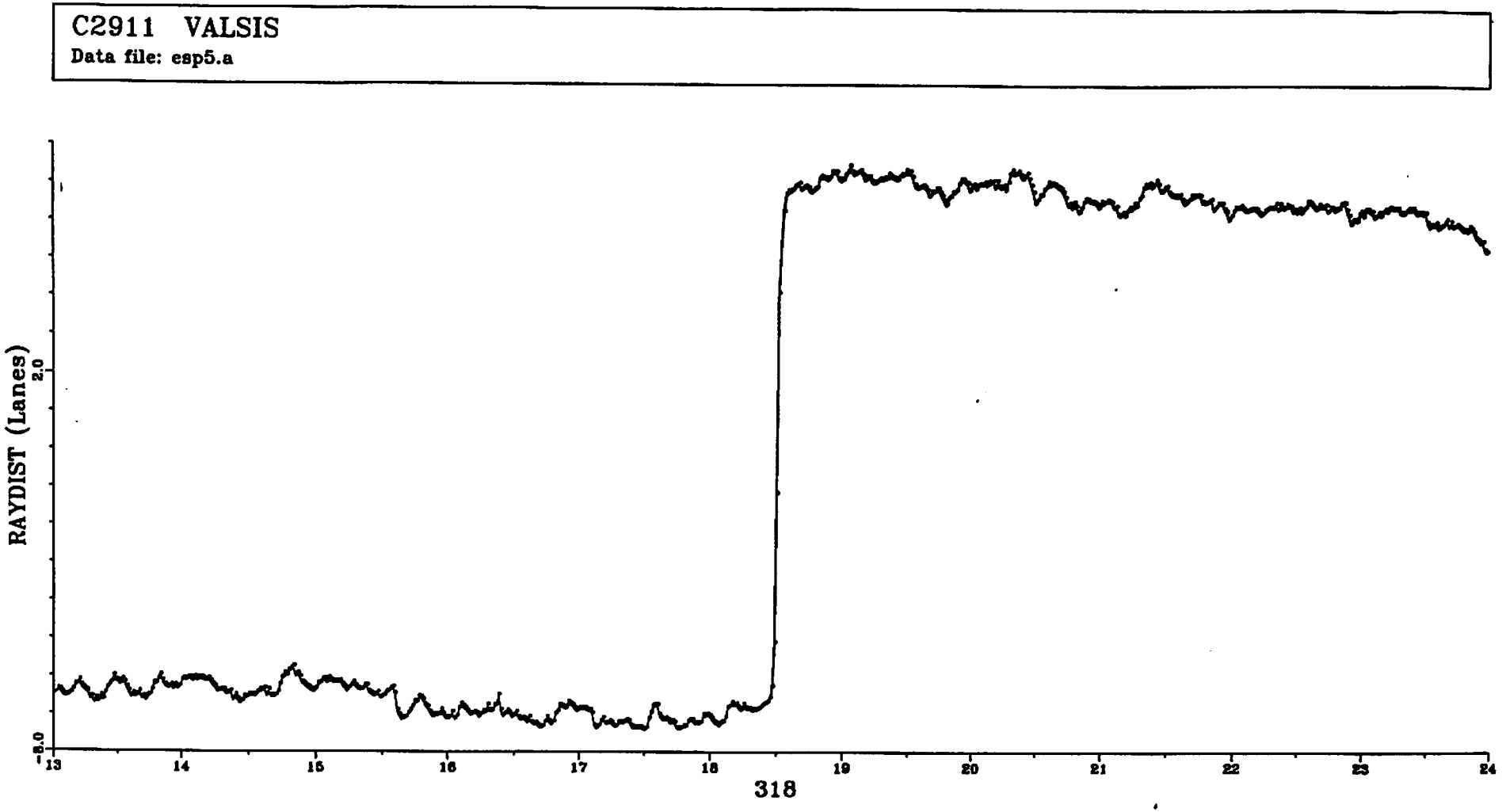


Fig. 7. Example of RAYDIST ranging data during ESP 5. The step at 1830 crossing of the two vessels at the mid-point. Each lane is approximately 45m.

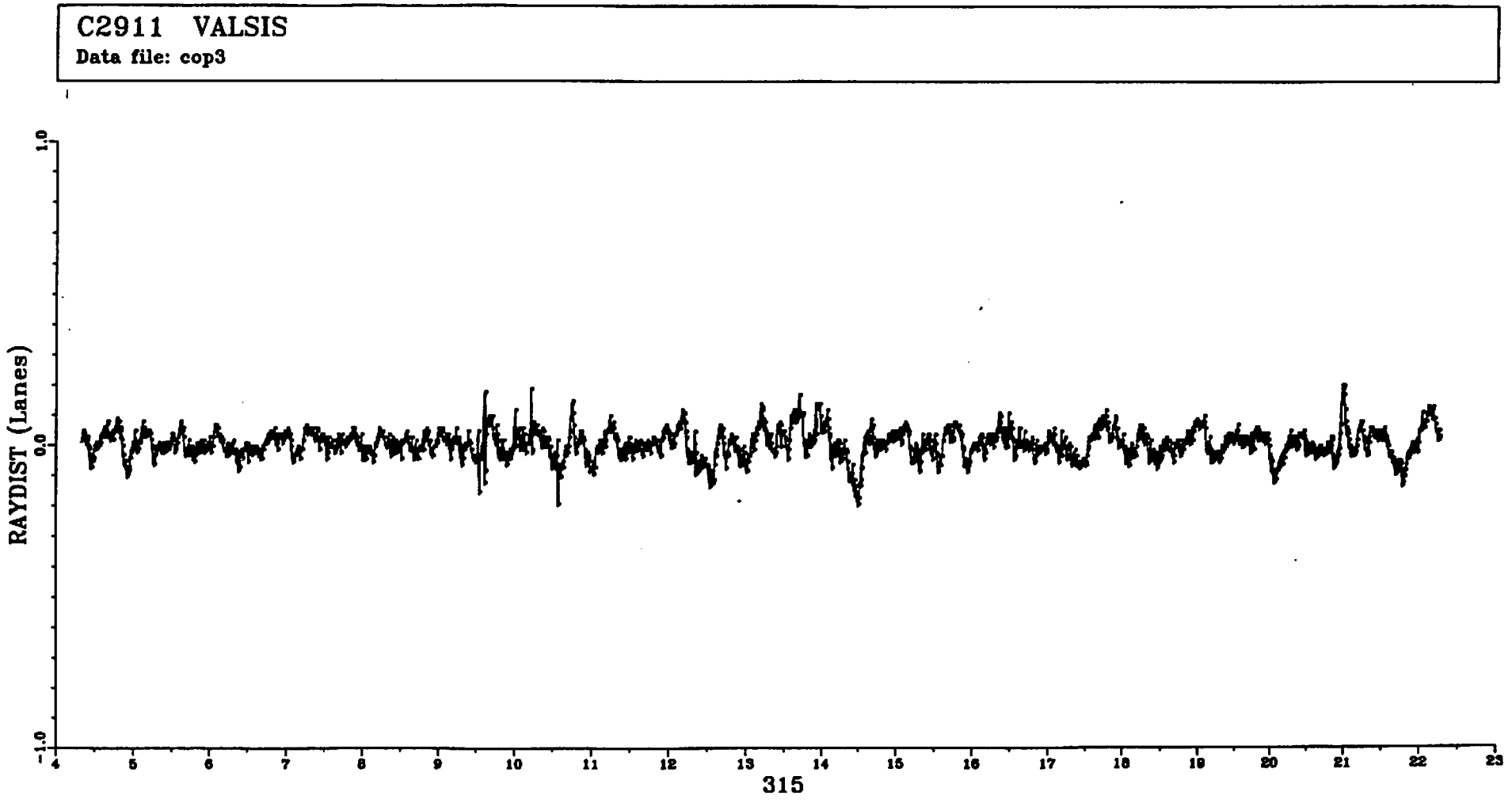
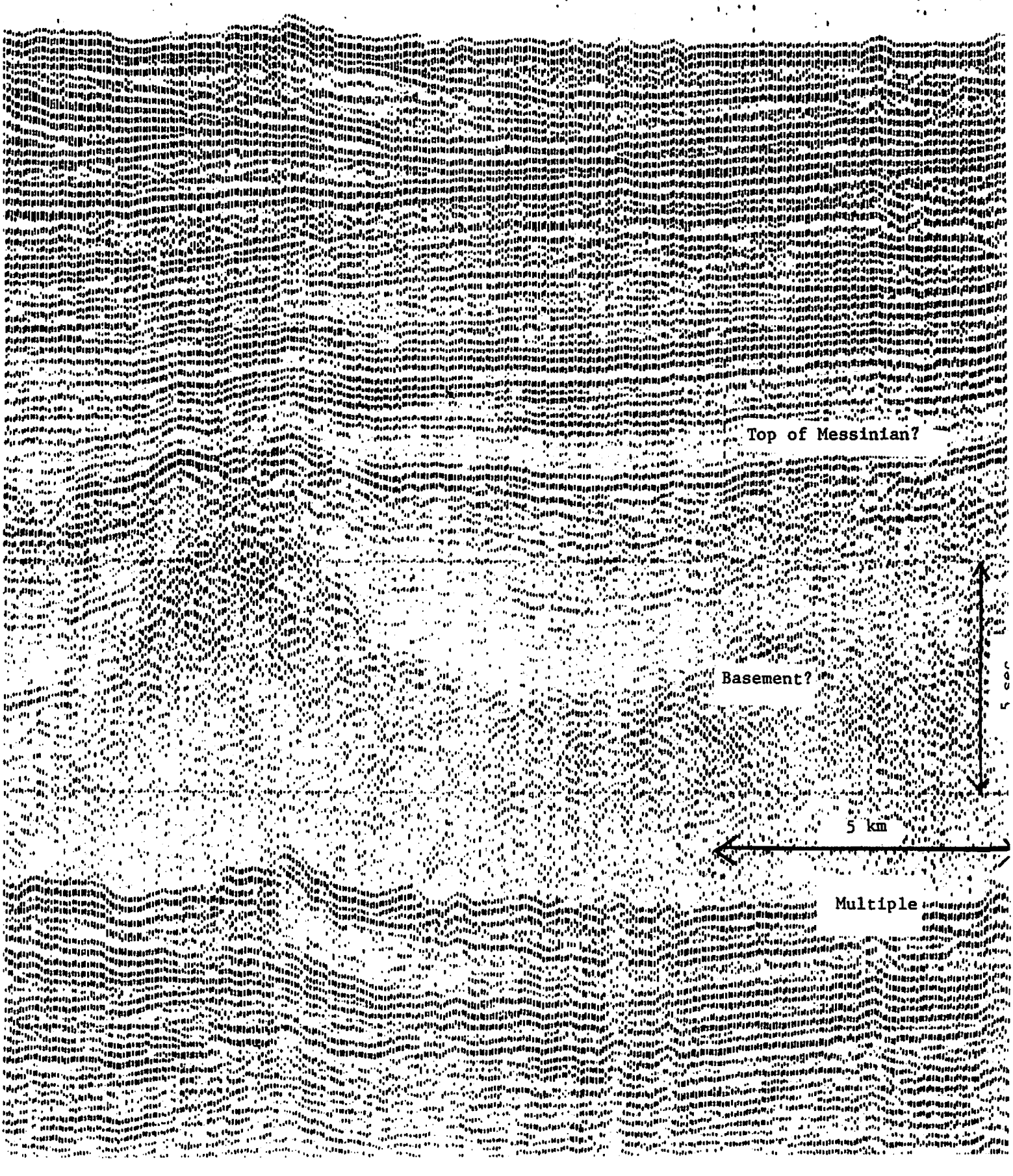


Fig. 8. Example of RAYDIST ranging data during COP 3.

Fig. 9. Example of single trace monitor record over the central Valencia trough between Ibiza and Barcelona (CDP 815).



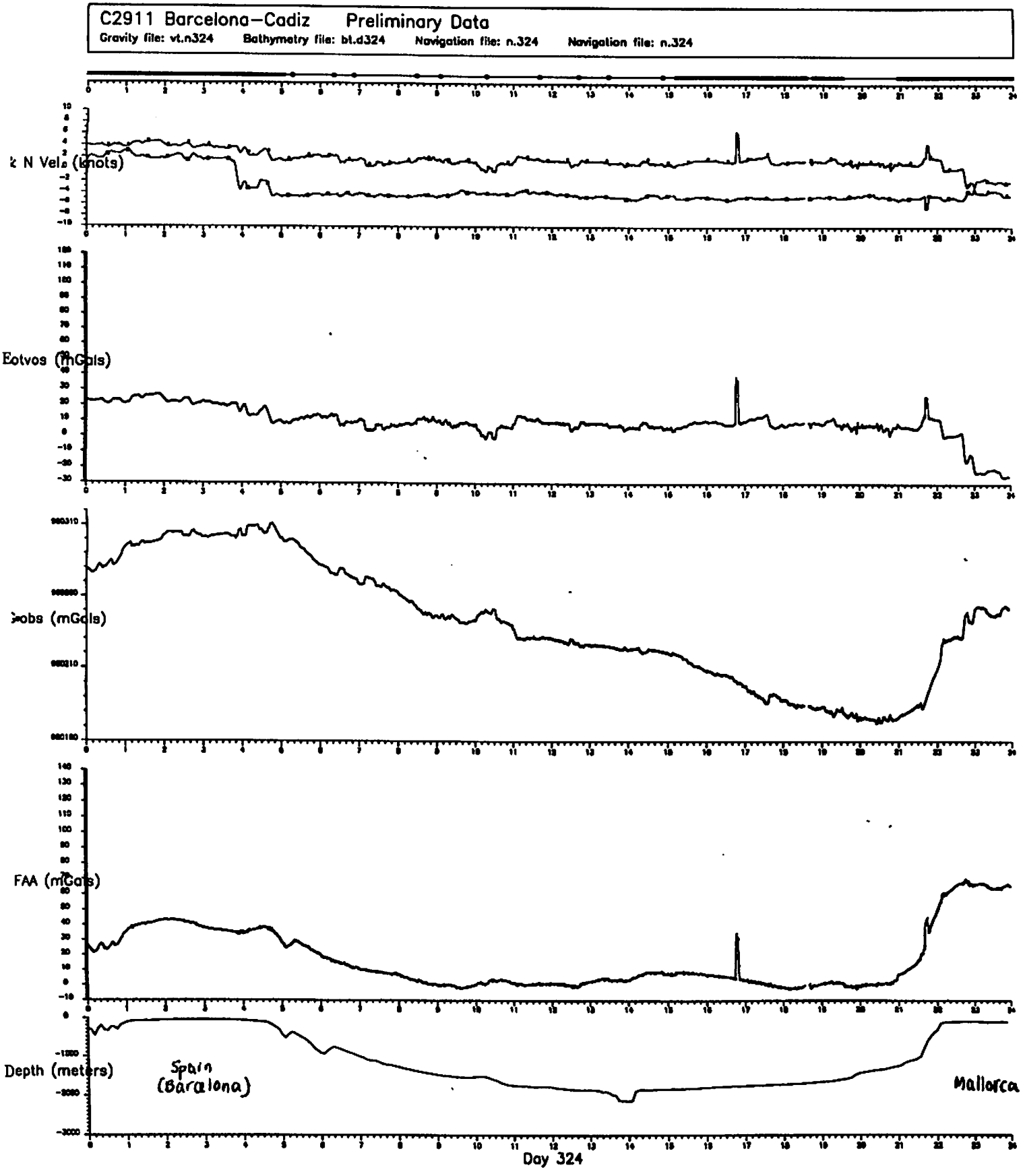


Fig. 10. Example of gravity and bathymetry profile obtained during COP 7 between Mallorca and Barcelona.