CRUISE REPORT

The S reflector and rifting processes: Iberia Abyssal Plain/Galicia Bank

Iberia Seismic Experiment 1997

ISE-97

SHIP NAME: R/V Maurice Ewing

CRUISE NUMBER: Ewing 97-05

OPERATING INSTITUTION: Lamont Doherty Earth Observatory

DATES: 10 July to 15 August, 1997

PORTS: Ponta Delgada, The Azores to Lisbon, Portugal (mid-cruise stop at Lisbon, Portugal)

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Cruise Objectives

We plan to conduct a joint USA-German-Spanish-Portugueuse multichannel and wide-angle seismic experiment to study the apparently non-volcanic Galicia Interior Basin/Galicia Bank rifted continental margin and the transform boundary with the Iberia Abyssal Plain margin segment to the south. A focus of the study will be improving our understanding of the S reflector under the outer Galicia Bank. S is a prominent reflector that forms the base of a set of faulted and tilted basement blocks. S appears to have played an important, but not yet understood, role in the structural evolution of the rifted margin.

The objectives of the proposed study are to determine:

1) the seismic velocity of the rocks that bound the S reflector where it is best expressed in the crust of the Galicia Bank.
2) using structure and seismic velocity, the character of the eastward termination of S where it appears to split into three or more, lower amplitude reflectors.
3) using structure and seismic velocity, the character of S where it terminates westward and identify its relationship, if any, with the Peridotite Ridge.
4) the seismic character of the Moho, if it is distinct from S, beneath the Galicia Bank.
5) the velocity depth function above S and compare it to that obtained by migration focusing analysis and use the result to determine the three dimensional shape of S.
6) the structure and thickness of the crust under the Galicia Interior Basin.
7) how the structure and thickness of the crust changes along the Iberia margin from the Galicia Bank into the Iberia Abyssal Plain and how those changes relate to the location and nature of a transform segment boundary.
8) the nature and thickness of the unrifted continental crust landward of the Galicia Interior Basin.

These objectives may be achieved by acquiring three densely instrumented MCS/OBS wide-angle seismic profiles (a total of 56 OBS deployments) and twelve complementary deep-penetration MCS profiles. The wide-angle profiles will be

located across 1) the Galicia Interior Basin, 2) the Galicia Bank, and 3) the transform boundary between the Galicia Bank and the Iberia Abyssal Plain.

The Iberia Margin is a good place to study rifted continental margins because 1) the margin from which it rifted, its conjugate, is well constrained, 2) the Iberia Margin and its conjugate margin are relatively sediment starved so basement, intracrustal reflectors, and Moho can be easily imaged, 3) because there has been no postrift volcanism or salt tectonics to disrupt the basement or the overlying sediments, or prevent their imaging, and 4) because we can build upon the results of ODP Legs 103 and 149, which provide "ground-truth" regarding the character of basement at several key points in the proposed survey area.

Equipment Employed

Seismic source

We used the Ewing 20 gun deep penetration airgun array described below. The array was towed at a nominal depth of 8.5 m. The position of the array with respect to the ship and the streamer is indicated in Figures 1-3. We fired the gun array at intervals of 20, 40, or 60 seconds during the experiment. Lines 1W and 1MW were shot at both 20 s and 60 s rep rates. The 60 s rep rate was intended to provide high quality OBS records while the 20 s rep rate was intended to provide the best quality MCS profile. All shooting was "on time" with a shot time randomizer (± 0.5 s Gaussian).

Deep penetration mode -- a 20-gun array with 8385 cu. in. total volume.

Vol	Z	X	Y
145	8.5	-16.8	-4.6
825	8.5	-15.2	4.6
260	8.5	-13.7	0.0
350	8.5	-12.2	-4.6
520	8.5	-10.7	4.6
350	8.5	-9.1	0.0
250	8.5	-7.6	-4.6
850	8.5	-6.1	4.6
500	8.5	-3.9	0.0
145	8.5	-2.4	-4.6

145	8.5	2.4	4.6
540	8.5	3.9	0.0
850	8.5	6.1	4.6
250	8.5	7.6	-4.6
350	8.5	9.1	0.0
520	8.5	10.7	4.6
305	8.5	12.2	-4.6
235	8.5	13.7	0.0
850	8.5	15.2	4.6
145	8.5	16.8	-4.6

With a nominal towing depth of 9 meters, this array will produce approximately 135 bar-meters (peak-to-peak, including frequencies up to 125 Hz) with a peak-to-bubble ratio of 7 or better. The relatively deep tow depth produces free-surface ghosting effects that enhance low frequencies, but effectively cuts off the spectrum above 60 Hz. The result is that this array has a spectrum that compares favorably at low frequencies to more powerful arrays tuned for a broader band By changing the towing depth to 6 meters, the high frequency output and peak-to-bubble ratio of his array can be enhanced, at the expense of low frequency performance.

Seismic Streamer

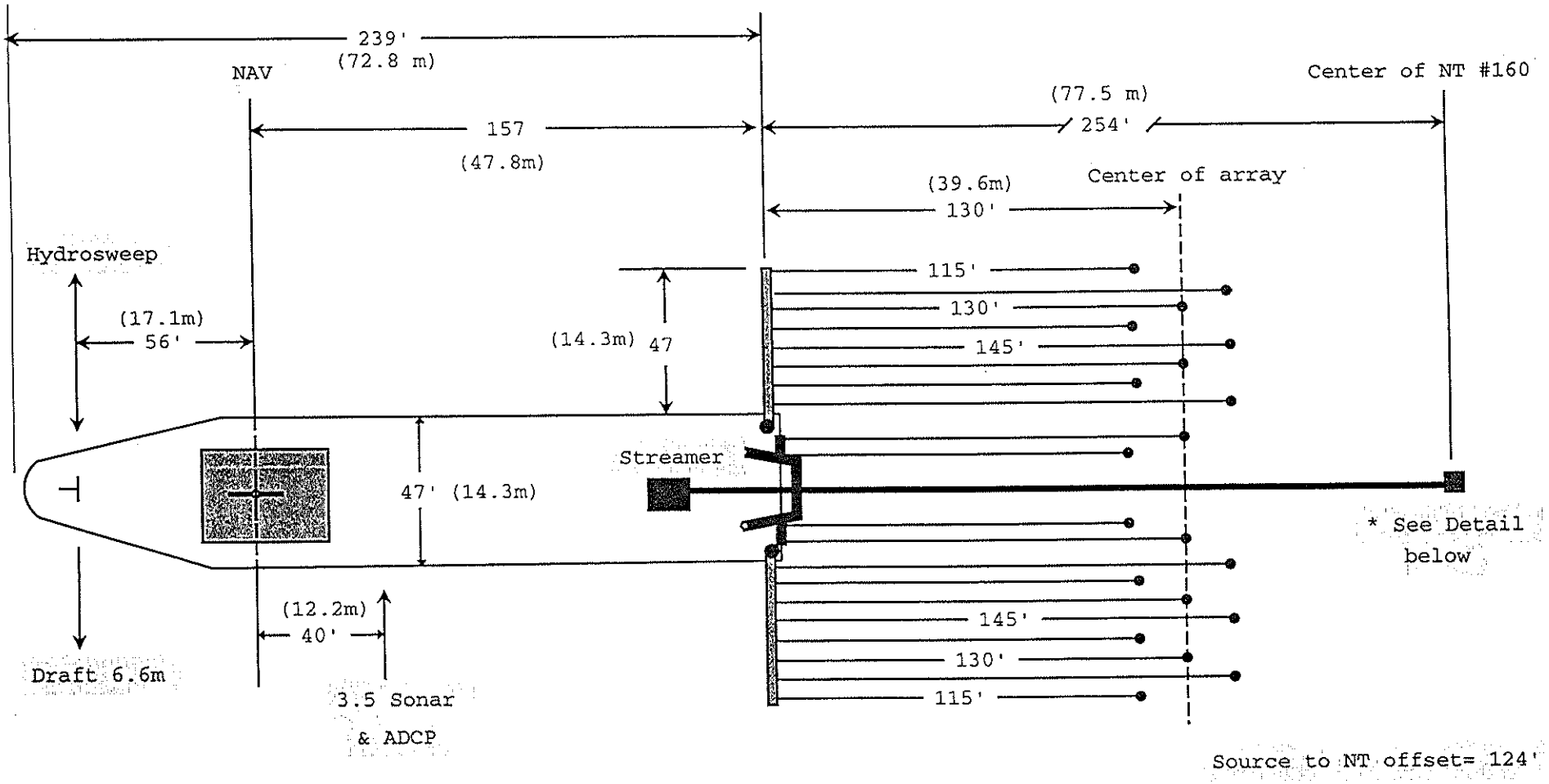
Three configurations of the Ewing streamer were used during the cruise. They are described in Figures 1 to3. Receiver (channel) spacing was 25 m.

The first streamer configuration shown (Figure 1) was used during Deployment 1. There were 160 live channels and a maximum offset of 4038 m.

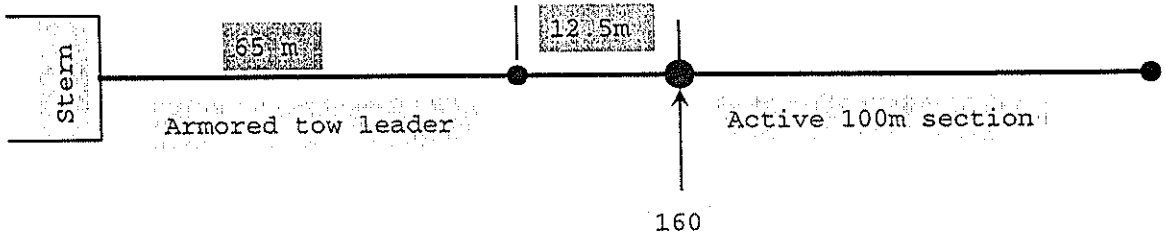
The second streamer configuration shown (Figure 2) was used during portions of Deployments 2 and 3. We used this configuration for lines shot to the west of 10°W. There are 164 live channels and a maximum offset of 4138 m.

The third streamer configuration shown (Figure 3) was used during a portion of Deployment 2. We used it for parts of lines 1, 12,14, and 17 shot east of 10°W. It has 40 live channels and a maximum offset of 1064 m. We used this short streamer in areas where there was significant crossing ship traffic.

MAURICE EWING SETBACK AND OFFSET DIAGRAM



CABLE = 160 CHANNEL- 40 ACTIVE SECTIONS- 4065 METERS TOTAL LENGTH

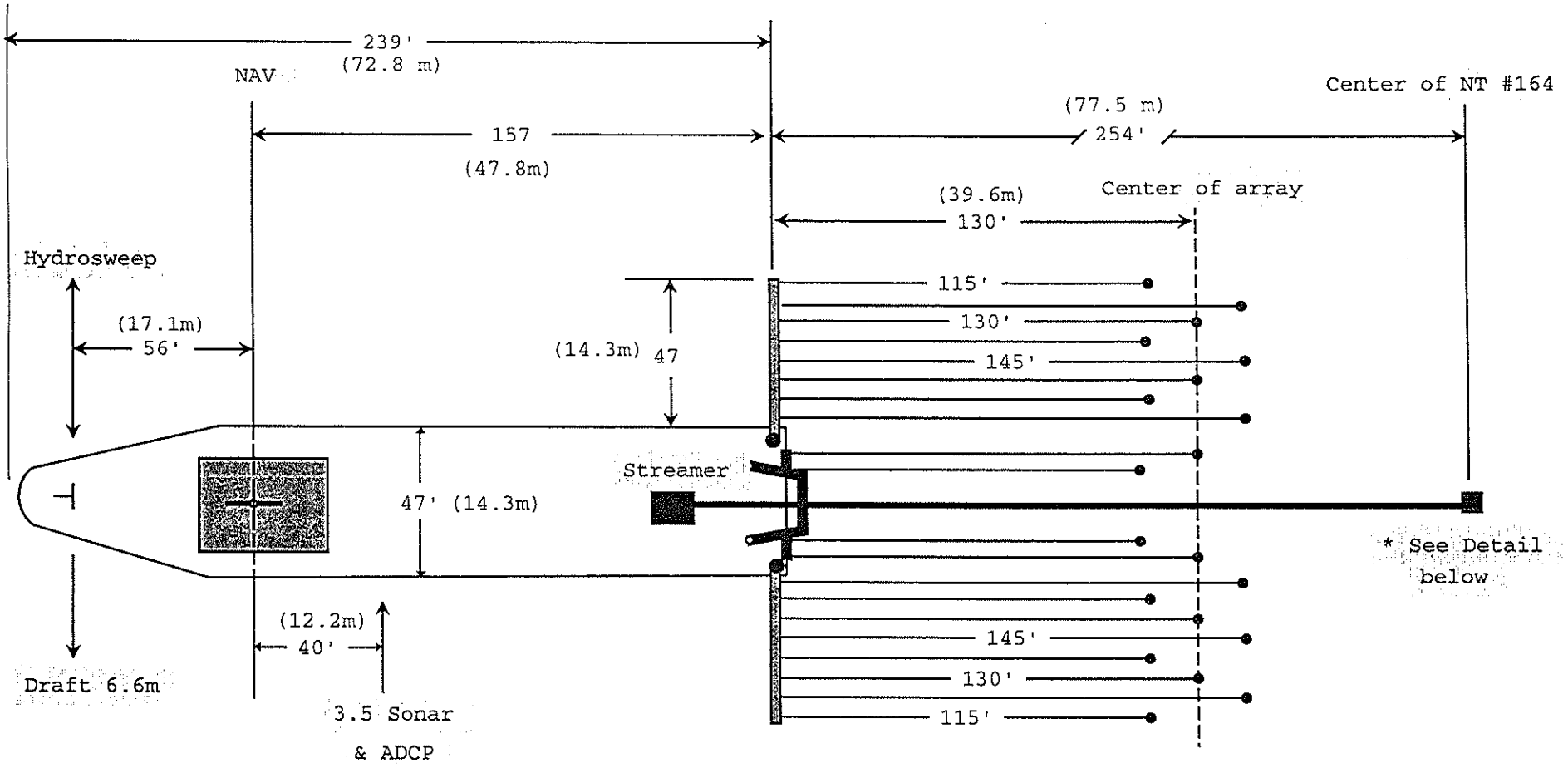


DEPLOYMENT #1

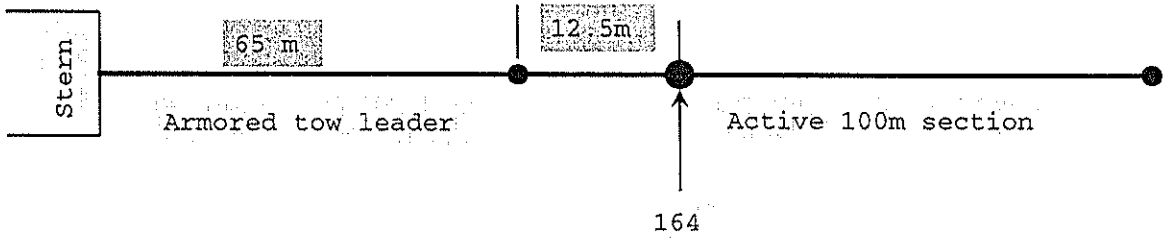
23 July 1997 cpl Note: Deck measurements were scaled from frame drawing and are approx.

Figure 1

MAURICE EWING SETBACK AND OFFSET DIAGRAM



CABLE = 164 CHANNEL- 41 ACTIVE SECTIONS- 4165 METERS TOTAL LENGTH

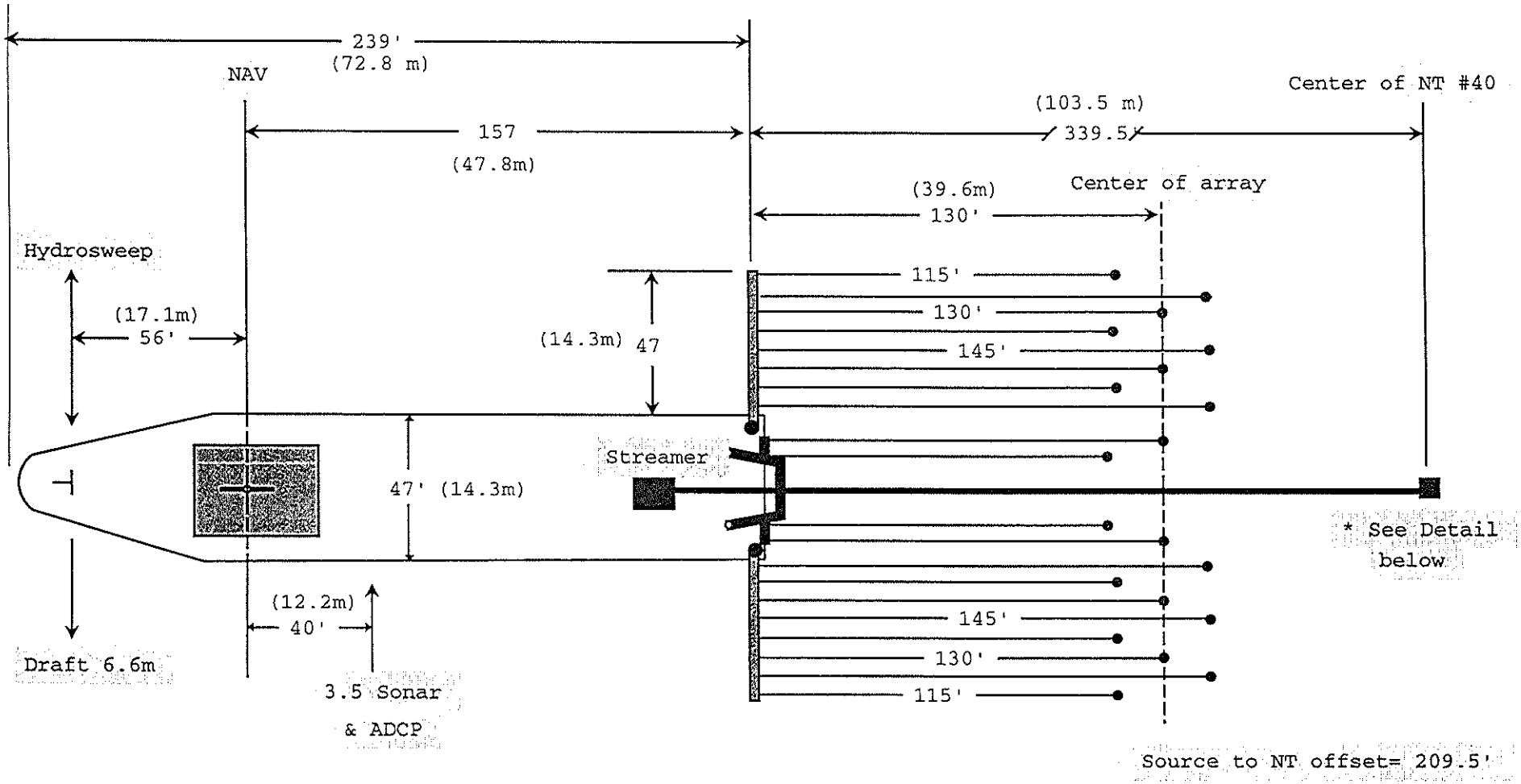


DEPLOYMENT #2

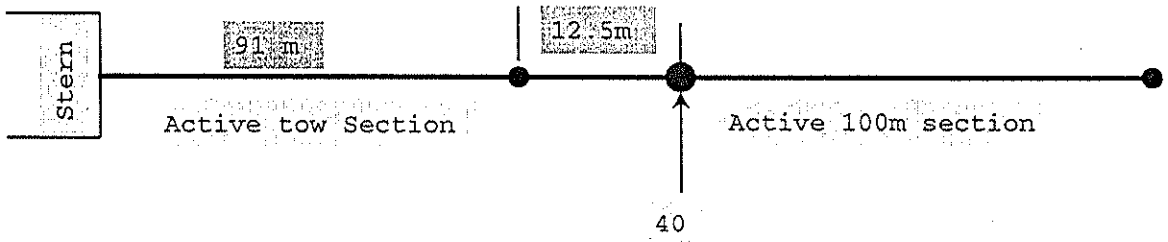
23 July 1997 cpl Note: Deck measurements were scaled from frame drawing and are approx.

Figure 2

MAURICE EWING SETBACK AND OFFSET DIAGRAM



CABLE = 164 CHANNEL- 11 ACTIVE SECTIONS in water- 1091 METERS TOTAL LENGTH IN WATER



SHORT STREAMER DEPLOYMENT

11 Aug 1997 cpl Note. For short streamer 172 channels were recorded but only 1-40 are valid

Figure 3

Seismic Recording System

We used the DSS-240 system for the MCS recording. Output was to 3480 Cartridge tapes in demultiplexed SEG-D format. All data were acquired at 2 ms sample interval. Record lengths were 25 sec when shooting at 40 or 60 s rep rate or 16 sec when shooting at 20 s rep rate. All 3480 Cartridge tapes were copied onto 8 or 4 mm tapes during the cruise for security and ease of later processing. The 3480 Cartridge tapes and copies are now stored at Rice University.

Magnetometer

The vessel is equipped with a Varian V-75 Magnetometer and deployment winch. The magnetometer was deployed during acquisition of all the MCS profiles. Data were recorded by the logging system and are currently stored at Rice University.

Bathymetry

The Hydrosweep bathymetry system was run throughout the cruise. The system provided centerbeam depths that were logged and are being used to process the MCS data and are stored at Rice University. The full swath hydrosweep data were acquired but have not been processed. These data are stored at LDEO.

Navigation

The primary navigation devices aboard the vessel are considered to be the GPS receivers. The vessel has two Magnavox 4200D second generation receivers aboard, with two additional units available as permanent shipboard equipment.

The ships Gyro system currently employs two Sperry Mk 37 gyro compasses, the primary unit is installed in the Gravity Room and the secondary unit mounted in the wheel house. The system is wired to provide five wire synchronous heading information as well as stepper output through a distribution amplifier to all other systems.

Heading information from an Ashtech 3 axis GPS reciever is also available.

Time reference is provided for by two Kinemetrics GOES sat clocks(where available), or a Kinemetrics GPS clock. All three sources are provided with an external frequency input of 5 Mhz generated by a pair of H/P Rubidium frequency standards.

Speed log information is provided by a FURUNO CI-30 three axis doppler speed log/current profiler.

CRUISE NARRATIVE

(All times are GMT)

10 July (191)

Took Departure from Ponta Delgada, The Azores, at 1224. Began transit to study area.

11 July (192)

Transit to study area. Stopped (1515-2036). to conduct GEOMAR OBH release test .

12 July (193)

Transit to study area.

13 July (194)

Arrived in study area 0130. Deployed OBS/OBH along lines 1, 4, 5, and 6. Deployed all 25 instruments for Deployment 1 between 0136 and 1957. Deployed streamer tail buoy at 2154. Deployed streamer through the night. Added sections, added lead to sections and replaced sections known to have problems.

14 July (195)

The entire streamer is assembled and deployed at 1300. Because of a bad section near the ship end of the streamer, we have not been able to test most of the streamer sections until now. Testing identifies a bad section 3100 m aft of the ship. We

recover the streamer to this point and replace the bad section. The entire streamer tests OK. We redeploy the full streamer length by 2030. It continues to test OK. See source/streamer configuration figure I for the geometry. The weather has gotten worse and we are not able to begin source deployment. We turn into the seas to keep the tension in the streamer low.

15 July (196)

Seas still too rough to deploy guns. We head to the west hoping to find better weather. We do, and begin deploying the airgun array at 1405. Guns and maggie deployed by 1536. We begin shooting Line 1 from east of OBS 111 to the west at 60 sec rep rate. At 1924 the gun control system crashed stoppong firing. We began a 360 turn to come back on line while fixing the problem. Back on line at 2211.

16 July (197)

Shooting westward on line 1 at 60 s rep rate. EOL at 0502. Turning around to come back on Line 1 to the east. BOL 1 at 0740. Shooting at 20 s rep rate. The weather still looks bad to the east, so we decide to shoot north on line 5, then shoot south on Line 6, then shoot north on 5 up to the intersection with line 1, before finishing Line 1. At 1340 we turn off Line 1 (butterfly turn to starboard) and shoot north on Line 5 at 40 s rep rate. EOL north part of line 5 at 1930. We turn 180 degrees to come onto Line 6 going south shooting at 40 s rep rate. We come online at 2041.

17 July (198)

Shooting south on line 6 at 40 s rep rate. EOL 6 at 0433. Turn to shoot the south part of Line 5 to the north at 40 s rep rate. We come online at 0600. We cross Line 1 and EOL south part of line 5 at 1017. We make butterfly turn to port to come onto line 1 shooting east at 20 s rep rate at 1117.

18 July (199)

Shooting line 1 east at 20 s rep rate. EOL 1 at 0113. Turning 180 degrees to shoot Line 1 to the west at 60 s rep rate. BOL 1 at 0249. EOL 1 (at the point we started shooting Line 1 on 15 July) at 1330. We are going north to shoot Line 4 to the west at 40 s rep rate. BOL 4 at 1525.

19 July (200)

Shooting line 4 west at 40 s rep rate. EOL 4 at 0049. Recover gun array. Recover streamer and tail buoy. Underway to recover first OBH at 0700. Seven OBH/OBS recovered.

20 July (201)

18 OBH/OBS recovered.

21 July (202)

One OBH/OBS recovered. End of Deployment 1 at 0010. Transit to first OBH site for Deplyment 2. Arrive 0900. Nine OBS/OBH deployed.

22 July (203)

Thirteen OBH/OBS deployed.

23 July (204)

Three OBS/OBH deployed. Instrument deployment complete at 0520. Transit to west end of Line 12 for streamer deployment. Streamer deployment begins 0735 and is complete by 1355. We have added one section (4 groups) at the ship end of the streamer. This is designed to put the 160 group part of the streamer 100 m further back. See source/streamer configuration figure II for the new geometry. Deploy gun array from 1400 to 1427. Begin Line 12 at 1703 shooting to the east at 40 s rep rate.

24 July (205)

Shooting line 12 to the east at 40 s rep rate. EOL west part of line 12 at 1552. The Captain has indicated that it will be very dangerous to tow the 4 km streamer across the shipping lanes east of 10°E longitude. We have elected to shoot all data in that area with the streamer shortened to 1 km (see streamer/source configuration figure III for this geometry). We began recovering streamer at 1612 and finished at 2000. We began shooting the east end of line 12 to the east at 40 s rep rate at 2130.

25 July (206)

Shooting Line 12 to the east at 40 s rep rate. EOL 12 at 0945. Simple turn to port to shoot Line 18 to north at 40 s rep rate. EOL 18 at 1344. Simple turn to port to

shoot west on Line 14 at 20 s rep rate. EOL east part of line 14 at 2240. Simple turn north on Line 19 shooting at 20 s rep rate.

26 July (207)

Shooting Line 19 to the north at 20 s rep rate. EOL 19 at 0503. Butterfly turn to port to come onto Line 1 (eastern part) shooting east at 40 s rep rate. BOL 1 at 0600. EOL 1 at 1517. Simple turn to north on Line 20 shooting at 20 s rep rate. EOL 20 at 2316. Simple turn to port onto Line 17. BOL 17 (eastern part) at 2326.

27 July (208)

Shooting Line 17 (eastern part) to the west at 40 s rep rate. EOL 17 (eastern part) at 0650. We deployed the full length streamer (164 channels; see streamer/source configuration figure III for this geometry). This was complete at 1036. We maneouvered to come back on Line 17 with several miles of overlap with the eastern portion already acquired. We began acquiring data at 1050 but experienced gun controller failures at 1112. We elected to begin a turn to restart the line. We did so, but experienced another computer failure at 1210 and again began a turn to strat the line over. We came online 17 (western part) at 1520 shooting at 40 s rep rate.

28 July (209)

Shooting Line 17 (western part) to the west at 40 s rep rate. EOL 17 (western part) at 0512. Simple turn to port onto Line 21 shooting southwest at 20 s rep rate. EOL 21 at 1328. Simple turn to starboard onto Line 2 to the west shooting at 20 s rep rate. EOL 2 at 2233. Turn to port to come onto Line 15 to the east at 20 s rep rate.

29 July (210)

Turning onto Line 15 to the east at 20 s rep rate. BOL 15 at 0002. EOL 15 at 0909. Simple turn to the portot onto Line 22 shooting northeast at 20 s rep rate. EOL 22 at 1357. Simple turn to starboard onto Line 1 (mid eastern part) shooting east at 40 s rep rate. BOL 1 (mid-eastern part) at 1402.

30 July (211)

Shooting Line 1 (mid eastern part) to the east at 40 s rep rate. EOL 1 (mid-eastern part) at 0455. Simple turn to starboard to Line 23 to the south at 20 s rep rate. EOL 23 at 1054. Begin simple turn to starboard to Line 14 (middle part) to be

shot to the west at 20 s rep rate. BOL 14 (middle part) at 1118. EOL 14 (middle part) at 2030. This is the end of shooting for Deployment 2. Gun array recovery is complete at 2144. Streamer recovery begins.

31 July (212)

Streamer and tail buoy recovery are complete at 0215. We haead to OBS location 243 at the east end of Line 12 for the first rtecovery at 1045. We recover instruments 243-248 along Line 12 during the remainder of the day.

1 August (213)

We recover instruments 249-251 along Line 12. We transit north to location 242 at the west end of Line 17 for a recovery at 2119. We recover instrument 241 later.

2 August (214)

We recover instruments 240 -236 along Line 17 by 1024. We transit south to location 235 at the east end of Line 1 for a recovery at 1430. We recover instruments 234-233. Insturment 232 is not found. There is no beacon signal. We elect to abandon the instrument so that we will not lose other instruments. Instruments 231-230 during the remainder of the day.

3 August (215)

We recover instruments 229-227 by 0432. We head for Lisbon via the location of Instrument 232. We hope it will have surfaced and be observable with the radio beacon. It has and we recover it at 0933. We now head directly to Lisbon to unload the German OBH equipment and crew.

4 August (216)

Arrive Lisbon, at dock by 1100. The first crane provided by the agent was no able to lift the German container. A larger one had to be brought. We depart Lisbon about 1800 and transit to the first deployment site.

5 August (217)

Transit to location 352 at south end of Line 9 for first OBS deployment at 0623. Instruments 353-362 deployed ending at 2059. We begin streamer deployment. We will use the 164 channel streamer (see streamer/source configuration figure III for this geometry).

6 August (218)

Streamer and gun array deployed at 0300. Transit to north end of Line 9. We arrive early, prior to the turn on time for the OBS's. We therfore elect to go further north than originally planned and shoot to the south at 20 s rep rate for MCS acquisition only. When the OBS's turn on we will switch to 60 s rep rate. Begin shooting north of Line 9 to the south at 20 s rep rate at 0638. Switch to 60 s rep rate at 0656.

7 August (219)

Shooting Line 9 to the south at 60 s rep rate. EOL 9 at 1243. Turn to starboard to come onto Line 24 to the north at 20 s rep rate. BOL 24 at 1431.

8 August (220)

Shooting Line 24 to the north at 20 s rep rate. EOL 24 at 0112. Butterfly turn to starboard to come onto Line 25 to the west at 20 s rep rate. BOL 25 at 0237. EOL 25 at 0825. Butterfly turn to starboard to come onto Line 26 to the south at 20 s rep rate. BOL 26 at 1042. Between 1232 and 1322 we send a small boat to check the tailbuoy GPS system. This system is needed for the next Ewing cruise and is being tested here. EOL 26 at 1537. Butterfly turn to starboard to come onto Line 27 shooting to the east at 20 s rep rate. BOL 27 at 1655. EOL 27 at 2019. Butterfly turn to starboard to come onto Line 28 shooting to the north at 20 s rep rate. BOL 28 at 2137.

9 August (221)

Shooting Line 28 to the north at 20 s rep rate. EOL 28 at 0220. Turn to port to come onto Line 29 shooting to the south at 20 s rep rate. BOL 29 at 0308. EOL 29 at 0609. Butterfly turn to starboard to come onto Line 30 shooting to the east at 20 s rep rate. BOL 30 at 0720. EOL 30 at 1145. Turn to port to come onto Line 10 shooting to the west at 20 s rep rate. BOL 10 at 1309.

10 August (222)

Shooting Line 10 to the west at 20 s rep rate. EOL 10 at 0355. Turn to starboard to come onto Line 11 shooting to the east at 20 s rep rate. BOL 11 at 0654. EOL 11 at 2117. Transit north to come onto Line 13 shooting to the west at 20 s rep rate. Data were recorded during this transit but have not been assigned a line number.

11 August (223)

Transiting north to come onto Line 13 shooting to the west at 20 s rep rate. BOL 13 at 0229. EOL 13 at 2013. Turn to starboard to come onto Line 14 (west part) shooting to the east at 20 s rep rate. BOL 14 at 2200.

12 August (224)

Shooting Line 14 (west part) to the east at 20 s rep rate. EOL 14 (west part) at 1756. Turn to port to come onto Line 15 (east part) shooting to the west at 20 s rep rate. BOL 15 (east part) at 2200.

13 August (225)

Shooting Line 15 (east part) to the west at 20 s rep rate. EOL 15 (east part) at 0643. That is the end of seismic data acquisition for the cruise. The gun array is brought in at 0800. There is a problem with pwoer to the streamer winch. This is fixed at 1100 and streamer recovery begins. Streamer and tail buoy are recovered. Transit to location 362 at north end of Line 9 to revoer OBS. OBS 362 recovered at 1818. Instruments 361-360 recovered later.

14 August (226)

Instruments 359-357 recoverd by 0439. Instrument 355 does not surface and we have to leave it behind. Instrument 354 recovered at 1121. Instrument 353 does not surface and we have to leave it behind. Instrument 352 recovered at 1545. We request, and Lamont generously grants, permission to return to sites 355 and 353 to look for the lost instruments. We leave site 355 at 2004 when we find no evidence the instrument has surfaced. We leave site 353 at 2230 when we find no evidence the instrument has surfaced.We transit to Lisbon.

15 August (227)

Arrive at dock in Lisbon, Portugal. The cruise is complete.

Data Observations and samples collected:

Latitudes are positive to the North. Longitudes are positive to the East.
Figure 4 is a map of the MCS profiles.

Multichannel Seismic Reflection Profiles & Magnetic Data

Line #	Endpoint 1		Endpoint 2	
1	42.078	-13.000	42.078	- 9.000
2	41.950	-12.000	41.950	-13.000
4	42.200	-12.000	42.200	-13.000
5	42.395	-12.417	41.786	-12.417
6	42.395	-12.525	41.786	-12.525
9	42.583	-11.192	40.170	-11.192
10	40.865	-11.120	40.865	-12.750
11	41.050	-12.600	41.050	-11.120
12	41.298	-12.700	41.298	- 9.000
13	41.463	-11.120	41.463	-13.000
14	41.595	-13.000	41.595	- 9.000
15	41.850	-11.120	41.850	-13.000
17	42.552	-11.600	42.694	- 9.281
18	41.298	- 9.000	41.595	- 9.000
19	41.607	-10.000	42.091	-10.000
20	42.078	- 9.000	42.694	- 9.281
21	42.552	-11.600	41.950	-12.000
22	41.850	-12.000	42.094	-11.600
23	42.091	- 9.950	41.606	- 9.950
24	41.190	-11.290	40.935	-11.290
25	40.935	-11.290	40.935	-11.850
26	40.983	-11.767	40.625	-11.767
27	40.625	-11.767	40.625	-11.495
28	40.625	-11.495	40.935	-11.495
29	40.935	-11.558	40.760	-11.570
30	40.760	-11.570	40.760	-11.120

Dale S. Sawyer is custodian of all Multichannel Seismic Reflection Profile and Magnetic Data

Ocean Bottom Seismograph Stations
Figure 4 is a map of the OBS locations.

Station #	Depth (m)	Latitude	Longitude	Type
101	5290	42.0801	-13.0004	G
102	5282	42.0797	-12.9038	G
103	5256	42.0820	-12.7759	G
104	5242	42.0837	-12.6424	G
106	5188	42.0851	-12.5252	U
107	5159	42.0851	-12.4794	U
108	5061	42.0868	-12.4170	U
109	4974	42.0878	-12.3331	U
110	4762	42.0891	-12.2246	U
111	4208	42.0902	-12.1157	U
112	3513	42.0923	-11.9824	G
113	3737	42.0928	-11.8492	G
114	2570	42.0933	-11.7035	G
115	2454	42.0941	-11.5581	G
116	2384	42.0943	-11.4012	G
117	2412	42.0954	-11.2544	G
118	2640	42.0956	-11.0493	G
119	5087	41.9537	-12.4172	G
120	5113	42.0251	-12.4172	U
121	4913	42.1415	-12.4169	U
122	4821	42.2014	-12.4172	U
123	5181	41.9533	-12.5245	G
124	5196	42.0174	-12.5256	G
125	5005	42.1433	-12.5245	U
126	5020	42.2011	-12.5253	U
227	2640	42.0954	-10.9402	U
228	2781	42.0948	-10.6973	U
229	2764	42.0937	-10.4550	U
230	2686	42.0922	-10.2127	U
231	2392	42.0908	-9.9699	U
232	2252	42.0886	-9.7627	U
233	1701	42.0867	-9.5631	U
234	237	42.0838	-9.3634	U
235	147	42.0806	-9.1571	U
236	124	42.6918	-9.3232	G
237	1196	42.6755	-9.6288	G
238	2124	42.6586	-9.9334	G
239	2691	42.6415	-10.2379	G
240	2283	42.6228	-10.5425	G
241	2018	42.6035	-10.8472	G
242	1723	42.5831	-11.1519	G
243	301	41.3001	-9.2385	G
244	2602	41.3048	-9.5398	G
245	3047	41.3085	-9.8386	G
246	3541	41.3114	-10.2579	G
247	2542	41.3122	-10.6774	G
248	3755	41.3124	-11.0957	G
249	3464	41.3108	-11.5154	G
250	3515	41.3078	-11.9337	U

Station #	Depth (m)	Latitude	Longitude	Type
251	5148	41.3037	-12.3526	U
352	4991	40.2303	-11.1919	U
354	4751	40.6801	-11.1921	U
356	4180	41.1217	-11.1918	U
357	3961	41.2901	-11.1914	U
358	3616	41.4297	-11.1921	U
359	2109	41.6501	-11.1917	U
360	2262	41.8497	-11.1917	U
361	2272	42.0298	-11.1923	U
362	2164	42.2001	-11.1918	U

Type U data were acquired using ocean bottom seismographs from the Institute for Geophysics of the University of Texas at Austin. The custodian for these data is Dr. Yosio Nakamura of that organization.

Type G data were acquired using ocean bottom hydrophones from GEOMAR Marine Research Laboratory in Kiel Germany. The custodian for these data is Dr. Tim Reston of the Department of Geology and Petroleum Engineering of the University of Aberdeen Scotland.

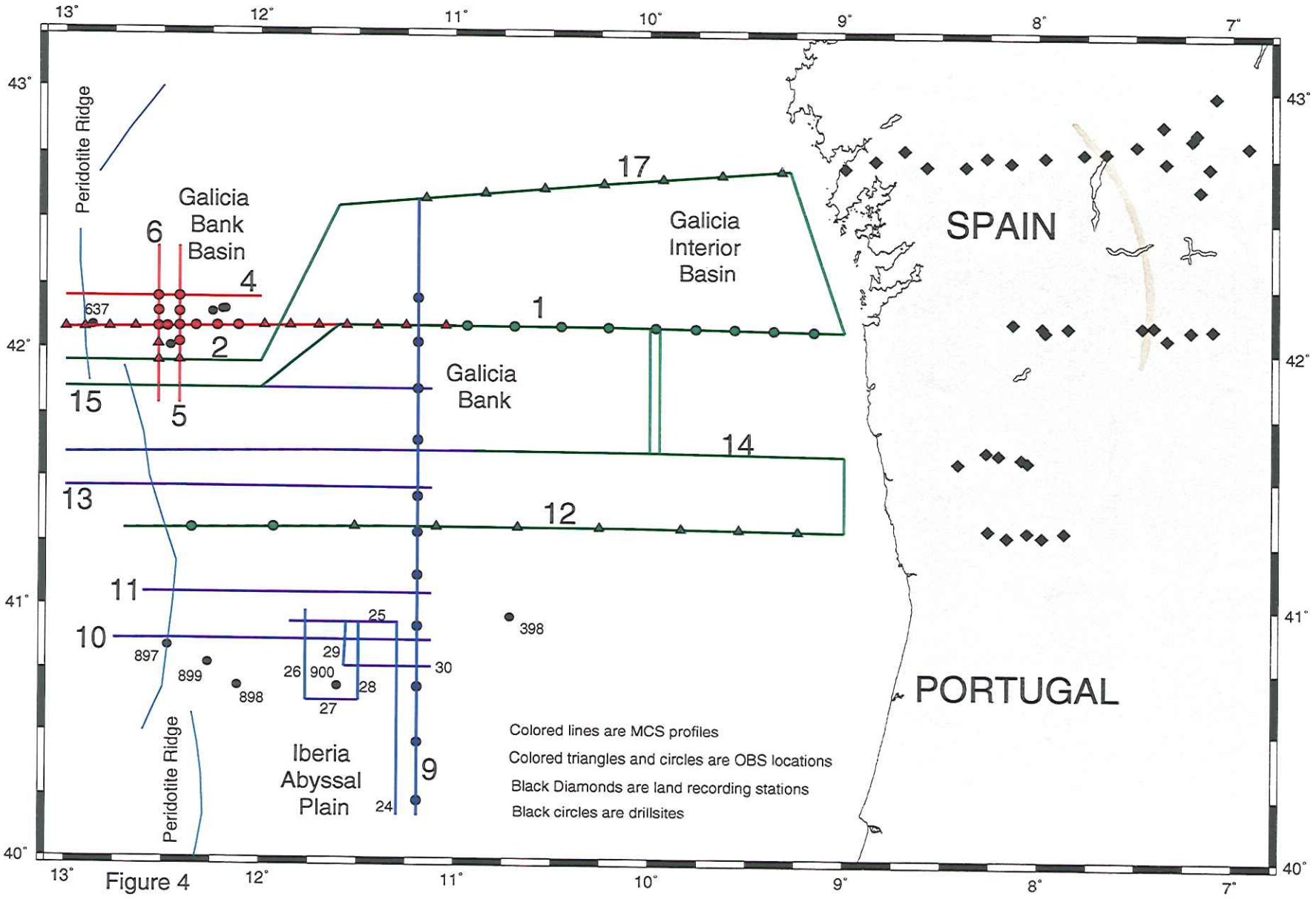
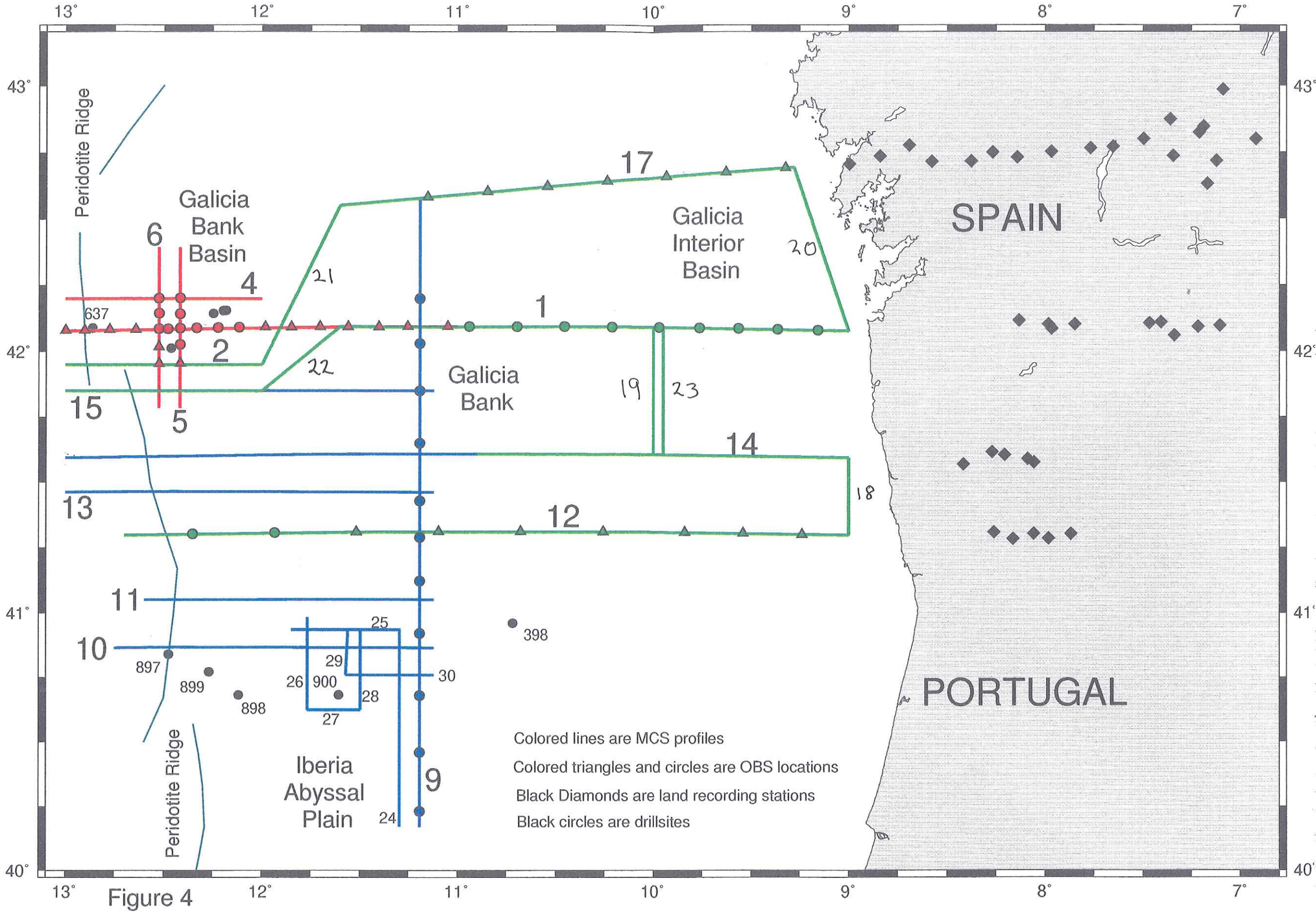

13°
12°
11°
10°
9°
8°
7°
43°
42°
41°
40°
Peridotite Ridge
Galicia Bank Basin
Galicia Interior Basin
Galicia Bank
Iberia Abyssal Plain
SPAIN
PORTUGAL
17
1
2
4
5
6
9
10
11
12
13
14
15
24
25
26
27
28
29
30
637
897
898
899
900
398
Colored lines are MCS profiles
Colored triangles and circles are OBS locations
Black Diamonds are land recording stations
Black circles are drillsites

Figure 4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