EN-105

LOW LEVEL WASTE OCEAN DISPOSAL PROGRAM

Report URI-20

ENDEAVOR CRUISE EN-105

NORTH ATLANTIC

SEPTEMBER 6 - SEPTEMBER 20, 1983

By

Edward P. Laine and Julie C. Fisher

December 1983

SANDIA LABORATORIES CONTRACT NO. 52-3793

EN-105

Abstract

The main operations of Endeavor Cruise EN-105 were carried out (September 6 - September 20, 1983) within two study locations: E-N2 located over the continental rise (35°30' - 36°00'N; 71°00' 72°30'W) and; E-N3 situated over the northern Hatteras Abyssal Plain (31°00' - 34°00'W; 69°00' - 73°00'). A total of 1995 trackline km of digitally recorded high resolution single channel seismic profiles were collected using watergun (1103 trackline km) and airgun (900 trackline km) sound sources. 3.5 kHz echosounding profiles were recorded the entire cruise for a total of 3328 trackline km. Three box cores, quadropod (3 cores from 2 lowerings), and one piston core were recovered. Box cores, quadropod cores, and a piston core were sub-sampled for pore water chemistry and the box cores were also sampled for stratigraphy and meiofauna. Two additional box core, 1 piston core, and 1 quadropod lowerings were attempted.

Introduction

R/V Endeavor departed Narragansett, Rhode Island at 1300z (GMT) on September 6, 1983. Detailed seismic surveys using air/watergun and high frequency 3.5 kHz were carried out within two previously identified study areas, E-N2 and E-N3 (Endeavor cruises EN-053, 1980; EN-069, 1981; EN-071, 1981; EN-084, 1982; EN-085, 1982 and EN-098, 1983; Reports URI-3, URI-5, URI-6, URI 10, URI-11) and between bottom sampling stations (Figs. 1, 2, 3, and 4). Eight operations were conducted within E-N2, and 3 lowering attempts were made within E-N3, but were unsuccessful or aborted due to weather conditions (Figs. 5 and 6).

Operations carried out on EN-105 are described in Table 1, and a summary of samples collected is presented in Table 2. The R/V Endeavor returned to Narragansett, Rhode Island at 1700z (GMT) on September 20, 1983. A listing of cruise participants appears in Table 3.

Table 1. Information Collected During EN-105

Type of Observation	Purpose
Box Core	Provide undisturbed bottom sample for interface pore water chemistry and near surface stratigraphy. Meiofauna samples taken for analysis of the meiofauna community.
Piston Core	Provide sample for down core pore water analysis and geotechnical/sedimentary analysis.
Quadropod	Provide undisturbed sample for interface pore water chemistry.
Seismic Survey:	
Airgun	Provide detailed high resolution profiles to determine the possibility of geologic hazards and hydrocarbon resources.
Watergun	Provide detailed high resolution profiles to determine the possibility of geologic hazards and hydrocarbon resources.
3.5 kHz	Provide detailed records of seafloor echocharacter for interpretation and identification of erosional and mass movement features.

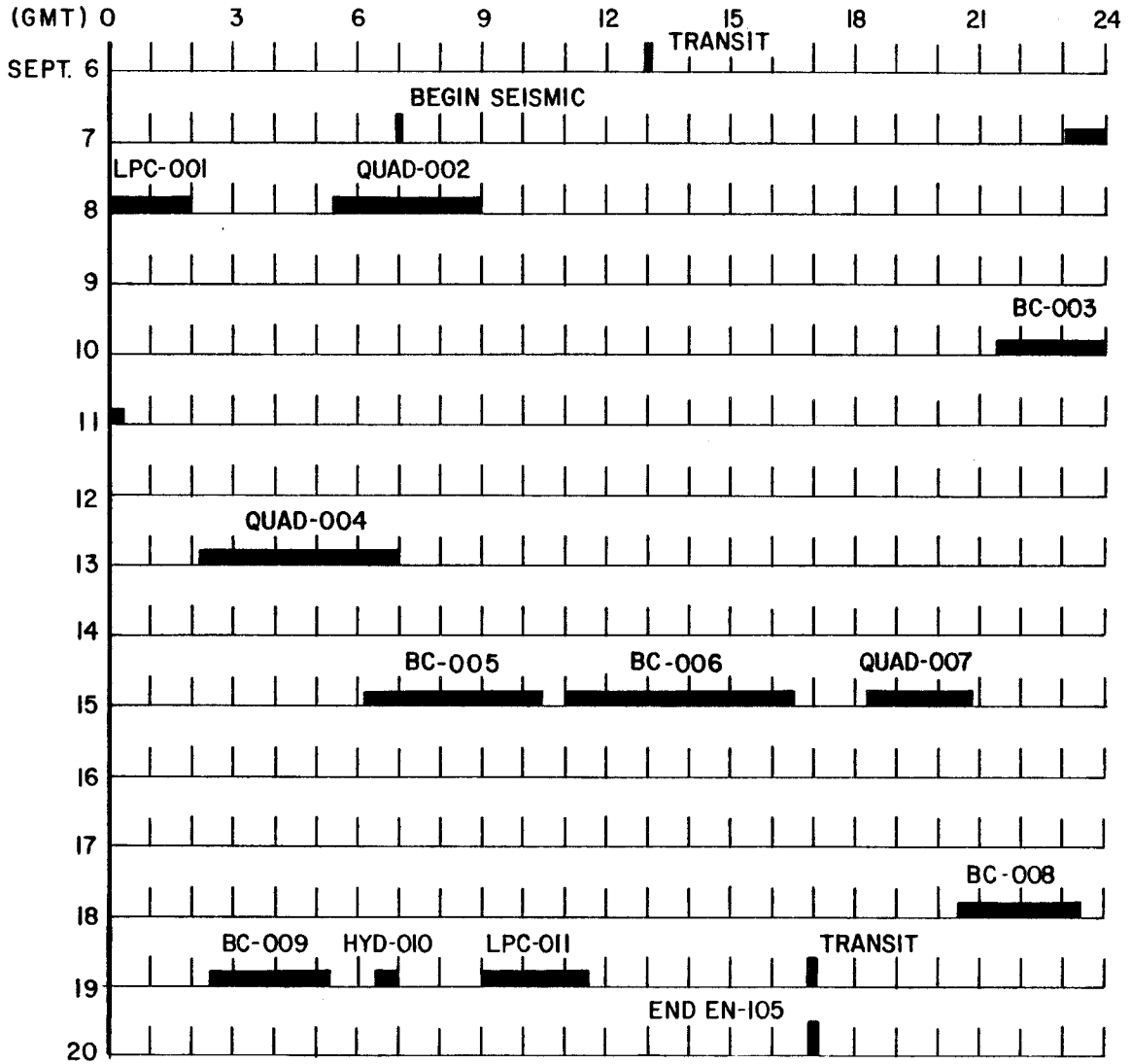

(GMT) 0
3
6
9
12
15
18
21
24
SEPT. 6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
TRANSIT
BEGIN SEISMIC
LPC-001
QUAD-002
BC-003
QUAD-004
BC-005
BC-006
QUAD-007
BC-008
BC-009
HYD-010
LPC-011
TRANSIT
END EN-105

Table 3. Scientific Staff EN-105

Edward P. Laine	Chief Scientist URI
Bob McMaster	Co-Chief Scientist URI
Stan Locker	Seismic Records URI
Julie Fisher	Core Archiving/Watch URI
Jim Singleton	Box Core Technician SCRIPPS INSTITUTION OF OCEANOGRAPHY
David Nelson	Marine Technician URI
Steve Imms	Marine Technician URI
Rod Davies	Core Technician URI
David Heggie	Pore Water Chemist URI
David Kahn	Pore Water Chemist URI
Doug Cullen	Pore Water Chemist URI
Andy Hudson	Watch URI
Tim Lewis	Auto Analyzer URI
David Butler	Compressor Technician URI
Anne Leifer	Watch URI

Results

Box Core

A Soutar box corer from Scripps Institution of Oceanography was deployed 3 times within E-N2 study area and 3 cores, 39.37 cm, 39.37 cm, and 50.8 cm in length were recovered (Fig. 5). Two unsuccessful lowerings were made within E-N3 study area (Fig. 6). In both cases the corer pre-tripped in the surge. A hydrostatic release and two wooden shear pins were later installed to prevent pre-tripping. Eleven sub-cores were taken from box core BC-003: four 10.16 cm diameter cores for pore water chemistry; six 3.81 cm diameter cores for meiofauna; and one 6.35 cm diameter core for stratigraphy. BC-008 and BC-009 were sampled in the same manner with the exception that only three, 10.16 cm diameter cores were taken for pore water chemistry and a 10.16 cm diameter core was taken for stratigraphy in place of the 6.35 cm diameter core. Meiofauna samples were extruded into glass jars and preserved with formalin (Na^2HPO^4) 10% buffered, spiked with rose bengal. The remaining mud from each box core was placed in plastic containers for use in geotechnical studies. Positions of sub-cores form BC-003, BC-008 and BC-009 are shown in Figs. 7, 8, and 9.

Piston Cores

Two lowerings were carried out within E-N2 (Fig. 5). LPC-001 recovered in 1136.5 cm of mud and was sampled for pore water chemistry as shown in Table 4. LPC-011 recovered no mud with the exception of the trigger core which contained 82.6 cm of mud. The core catcher was broken with only the ring and one tooth remaining, and the core liners were shattered. It is believed that the mud was extremely stiff and was lost during pullout.

Quadropod

Two successful lowerings of the quadropod were carried out within the E-N2 study area (Fig. 5). The first lowering was considered a test deployment and the instrument carried 4 cores (2 core catchers), but no Harpoon pore water probe (HP). Two cores, 85 cm in length were recovered. The drive shaft pins were sheared and the plate was situated about 2.54 cm above the lower limit

switch. Shearing may have been due to mud stiffness. Double pinging Benthos pinger on the quadropod frame indicated that the instrument tipped over soon after the beginning of its sampling sequence. The interface on the cores appeared good, but the supernatant liquid looked murky.

Two cores were collected in the second deployment, but one core was lost on deck during recovery. The instrument had tipped over during deployment before the plate came up, but after the valve on the HP had closed. No pore water was taken. Mud on probe ports indicated that the instrument shifted on bottom during deployment.

One lowering was attempted within E-N3 (Fig. 6), but was aborted at 535m wireout due to the sea state (18 foot seas, winds gusting to 70 knots).

Seismic Operations

EN-105 geophysical operations proved very successful, meeting all major scientific and operational objectives. A new high resolution digital single channel seismic profiling system, recently developed for the R/V Endeavor by other URI researchers (Belknap, et al., 1983), produced excellent records using both airgun and watergun sources. Eleven seismic line transects (4 dip lines and 7 strike lines, Fig. 2) are summarized in Table 5 by line number. Nine hundred trackline km of airgun array data (three guns of 120, 80, and 40 in^3) and 1098 trackline km of watergun data (80 in^3) were collected for a total of 1998 trackline km of high resolution reflection seismic data. All seismic data was recorded in both analog and digital format on magnetic tape for post-cruise processing (Tables 6 and 7). Far field source signatures for the gun configurations used, recorded on the previous cruise (EN-104), are available for deconvolution analysis. Three graphic recorders produced paper records at sweep rates of 4, 2.5, and 2 seconds. About 20% of the digitized data, plotted during the cruise as a quality control check, introduced trace summing and time variable gain.

In addition, 3.5 kHz echosounding records were collected during the entire cruise for about 3328 km of data.

All geophysical data (magnetic tapes and paper records) are stored at the Graduate School of Oceanography, University of Rhode Island. The analog

hydrostreamer output was filtered at 20-300 H_z (airguns) or 25-300 H_z (watergun) and recorded on 1/4" magnetic tape using a Hewlett-Packard Model 3964 A four channel recorder. The key pulse was recorded on channel 1 and the filtered seismic signal on channel 4 at a tape speed of 1-7/8"/sec. The disital acquisition system output was recorded on 9-track, 1/2" magnetic tape in demultiplexed SEG-Y format. The major OAS components consist of a HP2112A minicomputer, a Filter-Amplifier-Converter assembly, and Timing Controller. The digitized data was pre-filtered at 20-320 H_z. Typically, sample rate was 1 millisecond, with 4000 samples per shot, and a shot repetition rate of 10 seconds. Two hydrostreamers were used, each containing 2 groups of 50 hydrophones within a 45 m long active section. The length of the towing leaders was 183 m. Air pressure to the guns averaged 1850 $\pm$ 100 psi. Gun shot lag times used in firing airgun array were as follows: 120 cv. in = 0 delay, 80 cv. in. = 1 millisecond delay, and 40 cv. in. = 7 millisecond delay. A detailed description of R/V Endeavor's seismic profiling system is provided by Belknap, et al., (1983).

Table 4: Sampling of LPC-001 for Pore Water Chemistry

Section	Depth from top of core (cm)*
7	104
7	179
6	225
6	332
5	407
5	484
4	560
4	636
3	718
3	788
2	865
2	941
1	1017
1	1093

* Depths given are mid-points of duplicate 50 cc subcores taken with centrifuge tubes.

TABLE 5

EN-105 SEISMIC LINE INVENTORY

Line #	Length (km)	Date	Time (GMT) Start	Time (GMT) End	DAS* Reel #	Analog Reel #	Source**
1	378	9/7/83	0708	2056	1-5	1-3	120+80+40 in³ AG
1		9/8-9/83	1227	1900	6-16	3-10	120+80+40 in³ AG
2	72	9/9-10/83	1901	0155	17-19	11-12	120+80+40 in³ AG
3	163	9/10/83	0155	1826	20-25	12-16	120+80+40 in³ AG
4	160	9/11/83	0210	1712	26-31	17-20	120+80+40 in³ AG
5	44	9/11/83	1713	1809	32	20	80+40 in³ AG
5		9/11/83	1809	2210	32	20-21	80 in³ WG
5		9/11/83	2210	2230	32-33	21	80+40 in³ AG
6	122	9/11/83	2230	2254	34	21	80+40 in³ AG
6		9/11-12/83	2254	1433	34-40	21-25	120+80+40 in³ AG
7	156	9/12-13/83	1433	0038	41-44	25-27	80 in³ WG
7		9/19/83	1209	1650	83-84	52-53	80 in³ WG
8	472	9/13-14/83	1412	2153	45-56,85	28-35	80 in³ WG
8		9/15-16/83	2249	1816	57-63	36-40	80 in³ WG
	(line #9 omitted from numbering sequence)						
10	185	9/16-17/83	2311	1747	64-71	41-45	80 in³ WG
11	133	9/17-18/83	1747	0714	71-76	45-48	80 in³ WG
12	87	9/18/83	0747	1532	77-80	49-50	80 in³ WG
13	26	9/18/83	1532	1812	81-82	50-51	80 in³ WG

* DAS = Digital Acquisition System

** AG = Airguns WG = Watergun

TABLE 6

EN-105 ANALOG TAPE INVENTORY

Reel #	Line #	Date	Time (Z) Start	Time (Z) End	Shot Points Start	Shot Points End	Comments
1	1	9/7/83	0725	1133	103	~1560	
2	1	9/7/83	~1135	~1550	~1580	~3020	Tape ran out.
3	1	9/7-8/83	1749	1301	3852	205	
4	1	9/8/83	1304	~1714	219	~1700	Tape ran out.
5	1	9/8/83	1724	2125	1779	3230	
6	1	9/8-9/83	2131	0138	3261	4745	
7	1	9/9/83	0141	0540	4766	6200	
8	1	9/9/83	0546	0947	6233	7664	
9	1	9/9/83	0952	1400	7695	9180	
10	1	9/9/83	1402	~1828	9197	~10791	Tape ran out.
11	1,2	9/9/83	1833	2232	10823	1272	
12	2,3	9/9-10/83	2237	0239	1299	268	
13	3	9/10/83	0242	~0700	282	~1858	
14	3	9/10/83	0716	1114	1891	3354	
15	3	9/10/83	1118	1525	3379	4862	
16	3	9/10/83	1629	1827	4883	5947	
17	4	9/11/83	0210	0602	1	1396	

TABLE 6

EN-105 ANALOG TAPE INVENTORY

Reel #	Line #	Date	Time (Z) Start	Time (Z) End	Shot Points Start	Shot Points End	Comments
18	4	9/11/83	0605	1007	1413	2864	
19	4	9/11/83	1011	1420	2892	4385	
20	4,5	9/11/83	1425	~1835	4414	~550	Tape ran out.
21	5,6	9/11/83	~1942	~2356	~770	~516	
22	6	9/12/83	0000	0401			
23	6	9/12/83	0405	0806			
24	6	9/12/83	0810	1215	1309	2774	
25	6,7	9/12/83	1217	1613	2790	600	
26	7	9/12/83	1616	2015	617	2052	
27	7	9/12-13/83	2019	0034	2073	3603	
28	8	9/13/83	1412	1808	1	1419	
29	8	9/13/83	1812	2210	1439	2871	
30	8	9/13-14/83	2214	0216	2891	4342	
31	8	9/14/83	0219	0616	4362	17	
32	8	9/14/83	0621	1021	46	1487	
33	8	9/14/83	1024	1429	1505	2972	
34	8	9/14/83	1432	1823	2993	4380	
35	8	9/14/83	1828	~2153	4406	~5636	End track from north

TABLE 6

EN-105 ANALOG TAPE INVENTORY

Reel #	Line #	Date	Time (Z) Start	Time (Z) End	Shot Points Start	Shot Points End	Comments
36	8	9/15-16/83	2249	0252	1	1350	Begin at EN-091 tie.
37	8	9/16/83	0253	0655	1358	2261	
38	8	9/16/83	0658	1102	2282	3744	
39	8	9/16/83	1105	1509	3766	5225	
40	8	9/16/83	1511	1816	5242	6351	
41	10	9/16-17/83	2310	0312	~9	1400	
42	10	9/17/83	0314	0711	1411	2834	
43	10	9/17/83	0715	1112	2857	4280	
44	10	9/17/83	1115	1519	4298	5764	
45	10,11	9/17/83	1524	1927	5792	257	
46	11	9/17/83	1928	2331	264	1719	
47	11	9/17-18/83	2333	0335	1734	3182	
48	11	9/18/83	0336	0635	3190	4328	
49	12	9/18/83	0749	1145	13	1596	
50	12,13	9/18/83	1148	1542	1615	59	
51	13	9/18/83	1543	1813	68	1065	Continue line 4.
52	7	9/19/83	1209	1612	1	1447	
53	7	9/19/83	1615	1650	1470	1685	

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
1	1	9/7/83	0708	0955	1	1004	120+80+40 AG
2	1	9/7/83	0955	1000	1005	1038	120+80+40 AG
1	1	9/7/83			1039	-	120+80+40 AG
2	1	9/7/83			1040	-	120+80+40 AG
1	1	9/7/83			1041	1053	120+80+40 AG
2	1	9/7/83	0959	1300	1054	2057	120+80+40 AG
3	1	9/7/83	1300	1538	2058	3061	120+80+40 AG
4	1	9/7/83	1538	1825	3062	4065	120+80+40 AG
5	1	9/7/83	1825	2056	4066	4969	120+80+40 AG
6	1	9/8/83	1227	1515	1	1004	120+80+40 AG
7	1	9/8/83	1515	1802	1005	2008	120+80+40 AG
8	1	9/8/83	1802	2050	2009	3012	120+80+40 AG
9	1	9/8/83	2051	2336	3013	4016	120+80+40 AG
10	1	9/8-9/83	2337	0224	4017	5020	120+80+40 AG
11	1	9/9/83	0224	0511	5021	6024	120+80+40 AG
12	1	9/9/83	0511	0801	6025	7028	120+80+40 AG
13	1	9/9/83	0802	1048	7029	8032	120+80+40 AG
14	1	9/9/83	1049	1333	8033	9036	120+80+40 AG
15	1	9/9/83	1333	1623	9037	10040	120+80+40 AG
16	1	9/9/83	1623	1900	10041	10982	120+80+40 AG
17	2	9/9/83	1901	2147	1	1004	120+80+40 AG

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
18	2	9/9-10/83	2148	0035	1005	2008	120+80+40 AG
19	2	9/10/83	0035	0155	2009	2487	120+80+40 AG
20	3	9/10/83	0155	0442	1	1004	120+80+40 AG
21	3	9/10/83	0442	0729	1005	2008	120+80+40 AG
22	3	9/10/83	0730	1017	2009	3012	120+80+40 AG
23	3	9/10/83	1018	1304	3013	4016	120+80+40 AG
24	3	9/10/83	1304	1526	4017	5020	120+80+40 AG
25	3	9/10/83	1527	1826	5021	5947	120+80+40 AG
26	4	9/11/83	0210	0457	1	1004	120+80+40 AG
27	4	9/11/83	0457	0744	1005	2008	120+80+40 AG
28	4	9/11/83	0745	1032	2009	3012	120+80+40 AG
29	4	9/11/83	1033	1319	3013	4016	120+80+40 AG
30	4	9/11/83	1319	1606	4017	5020	120+80+40 AG
31	4	9/11/83	1606	1712	5021	5305	120+80+40 AG
32	5	9/11/83	1728	2020	1	1004	80+40 AG, 80 WG
33	5	9/11/83	2020	2230	1005	1799	80 WG, 120+80+40 AG

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
34	6	9/11-12/83	2230	0117	1	1004	120+80+40 AG
35	6	9/12/83	0117	0405	1005	2008	120+80+40 AG
36	6	9/12/83	0405	0419	2009	2095	120+80+40 AG
37	6	9/12/83	0432	0719	1	1004	120+80+40 AG
38	6	9/12/83	0734	1007	1090	2008	120+80+40 AG
39	6	9/12/83	1008	1254	2009	3012	120+80+40 AG
40	6	9/12/83	1255	1433	3013	3606	120+80+40 AG
41	7	9/12/83	1433	1721	1	1004	80 WG
42	7	9/12/83	1721	2008	1005	2008	80 WG
43	7	9/12/83	2008	2255	2009	3012	80 WG
44	7	9/12-13/83	2255	0038	3013	3628	80 WG
45	8	9/13/83	1412	1659	1	1004	80 WG
46	8	9/13/83	1659	1947	1005	2008	80 WG
47	8	9/13/83	1947	2234	2009	3012	80 WG
48	8	9/13-14/83	2235	0121	3013	4016	80 WG
49	8	9/14/83	0122	0408	4017	5020	80 WG
50	8	9/14/83	0409	0611	5021	5194	80 WG

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
51	8	9/14/83	0614	0904	1	1000	80 WG
52	8	9/14/83	0904	1148	1005	2008	80 WG
53	8	9/14/83	1148	1435	2009	3012	80 WG
54	8	9/14/83	1436	1723	3013	4016	80 WG
55	8	9/14/83	1723	2010	4017	5020	80 WG
56	8	9/14/83	2010	2153	5021	5636	80 WG
57	8	9/15-16/83	2249	0136	1	1004	80 WG
58	8	9/16/83	0202	0403	1051	1779	80 WG
59	8	9/16/83	0534	0822	1780	2783	80 WG
60	8	9/16/83	0822	1109	2784	3787	80 WG
61	8	9/16/83	1109	1357	3788	4791	80 WG
62	8	9/16/83	1357	1644	4792	5795	80 WG
63	8	9/16/83	1644	1816	5796	6351	80 WG
64	10	9/16-17/83	2311	~0045	~9	~530	80 WG
65	10	9/17/83	0045	0206	531	1004	80 WG
66	10	9/17/83	0206	0453	1005	2008	80 WG
67	10	9/17/83	0454	0740	2009	3012	80 WG

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
68	10	9/17/83	0741	1028	3013	4016	80 WG
69	10	9/17/83	1028	1315	4017	5020	80 WG
70	10	9/17/83	1316	1603	5021	6024	80 WG
71	10,11	9/17/83	1603	1844	6025	6992	80 WG
72	11	9/17/83	1844	2132	1	1004	80 WG
73	11	9/17-18/83	2132	0019	1005	2008	80 WG
74	11	9/18/83	0019	0306	2009	3012	80 WG
75	11	9/18/83	0306	0548	3013	4016	80 WG
76	11	9/18/83	0548	0635	4017	4328	80 WG
77	12	9/18/83	0747	1017	1	1004	80 WG
78	12	9/18/83	1017	1246	1005	2008	80 WG
79	12	9/18/83	1247	1516	2009	3012	80 WG
80	12	9/18/83	1517	1532	3013	3121	80 WG

TABLE 7

EN-105 DAS TAPE INVENTORY

Reel #	Line #	Date	Time (GMT) Start	Time (GMT) End	Shot Points Start	Shot Points End	Source
81	13	9/18/83	1533	1803	1	1004	80 WG
82	13	9/18/83	1803	1812	1005	1065	80 WG
83	7	9/19/83	1209	1456	1	1004	80 WG
84	7	9/19/83	1456	1650	1005	1685	80 WG
85	8	9/14/85	~0430	0616	~5147	17	80 WG, digitized from analog reel #31.

Figure Captions

Fig. 1. Coastline and location of E-N2 and E-N3 study areas.

Fig. 2. Location of tracklines from EN-105.

Fig. 3. Location of detailed survey carried out within E-N2 study area.

Fig. 4. Location of survey within E-N3 study areas.

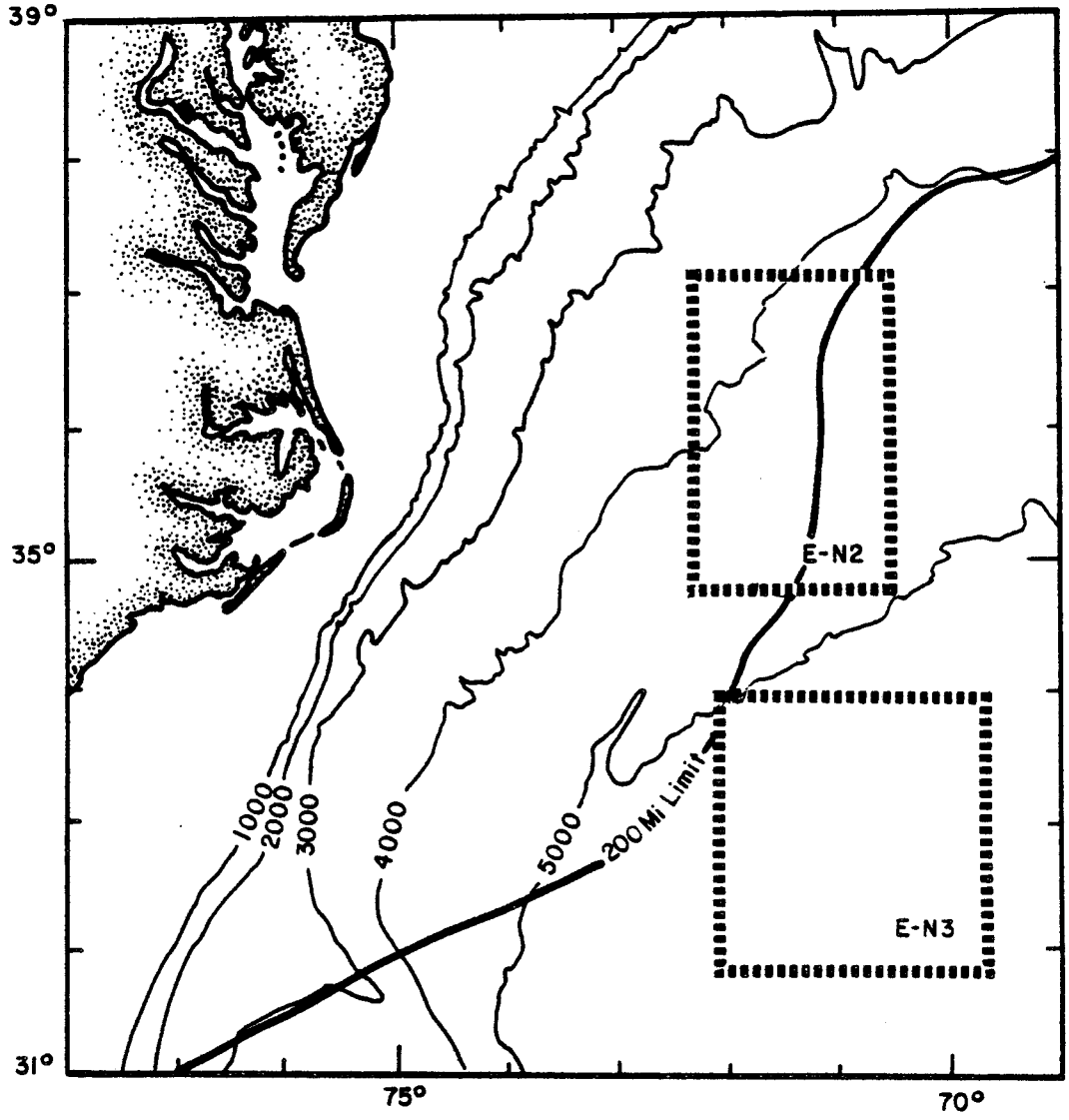
Fig. 5. Locations of station operations carried out within E-N2 study area.

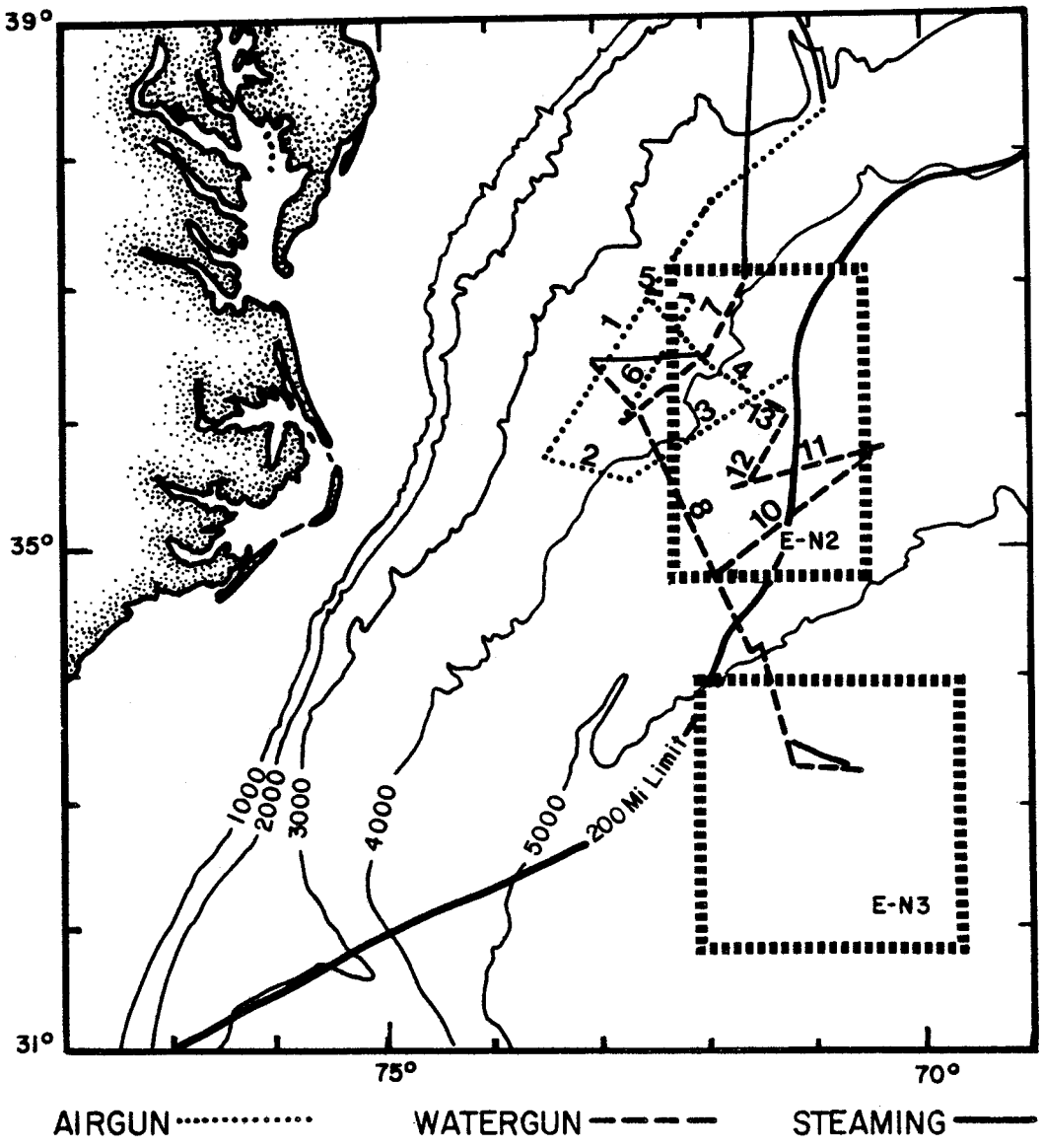
Fig. 6. Location of station operations within E-N3.

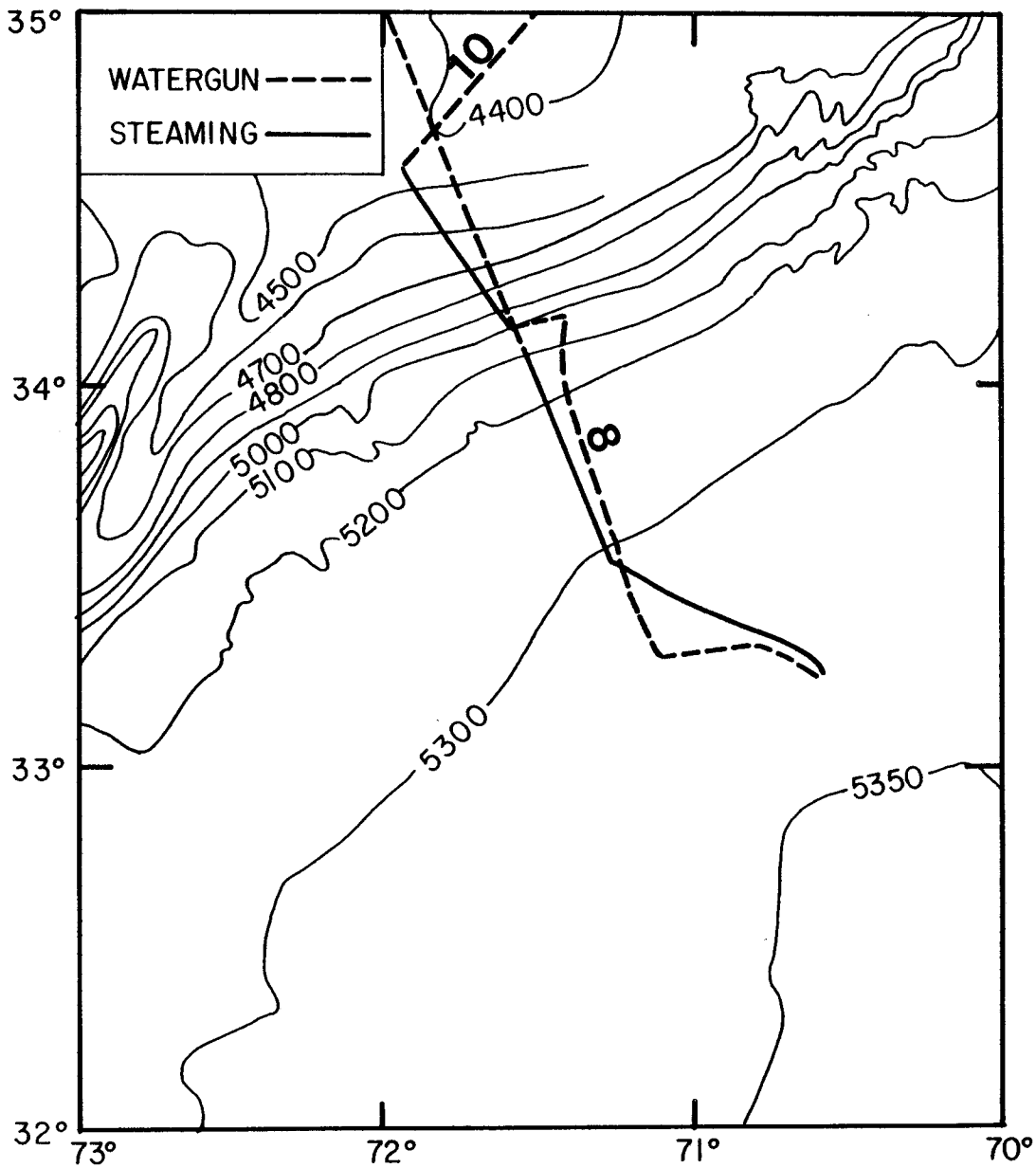
Fig. 7. Box Core - 003 diagram: positions of subsamples; #'s 1-4=10.16 cm cores; #'s 5-10 = 3.81 cm cores; #11 = 6.35 cm core.

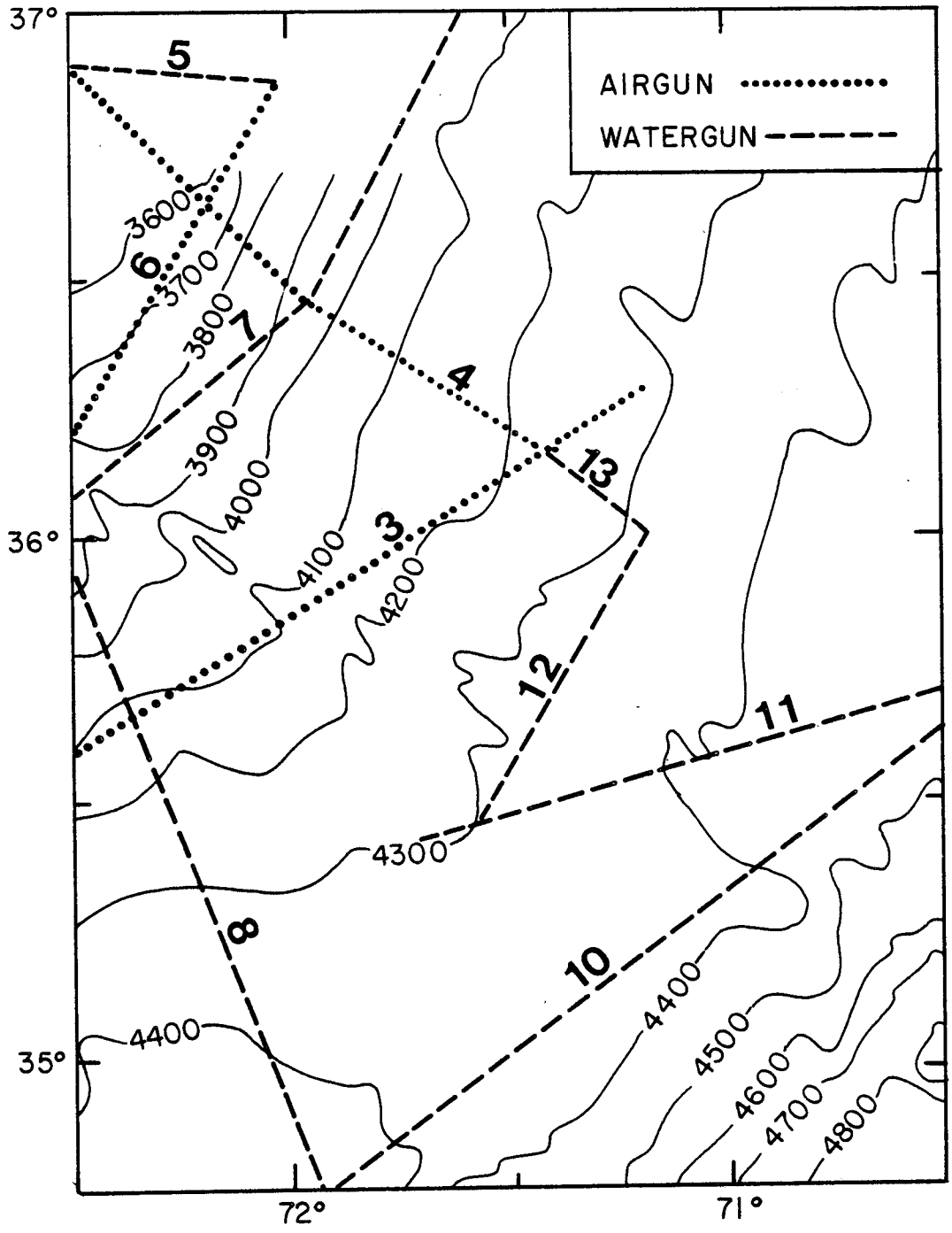
Fig. 8. Box Core - 008 diagram: positions of subsamples #1-4 = 10.16 cm cores (#4 for stratigraphy) #5-10 = 3.81 cm cores.

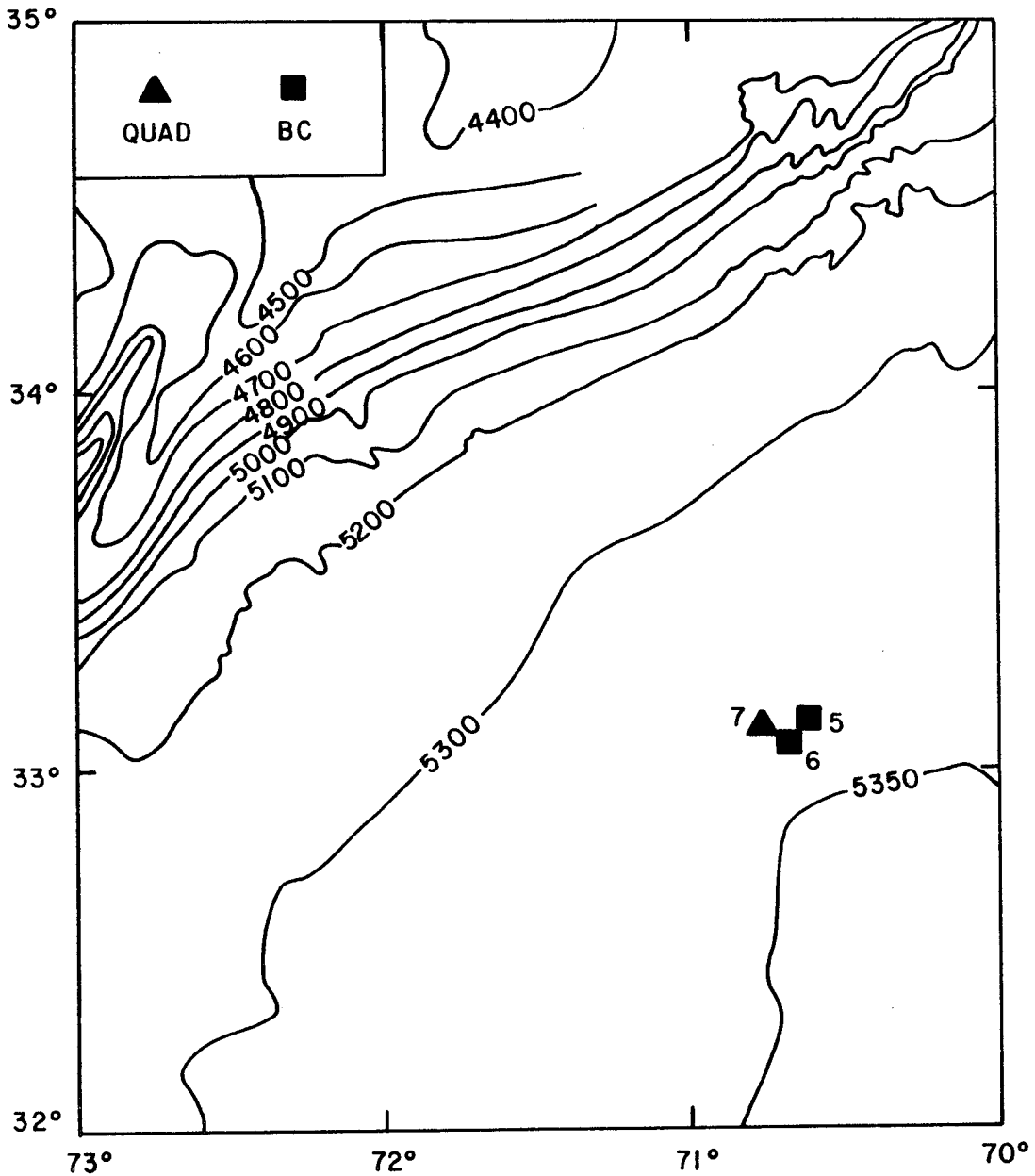
Fig. 9. Box Core - 009 diagram: positions of subsamples #1-4 = 10.16 cm cores (#4 for stratigraphy) #5-10 = 3.81 cm cores.

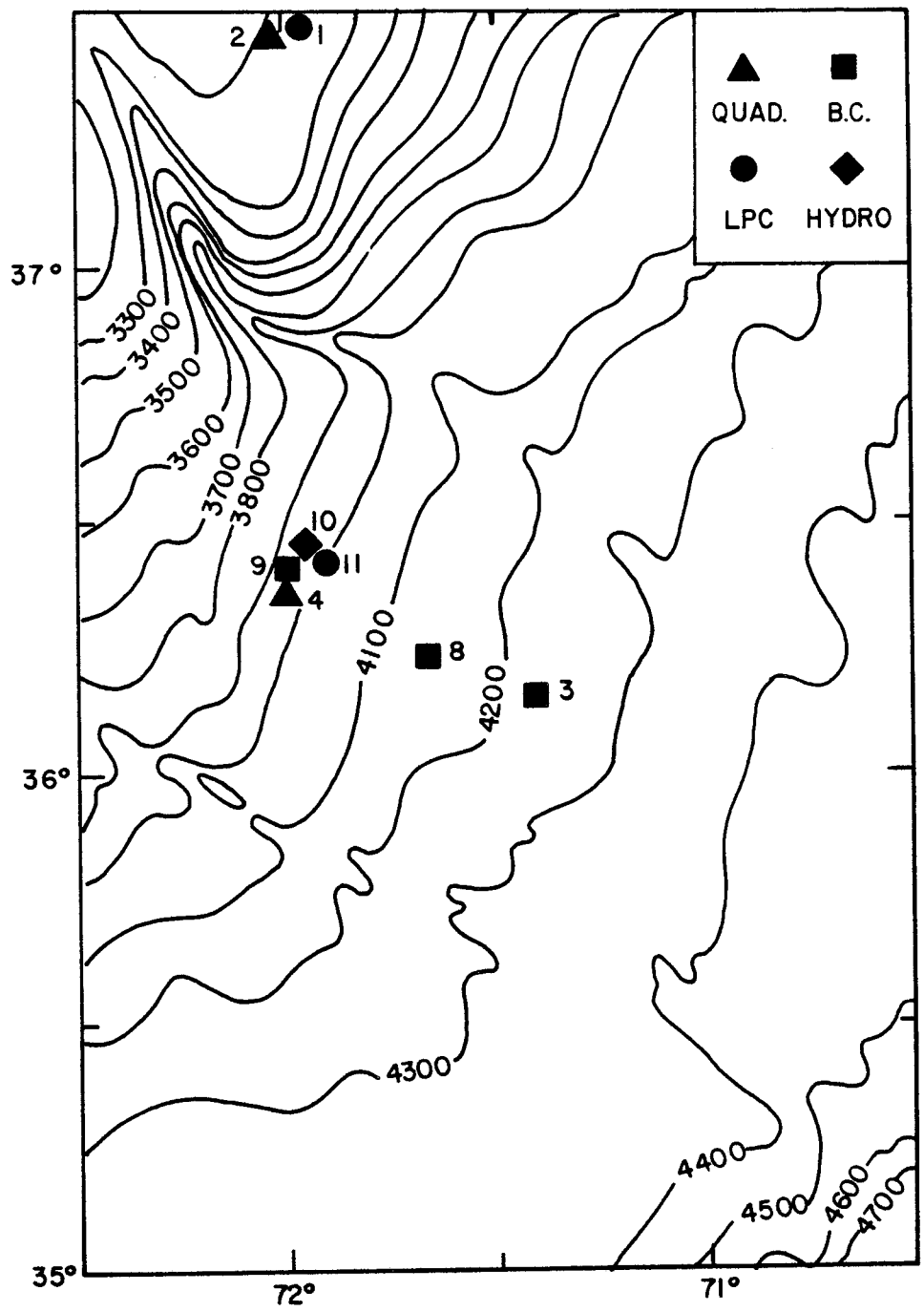

39°
35°
31°
75°
70°
E-N2
E-N3
1000
2000
3000
4000
5000
200 Mi Limit


39°
35°
31°
75°
70°
1
2
3
4
5
6
7
8
10
11
12
13
E-N2
E-N3
1000
2000
3000
4000
5000
200 Mi Limit
AIRGUN
WATERGUN
STEAMING

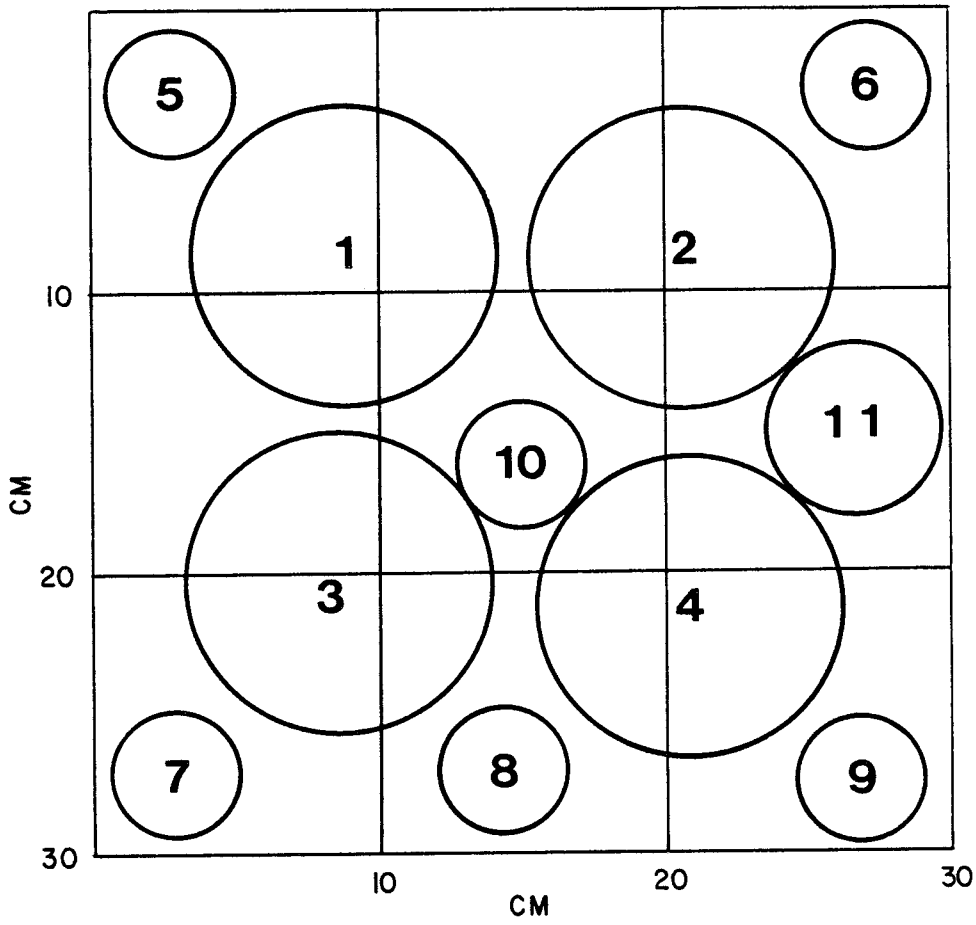

WATERGUN
STEAMING
10
8
4400
4500
4700
4800
5000
5100
5200
5300
5350
35°
34°
33°
32°
73°
72°
71°
70°


AIRGUN
WATERGUN
37°
36°
35°
72°
71°
5
6
7
4
3
13
12
11
10
8
3600
3700
3800
3900
4000
4100
4200
4300
4400
4400
4500
4600
4700
4800

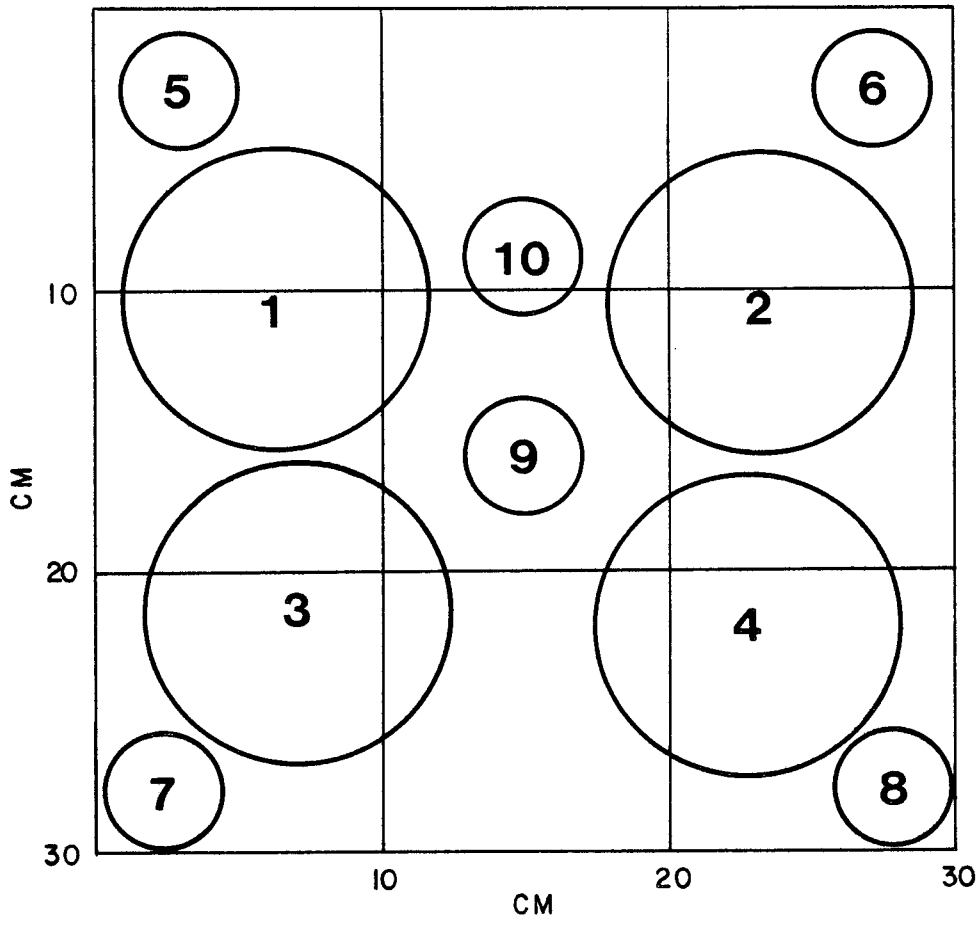

35°
34°
33°
32°
73°
72°
71°
70°
QUAD
BC
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
5350
7
5
6


QUAD.
B.C.
LPC
HYDRO
37°
36°
35°
72°
71°
3300
3400
3500
3600
3700
3800
4100
4200
4300
4400
4500
4600
4700
1
2
3
4
8
9
10
11

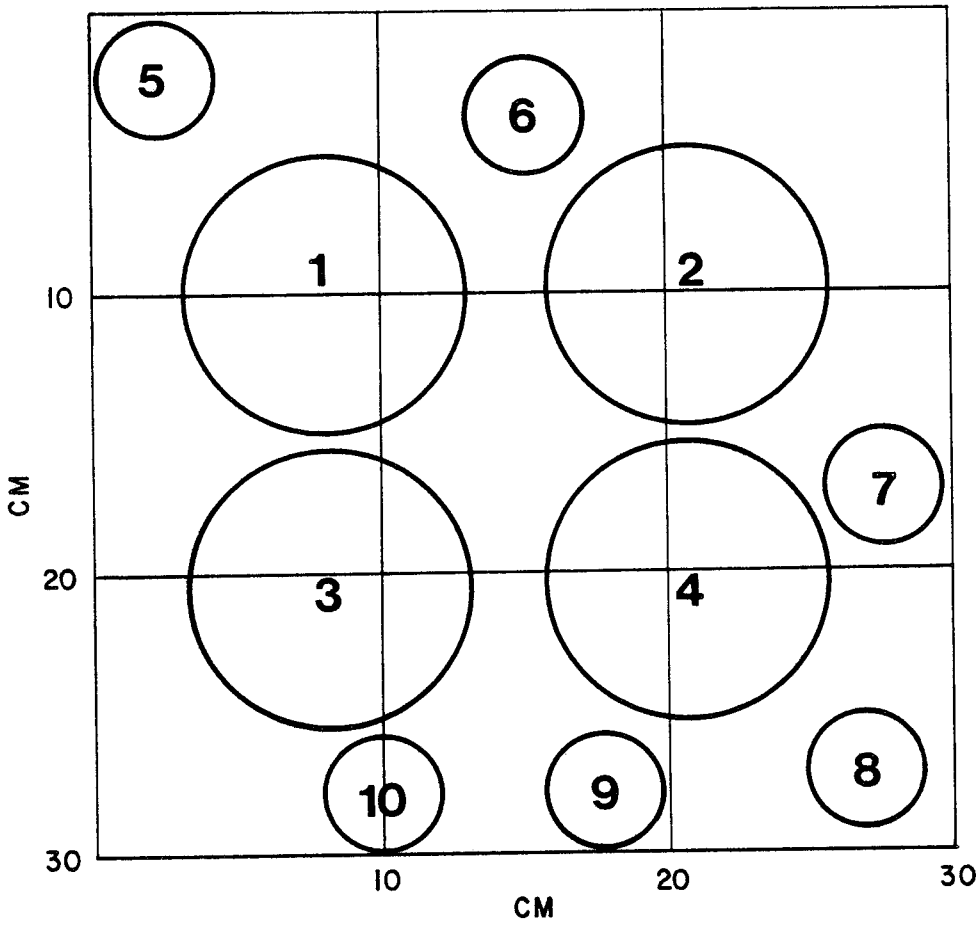
EN-105 BOX CORE 003 SEPT. 10, 1983
STA. 2 36° 10'.0 N 71° 24'.0 W



EN-105 BOX CORE 008 SEPT. 18, 1983
STA. 5 36°13'.69 N 71°39'.16 W



EN-105 BOX CORE 009 SEPT. 19, 1983
STA. 3 36°26'.17 N 71°58'.34 W



References

Belknap, P. C., R. S. Detrick, and R. L. Larson, 1983. R/V Endeavor's digital single channel seismic profiling system: GSO Technical Report 83-1, Univ. of Rhode Island, Narragansett, RI., 27 pp.

Laine, E. P., Fisher, J. C., Smith, J. E., McCreery, C. J., Dickson, S. M., Ashraf, A. and Schramm, C., 1980, "Final Report of 1980 Field Program (EN-053)," Low Level Waste Ocean Disposal Program Report URI-3, 99 pp.

Laine, E. P. and Friedrich, N. E., 1981, "Cruise Report R/V Endeavor Cruise EN-069, North Atlantic June 19 - July 4, 1981," Low Level Ocean Disposal Program URI-5, 25 pp.

Laine, E. P. and Friedrich, N. E., 1981, "Cruise Report R/V Endeavor Cruise EN-071, North Atlantic August 8 - 18, 1981," Low Level Waste Ocean Disposal Program Report URI-6, 17 pp.

Laine, E. P. and Friedrich, N. E., 1982, "Cruise Report R/V Endeavor Cruise EN-084, North Atlantic, May 15-24, 1982," Low Level Waste Ocean Disposal Program Report URI-10, 26 pp.

Laine, E. P. and Fisher J. C., 1982, "Cruise Report R/V Endeavor Cruise EN-085 North Atlantic May 27-June 8, 1982," Low Level Waste Ocean Disposal Program Report URI-11, 34 pp.