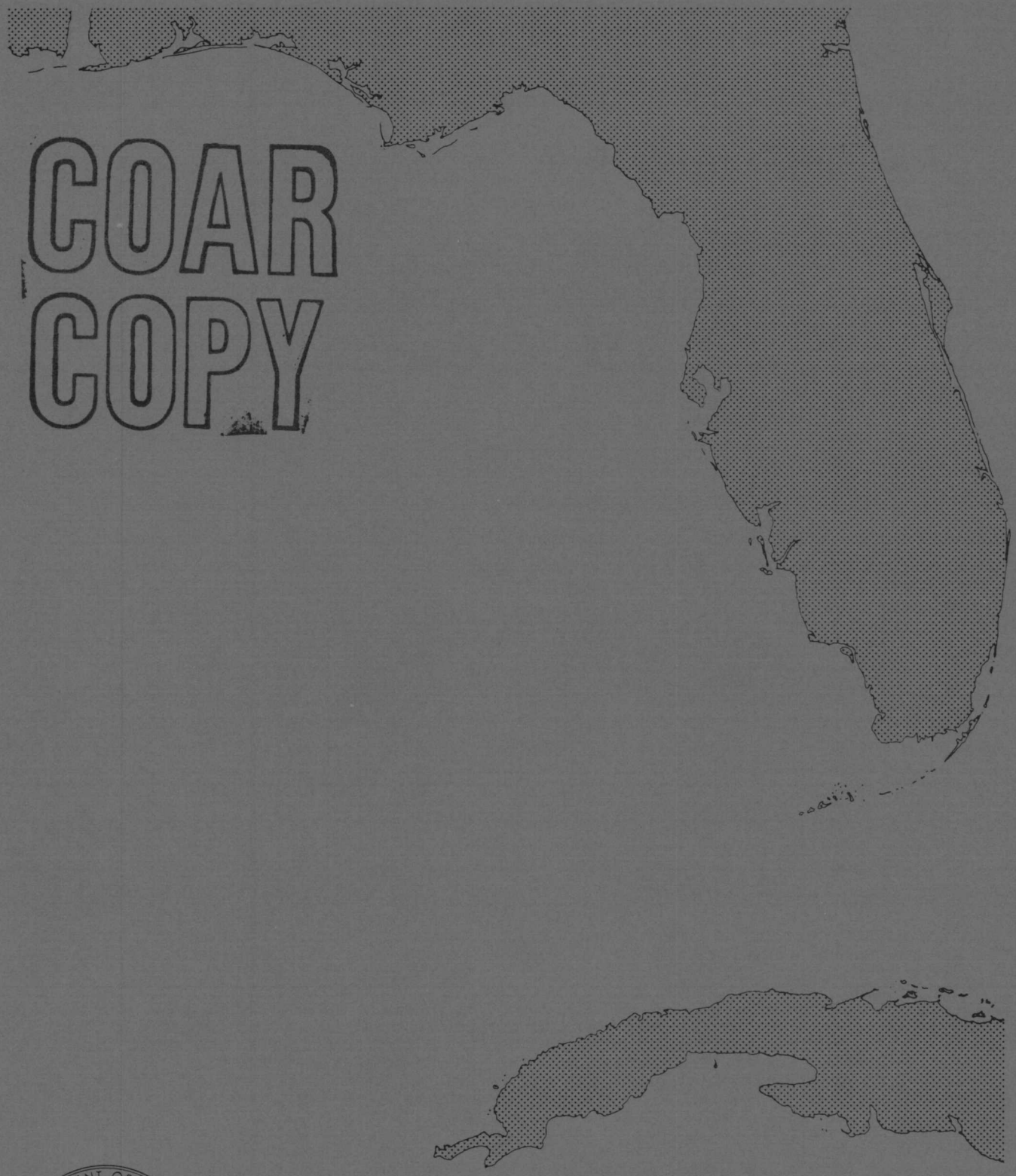

Prepared for:
U.S. Department of the Interior, Minerals Management Service
Gulf of Mexico OCS Region, Metairie, Louisiana
Contract 14-12-0001-29142
April 15, 1983

This report has been reviewed by the Minerals Management Service and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Minerals Management Service, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

APPENDIX A - METHODOLOGY

SOUTHWEST FLORIDA SHELF ECOSYSTEMS STUDY - YEAR 1

Prepared for
U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
Metairie, Louisiana

Contract 14-12-0001-29142

April 15, 1983

Woodward-Clyde Consultants
Consulting Engineers, Geologists and Environmental Scientists

Continental Shelf Associates, Inc.
"Applied Marine Science and Technology"

41322

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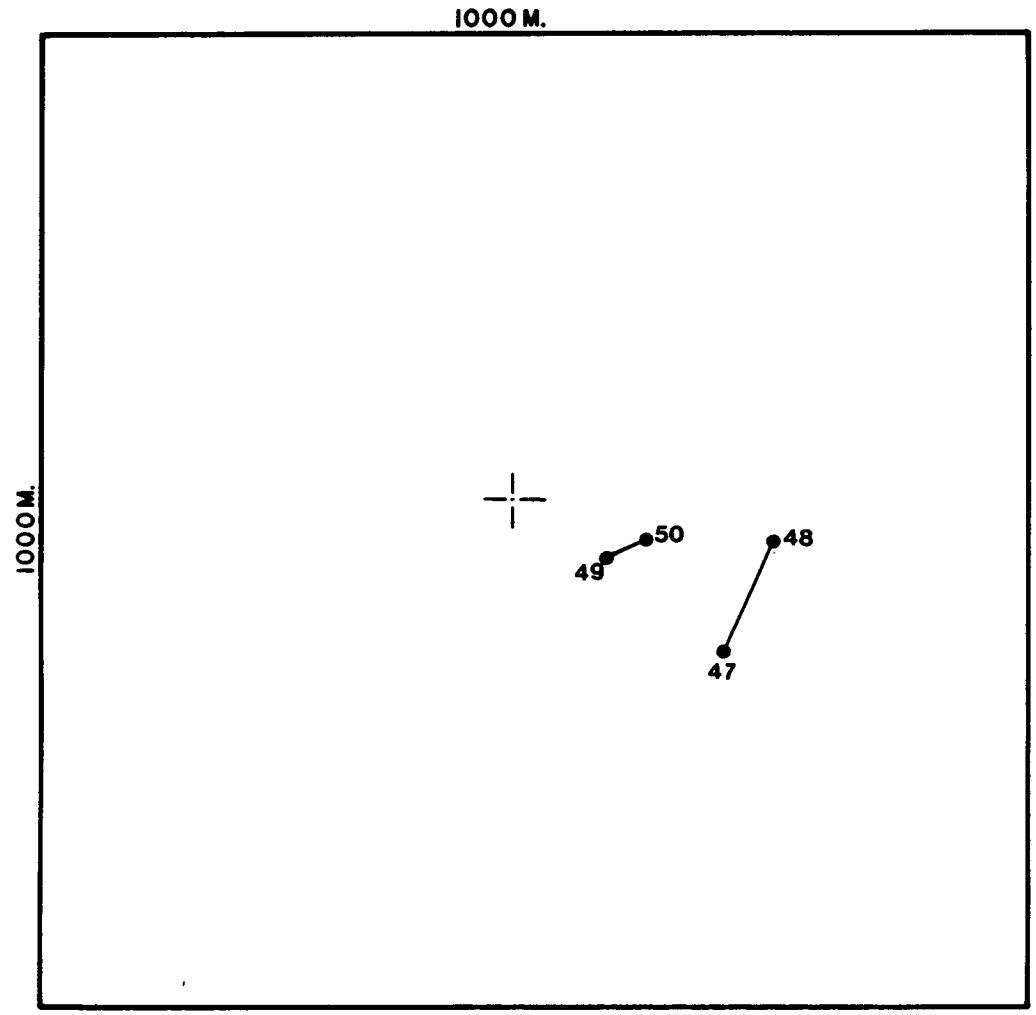

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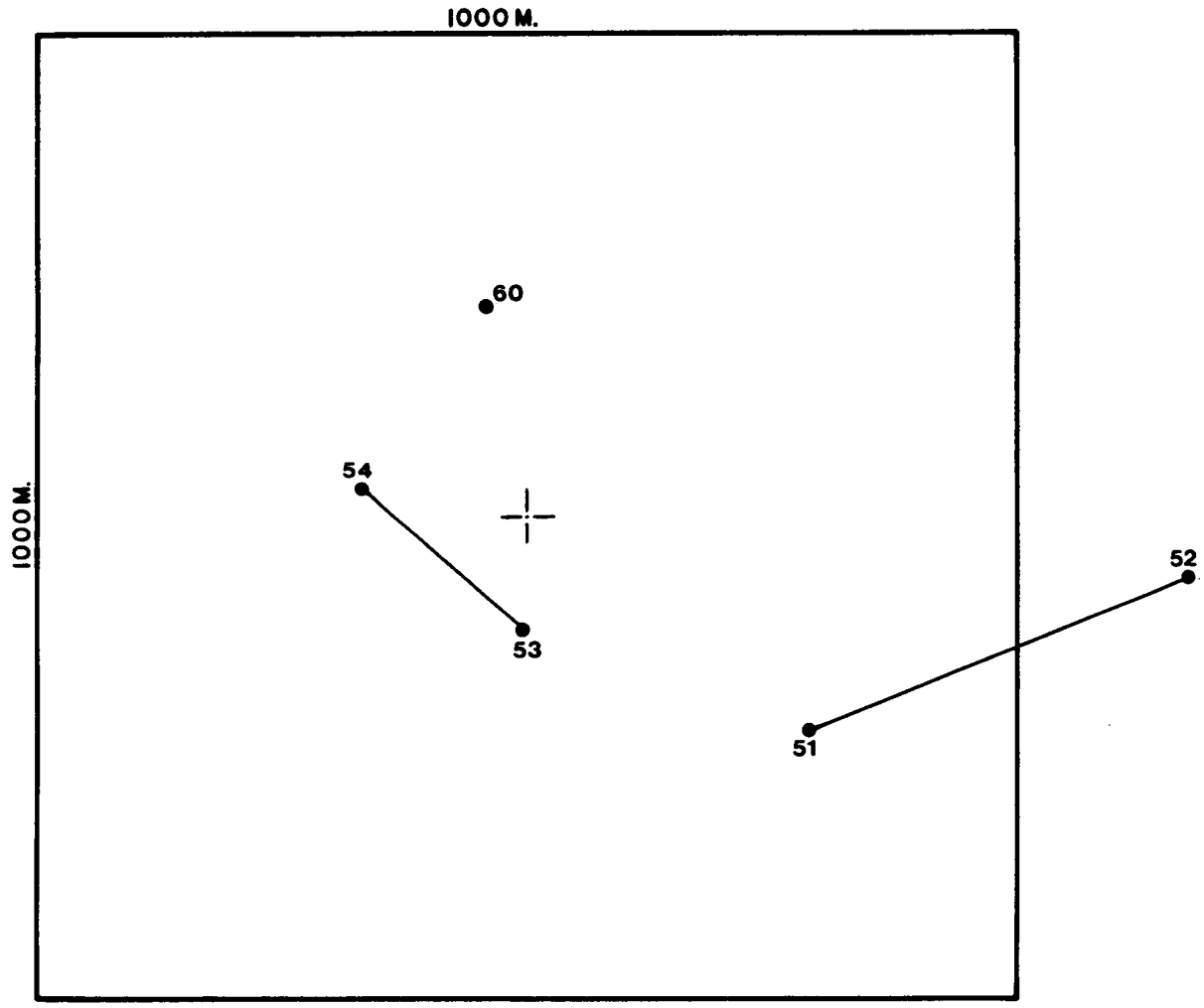
48	END PHOTOMETER PROFILE
49	BEGIN HYDROLAB PROFILE
49	HYDROCAST
50	END HYDROLAB PROFILE

= LAT. 26°45.77'
LONG. 82°43.11'

STATION 1- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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53	BEGIN HYDROLAB PROFILE
54	END HYDROLAB PROFILE
54	HYDROCAST A
60	HYDROCAST B

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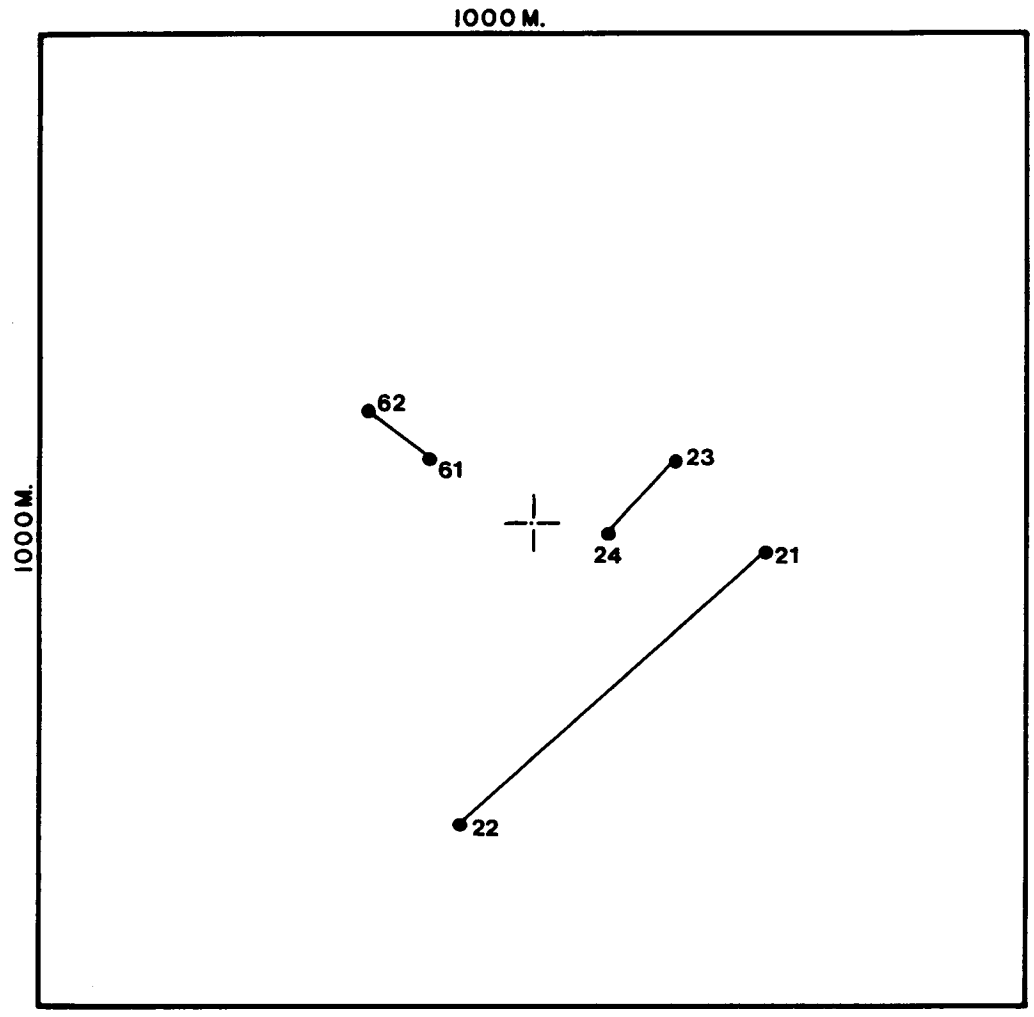
STATION 2- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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22	HYDROCAST
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24	END TRANSMISSOMETER PROFILE
61	BEGIN PHOTOMETER PROFILE
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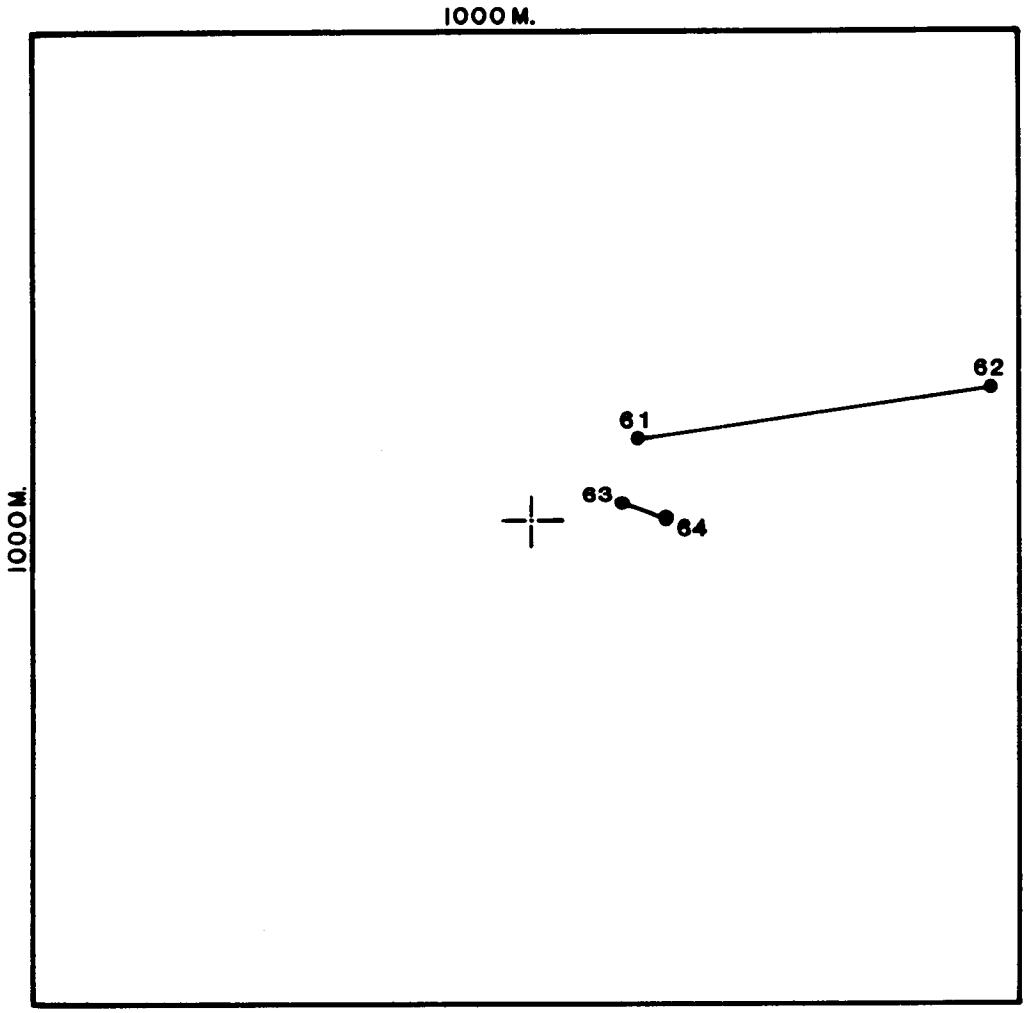
STATION 3- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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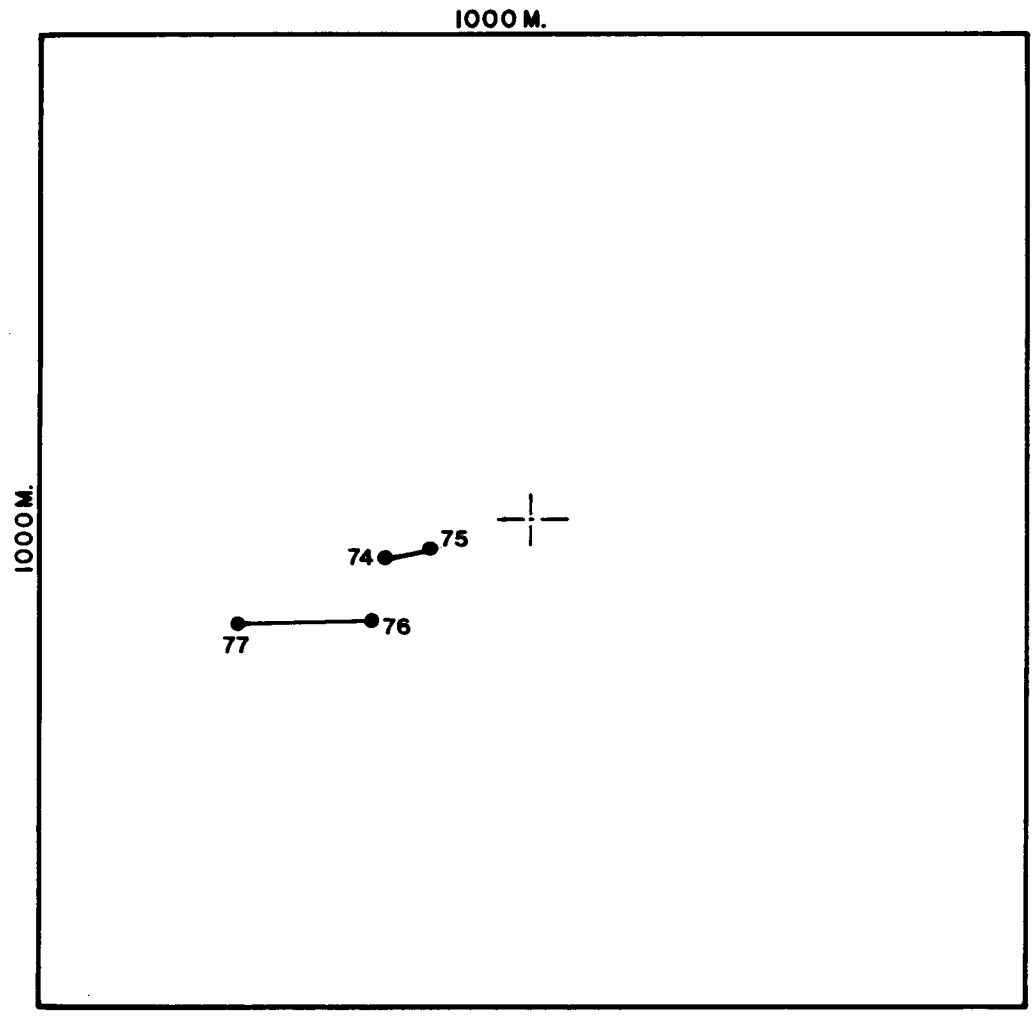
STATION 4- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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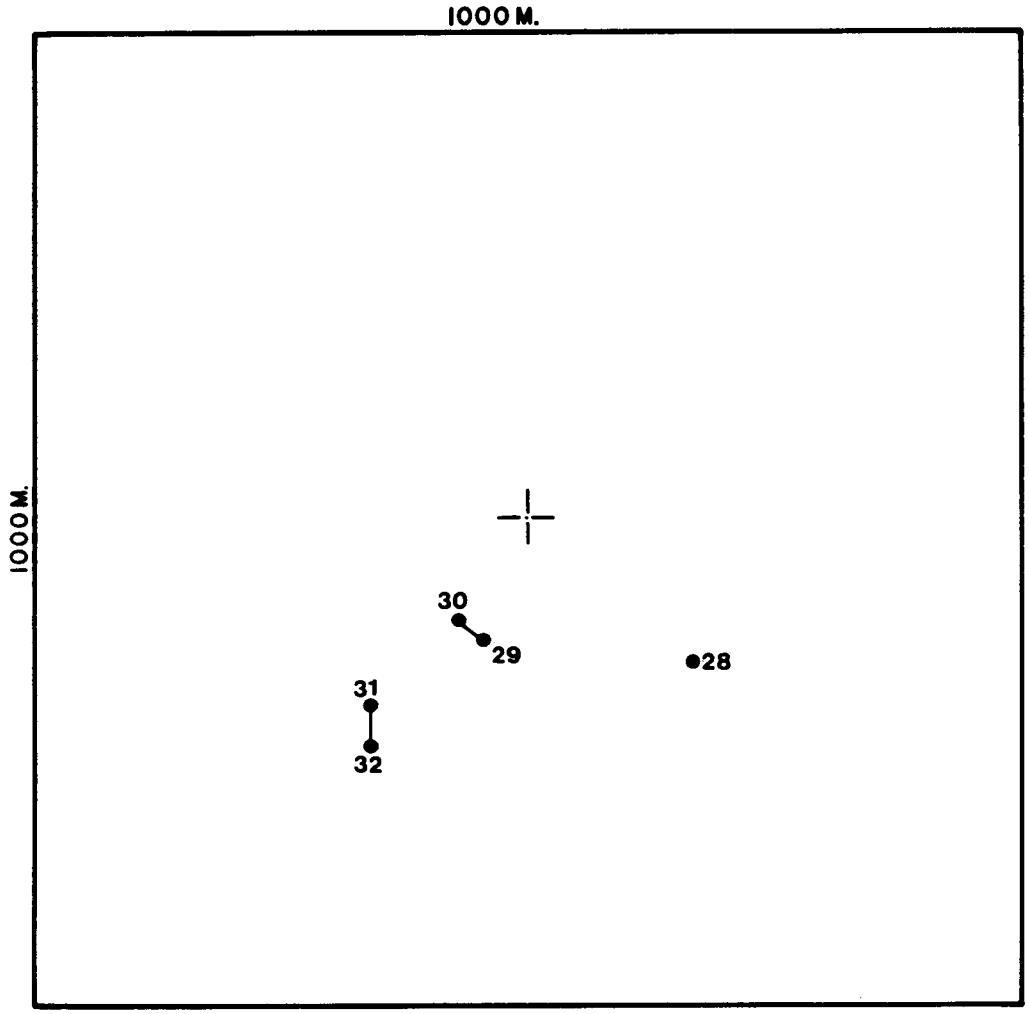
STATION 5- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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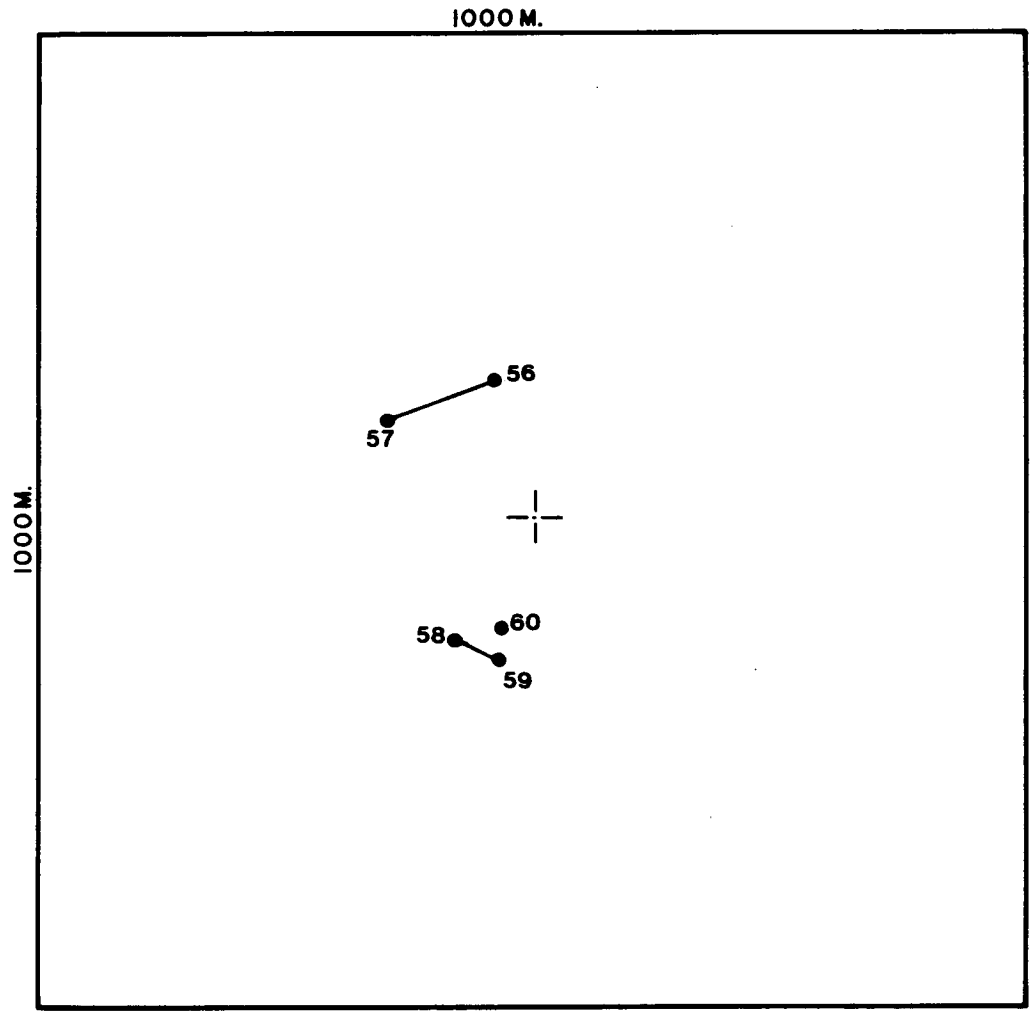
LONG. 82°38.35'

STATION 6- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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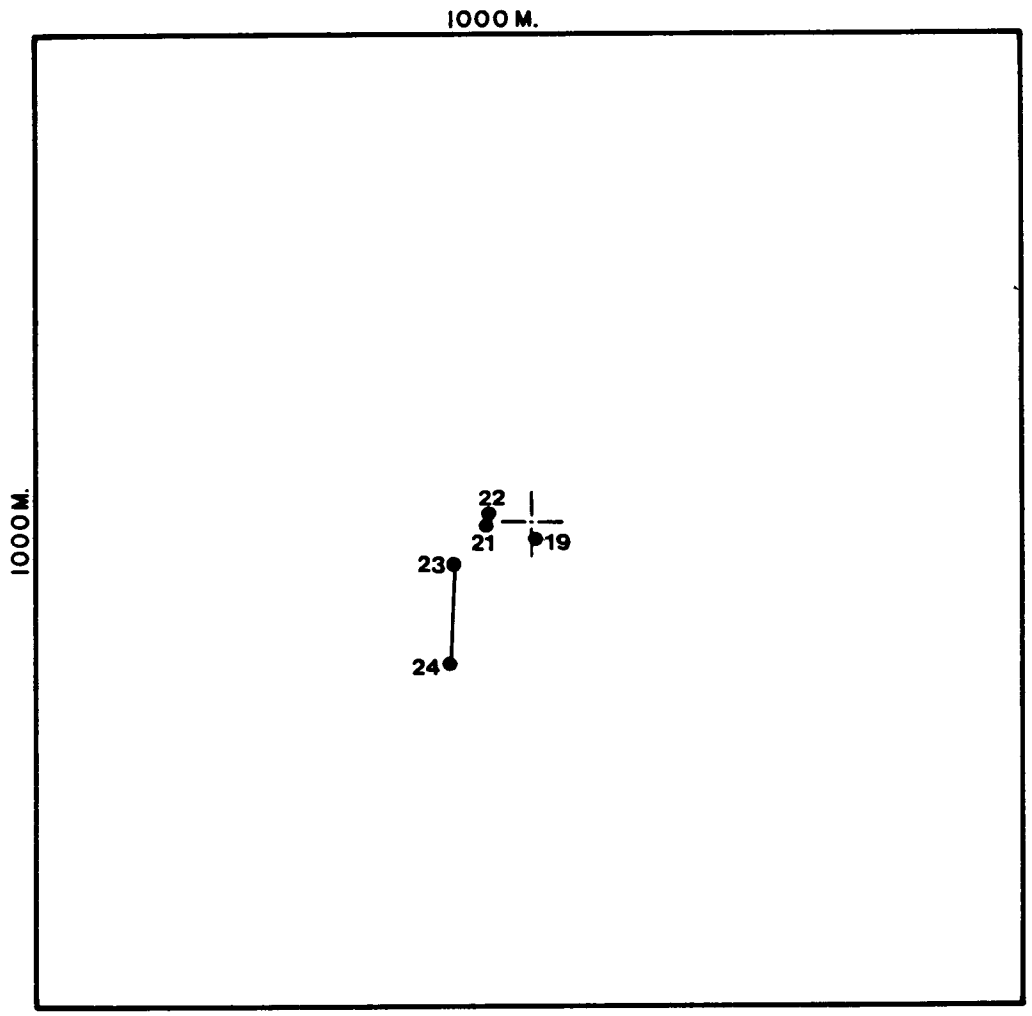
STATION 7- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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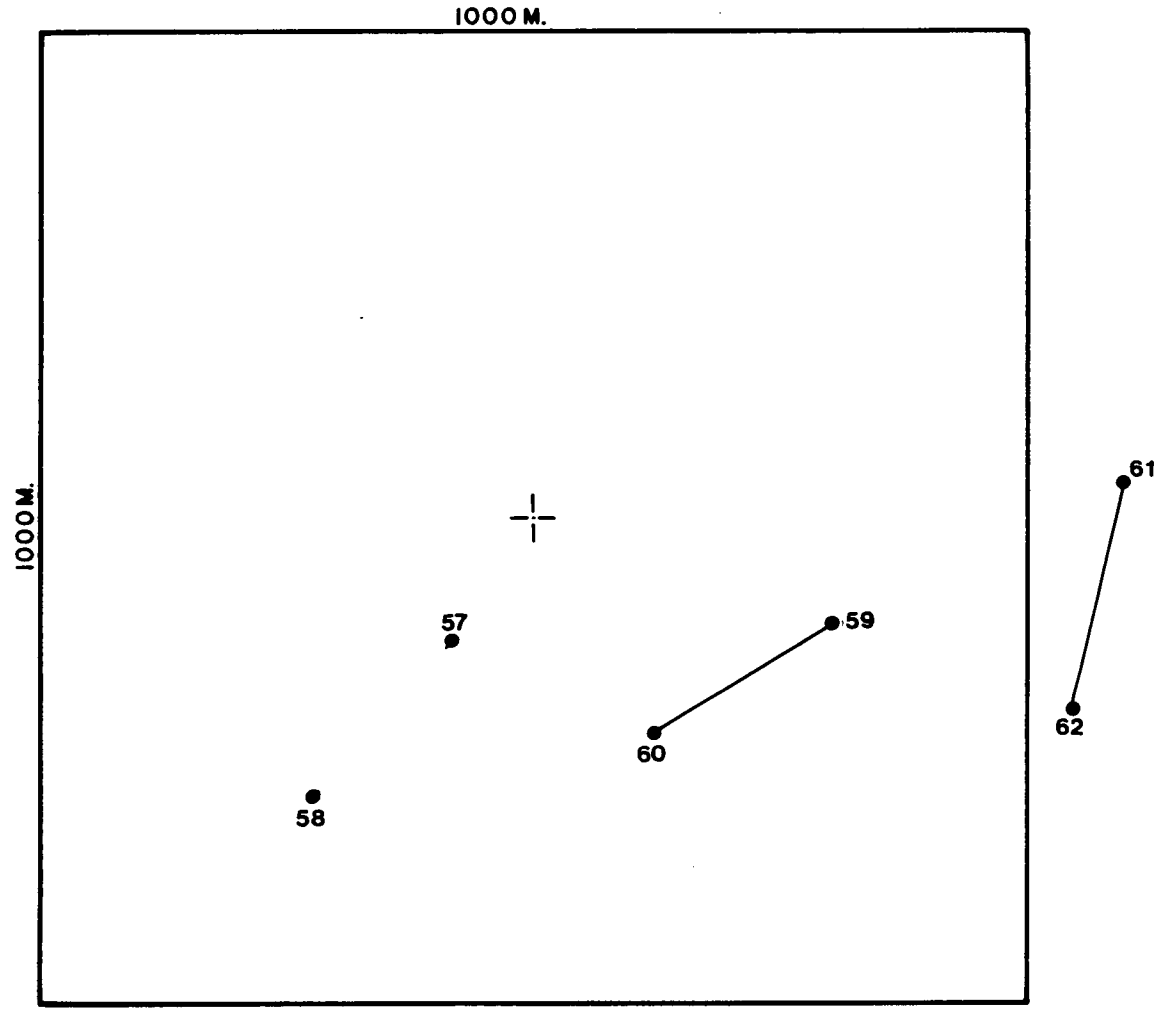
STATION 8- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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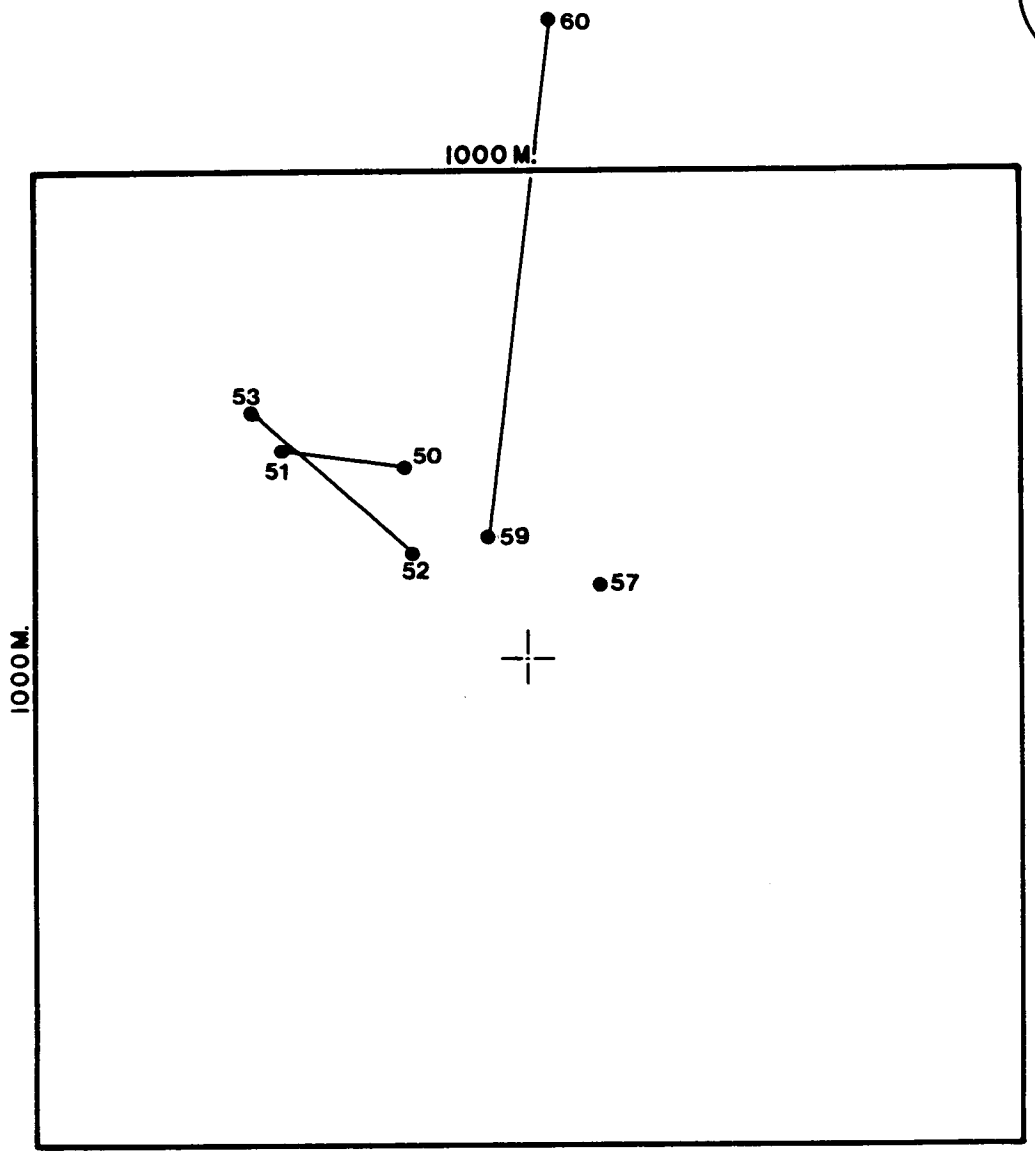
58	HYDROCAST B	61	BEGIN TRANSMISSOMETER PROFILE
59	BEGIN HYDROLAB PROFILE	62	END TRANSMISSOMETER PROFILE

= LAT. 26°16.83′
LONG. 83°23.81′

STATION 9- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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60	END HYDROLAB PROFILE

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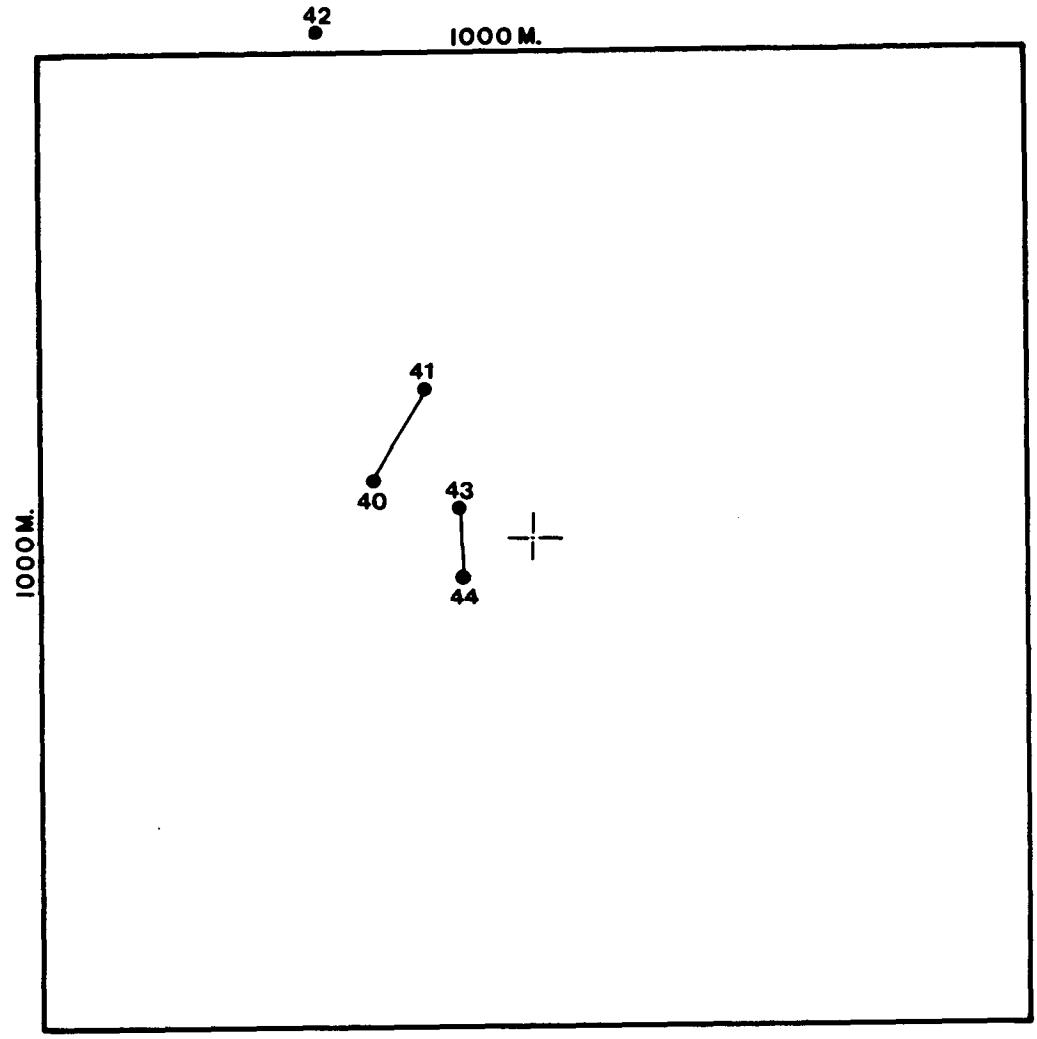
STATION 10- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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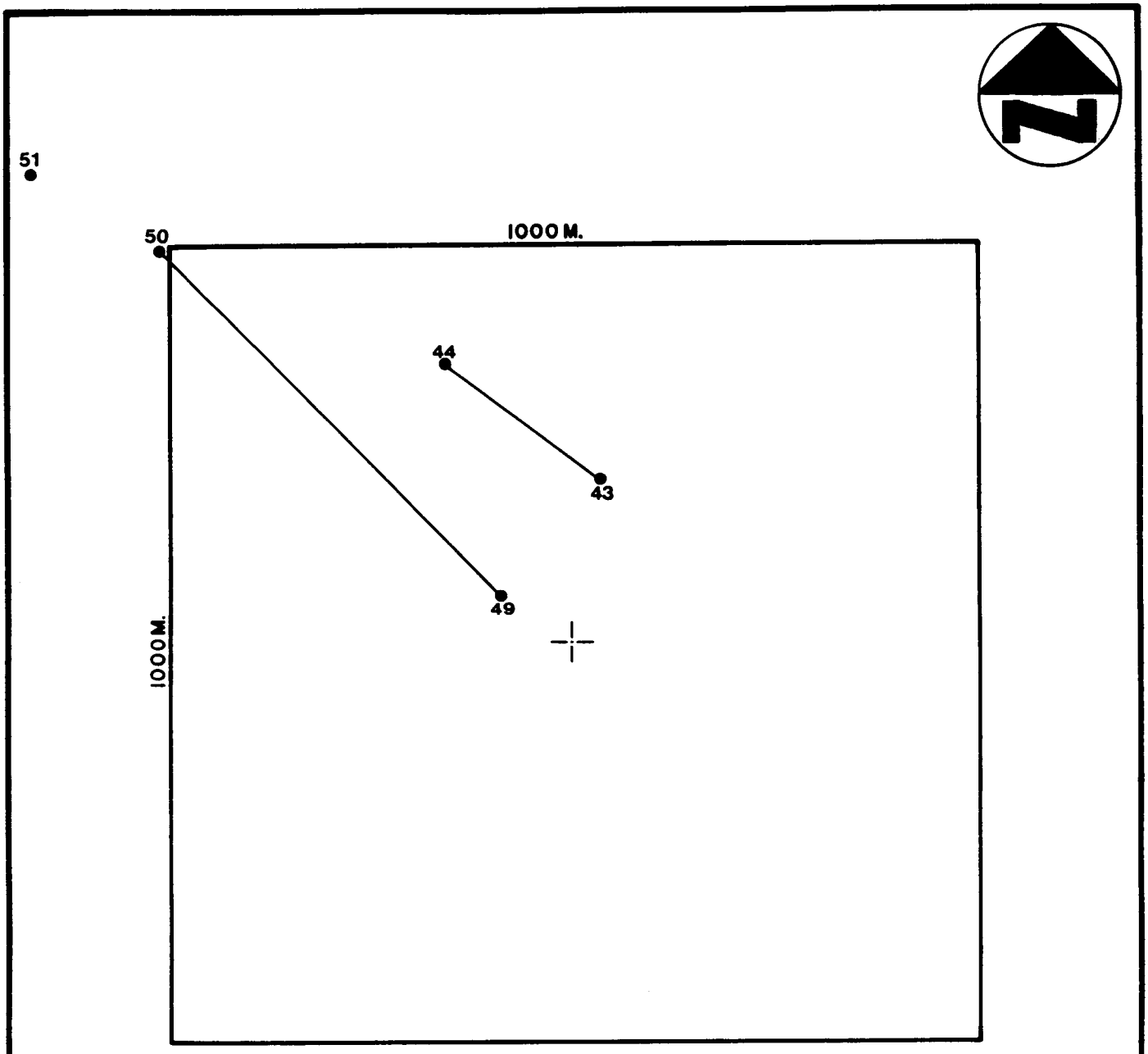
STATION 11- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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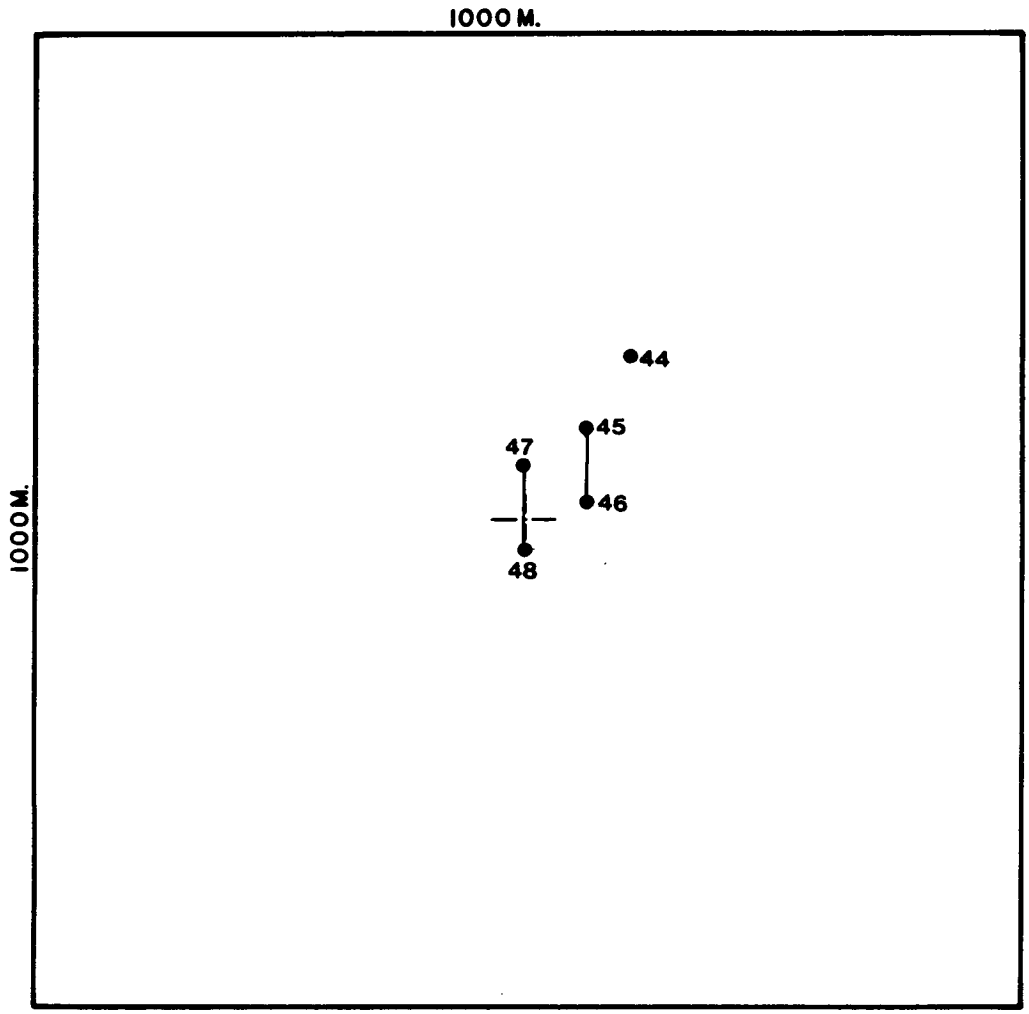
50	END HYDROLAB PROFILE
50	HYDROCAST A
51	HYDROCAST B

= LAT. 26°16.72′
LONG. 83°47.67′

STATION 12- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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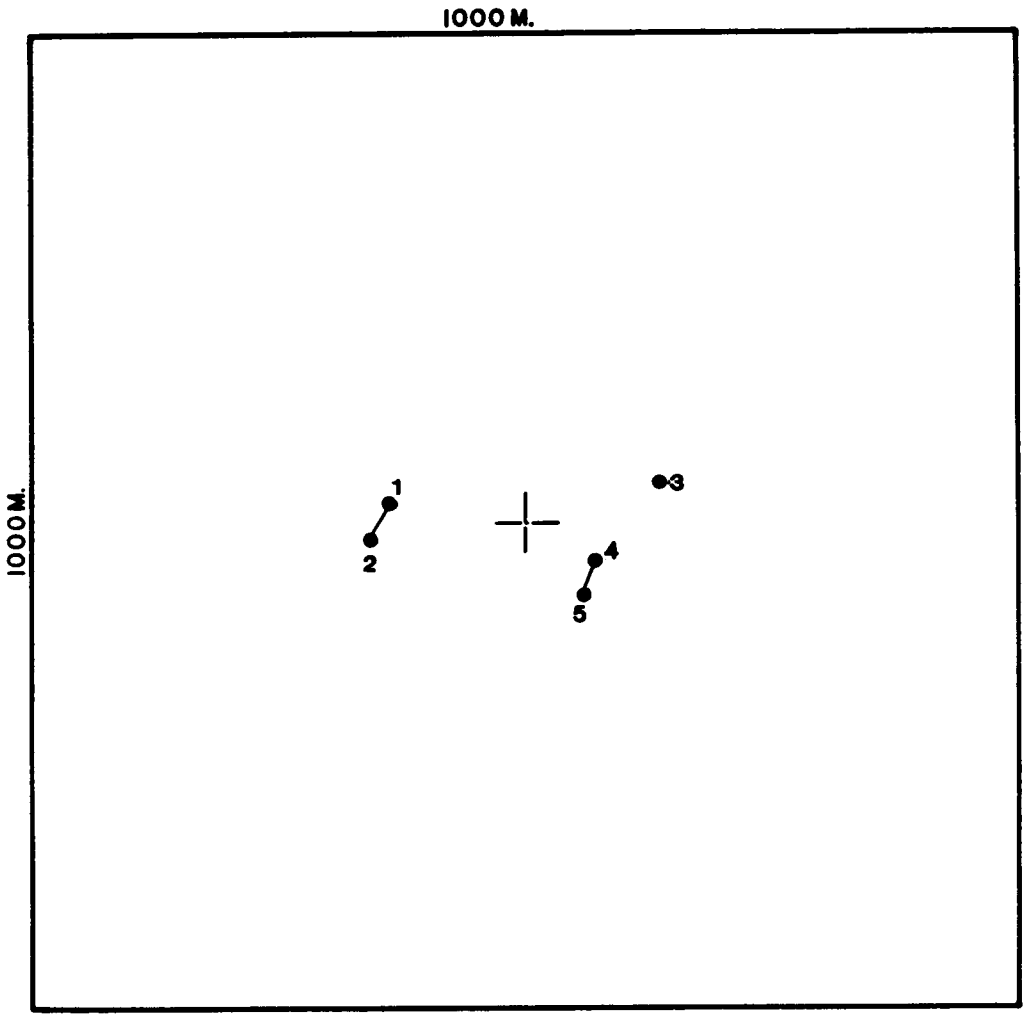
STATION 13- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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2	END PHOTOMETER PROFILE
3	HYDROCAST
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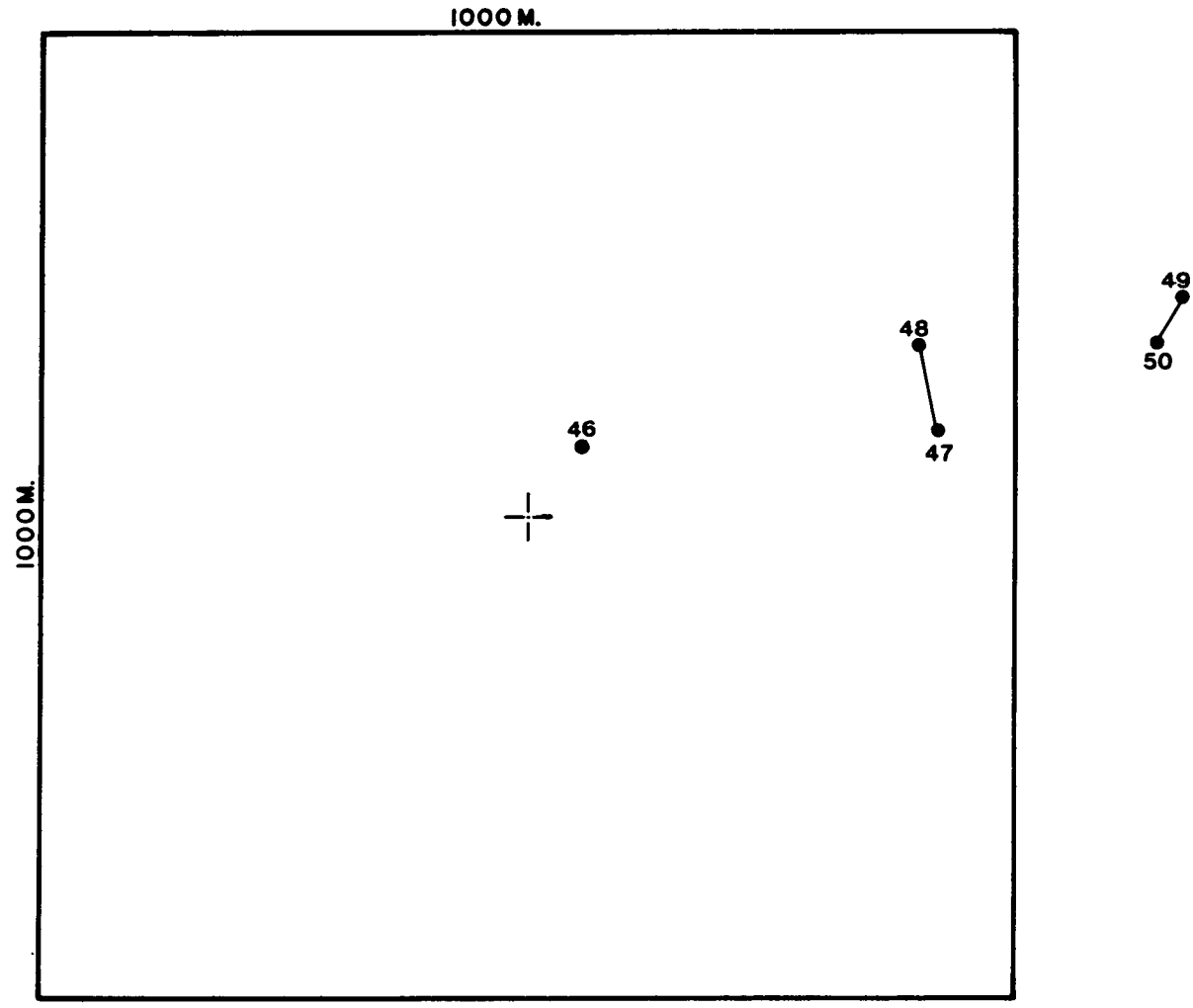
LONG. 82°23.82'

STATION 14- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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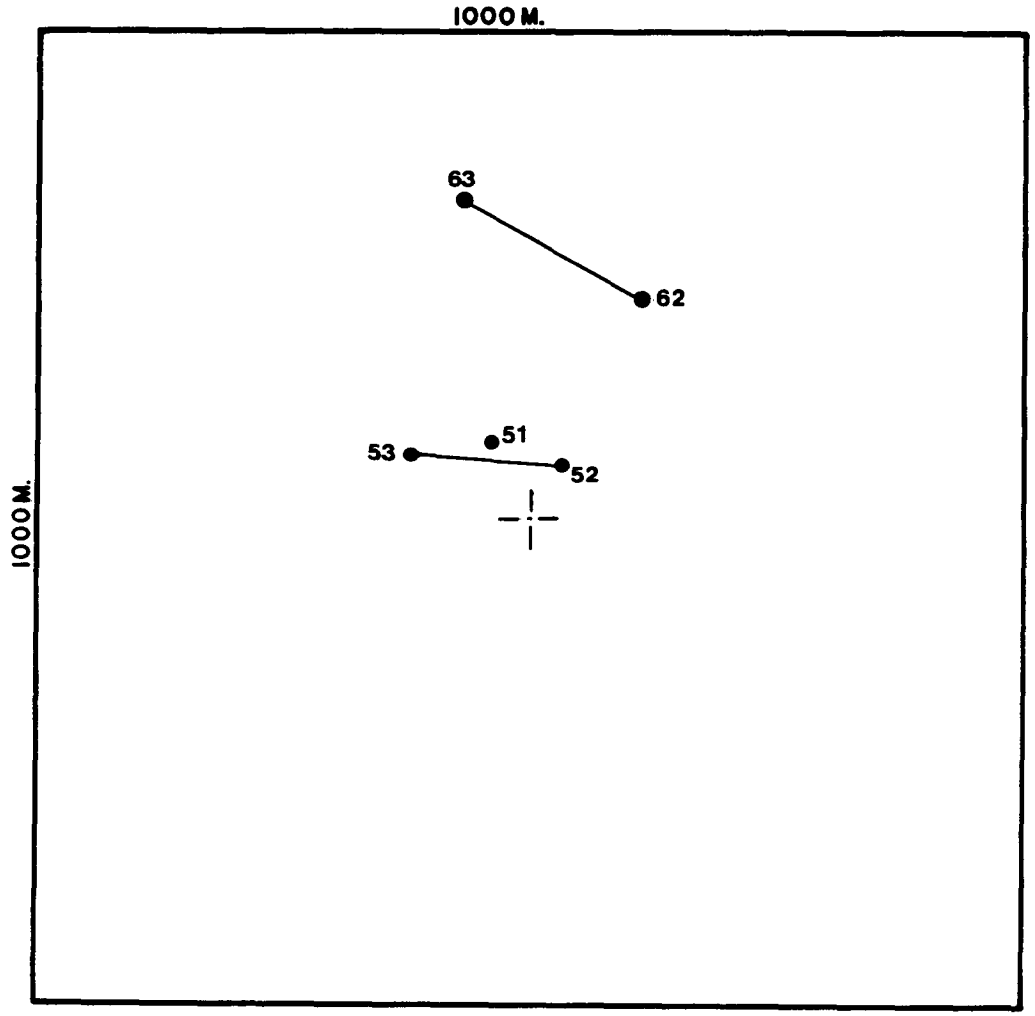
LONG. 82°31.62'

STATION 15- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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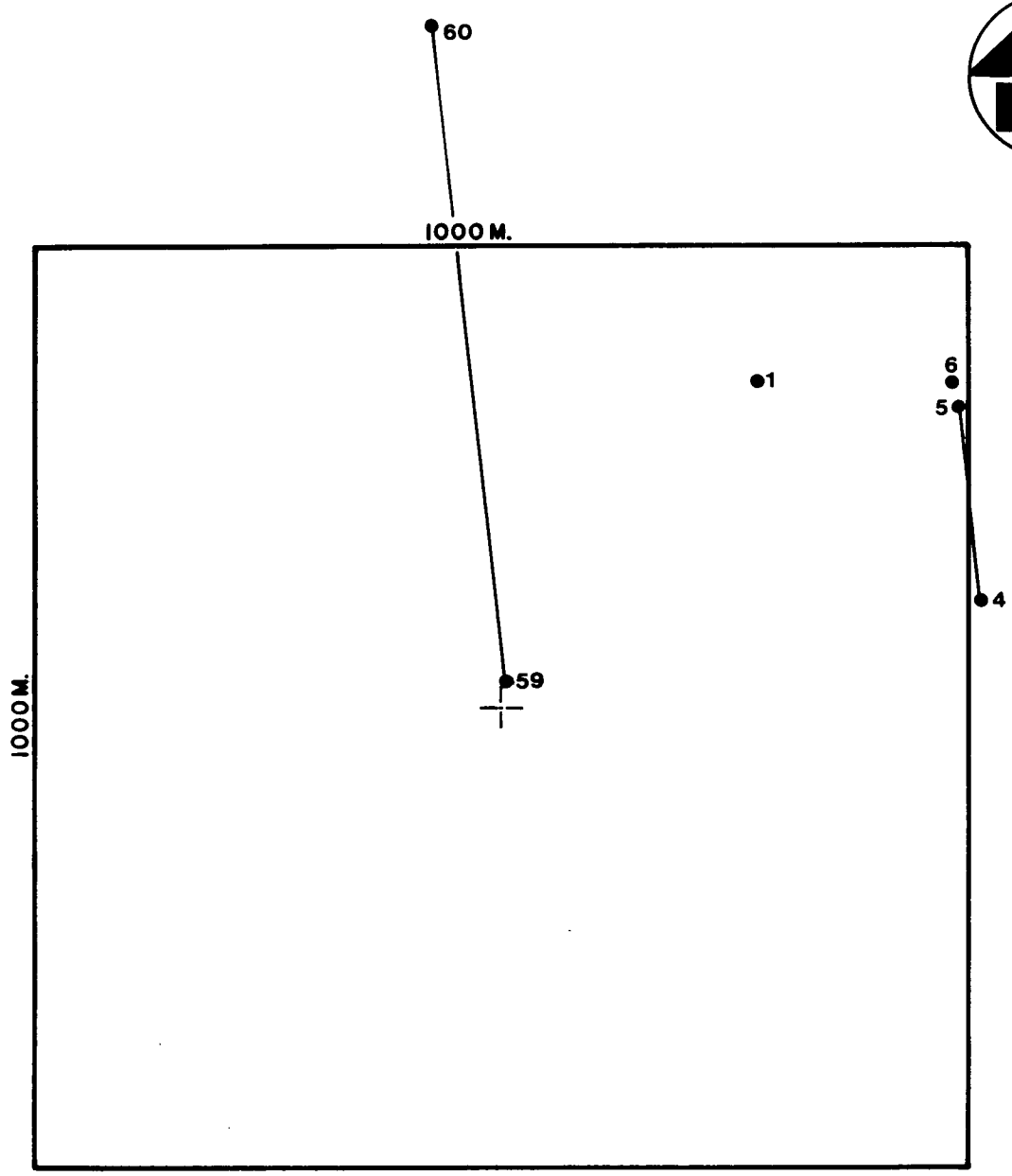
= LAT. 25°45.70'
LONG. 83°11.07'

STATION 16- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE III



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FIXMARK	EVENT
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6	HYDROCAST B
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59	BEGIN PHOTOMETER PROFILE
60	END TRANSMISSOMETER PROFILE
60	END PHOTOMETER PROFILE

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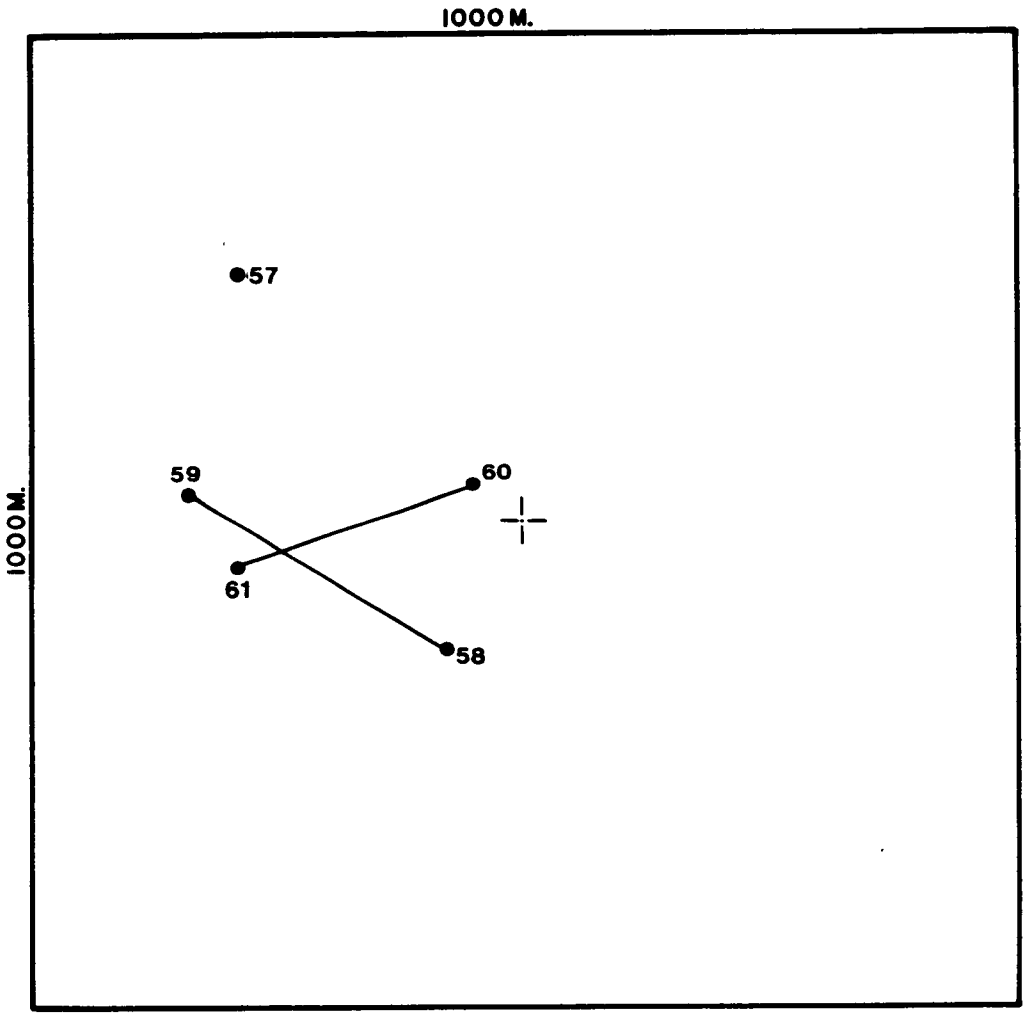
LONG. 83°20.24'

STATION 17- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



LEGEND

FIXMARK	EVENT
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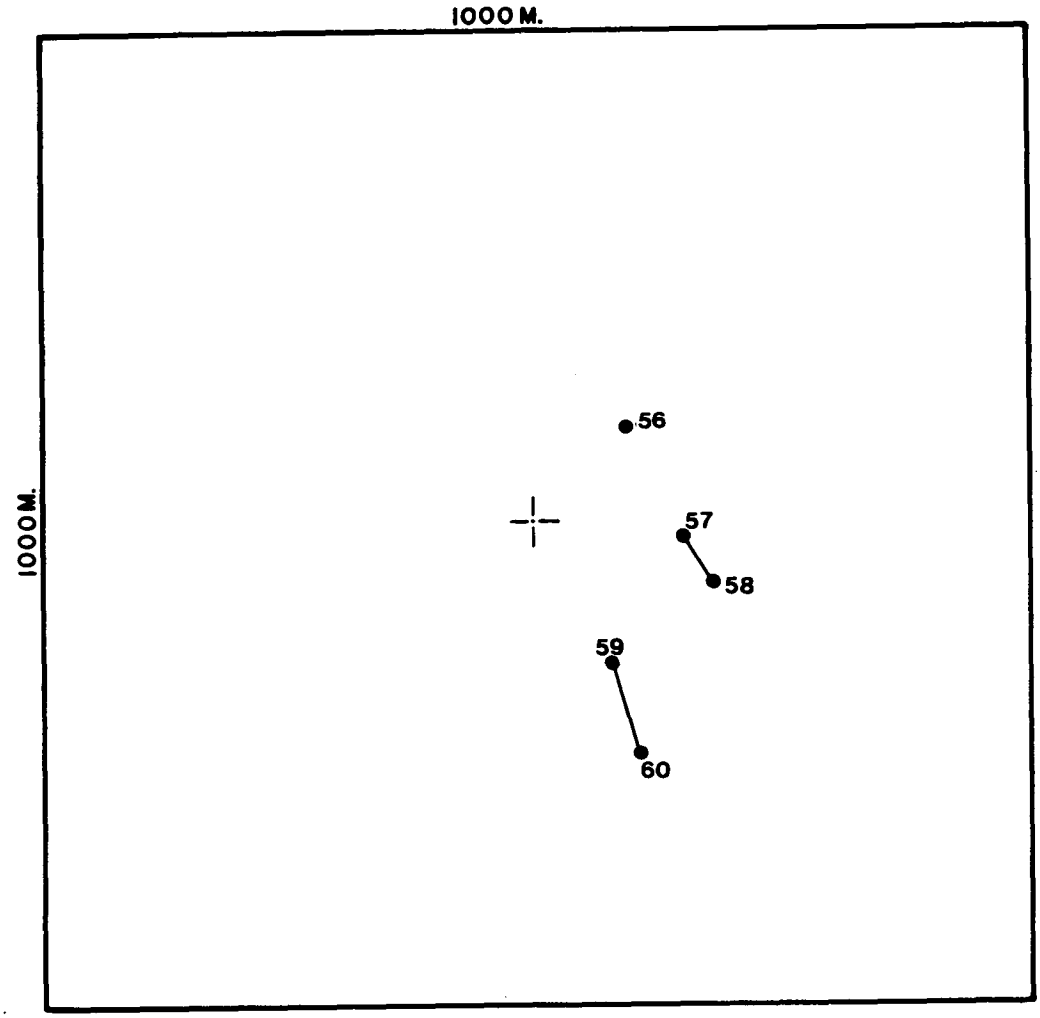
59	END HYDROLAB PROFILE
60	BEGIN TRANSMISSOMETER PROFILE
61	END TRANSMISSOMETER PROFILE

= LAT. 25°45.37′
LONG. 83°42.22′

STATION 18- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



LEGEND

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59	BEGIN TRANSMISSOMETER PROFILE
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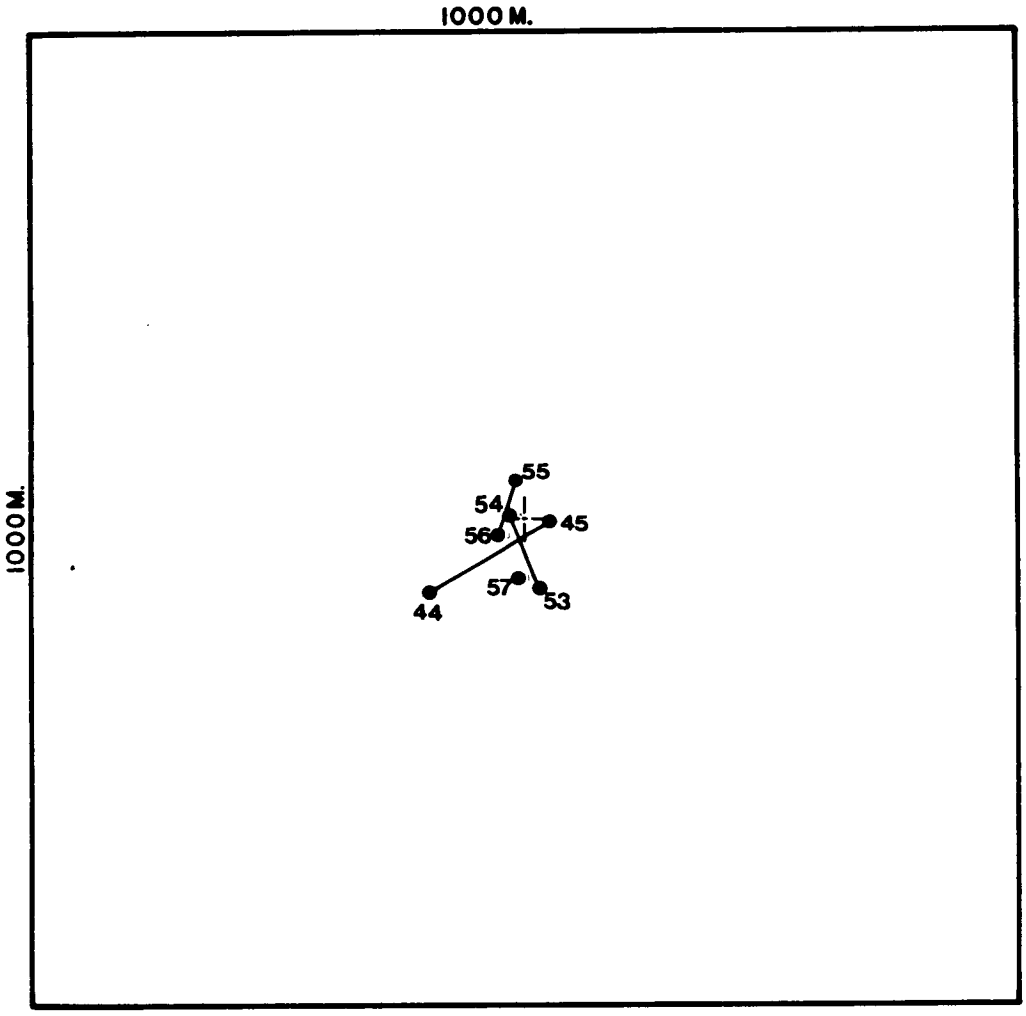
LONG. 82°09.00'

STATION 19- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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54	END TRANSMISSOMETER PROFILE
55	BEGIN HYDROLAB PROFILE
56	END HYDROLAB PROFILE
57	HYDROCAST

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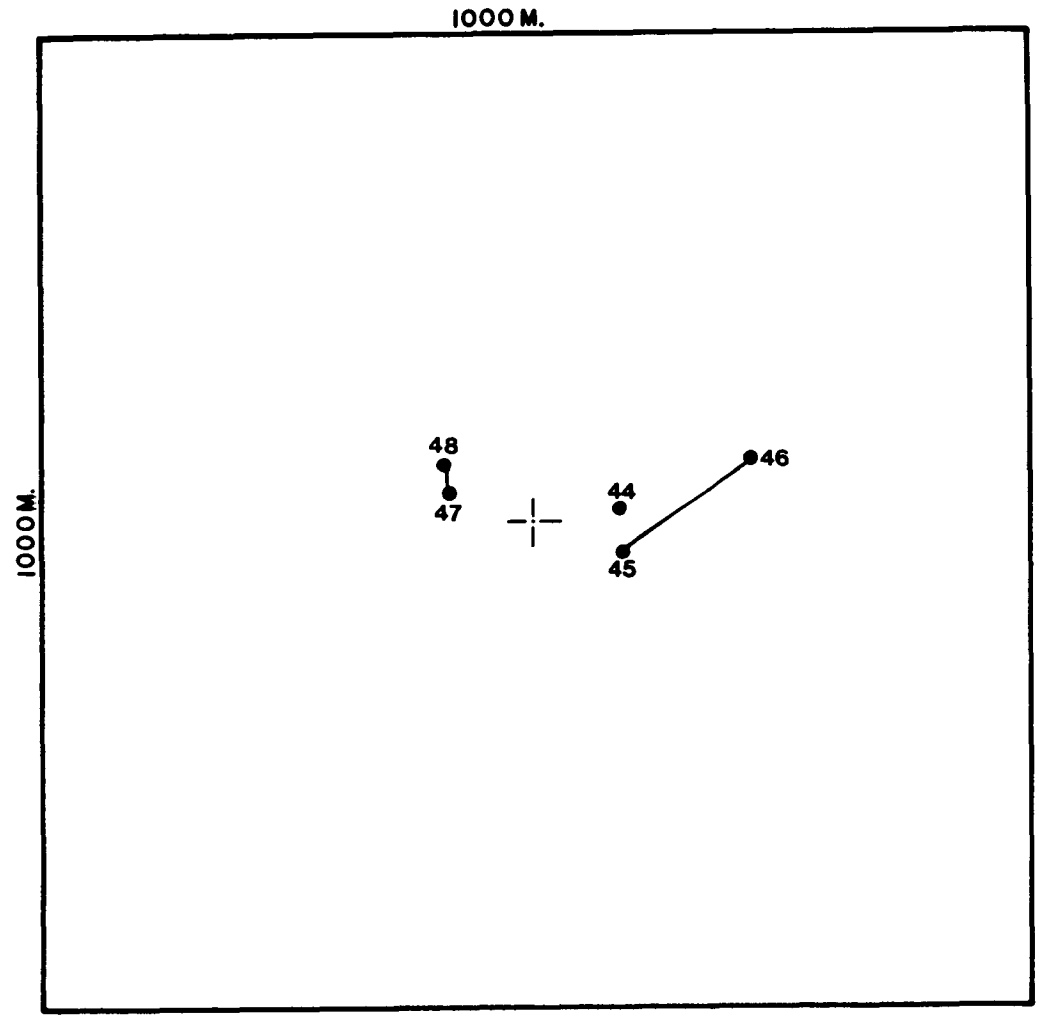
LONG. 82°09.73'

STATION 20- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



LEGEND

FIXMARK	EVENT
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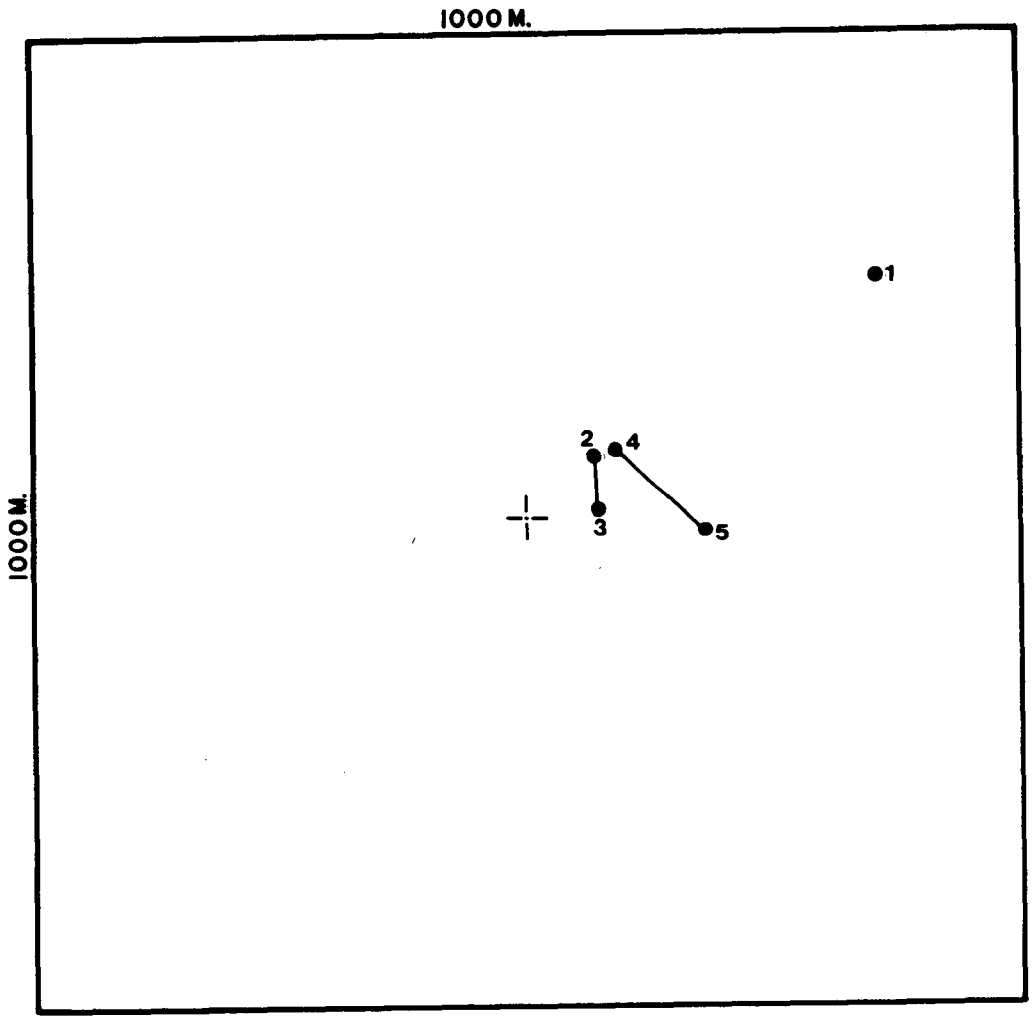
46	END HYDROLAB PROFILE
47	BEGIN TRANSMISSOMETER PROFILE
48	END TRANSMISSOMETER PROFILE

= LAT. 25°17.26'
LONG. 82°52.16'

STATION 21- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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FIXMARK	EVENT
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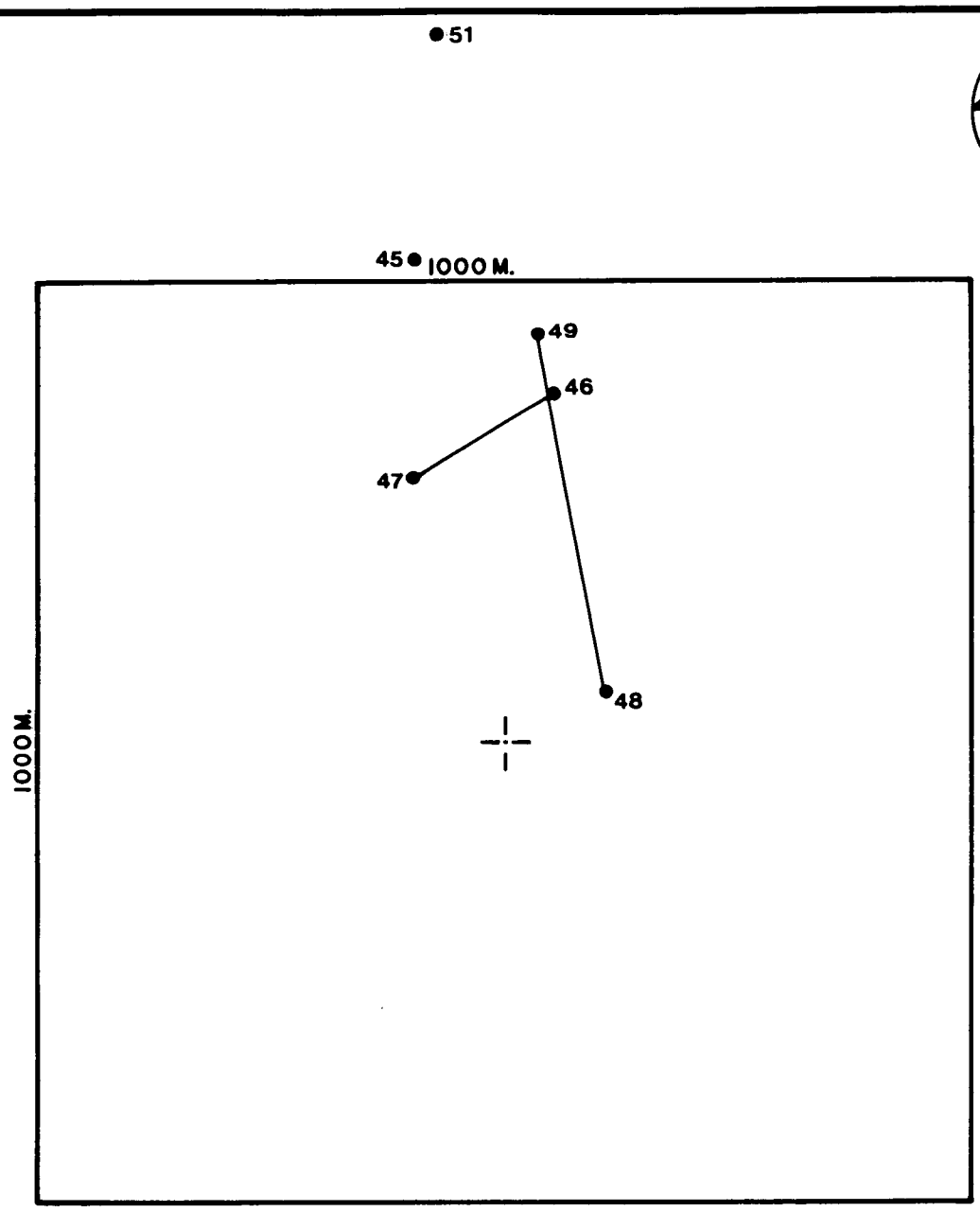
3	END TRANSMISSOMETER PROFILE
4	BEGIN HYDROLAB PROFILE
5	END HYDROLAB PROFILE

= LAT. 25°17.18'
LONG. 83°02.07'

STATION 22- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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FIXMARK	EVENT
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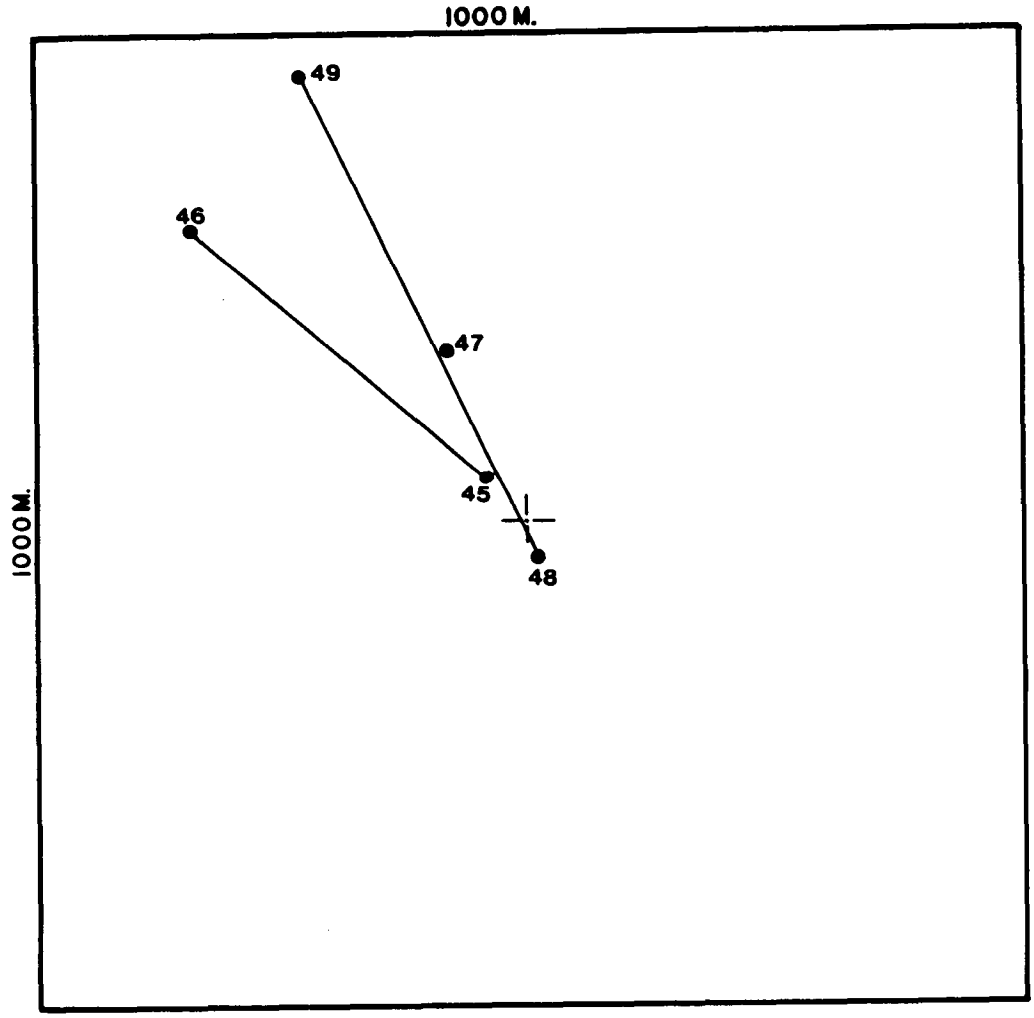
48	BEGIN TRANSMISSOMETER PROFILE
49	END TRANSMISSOMETER PROFILE
51	HYDROCAST B

= LAT. 25°16.89'
LONG. 83°37.79'

STATION 23- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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FIXMARK	EVENT
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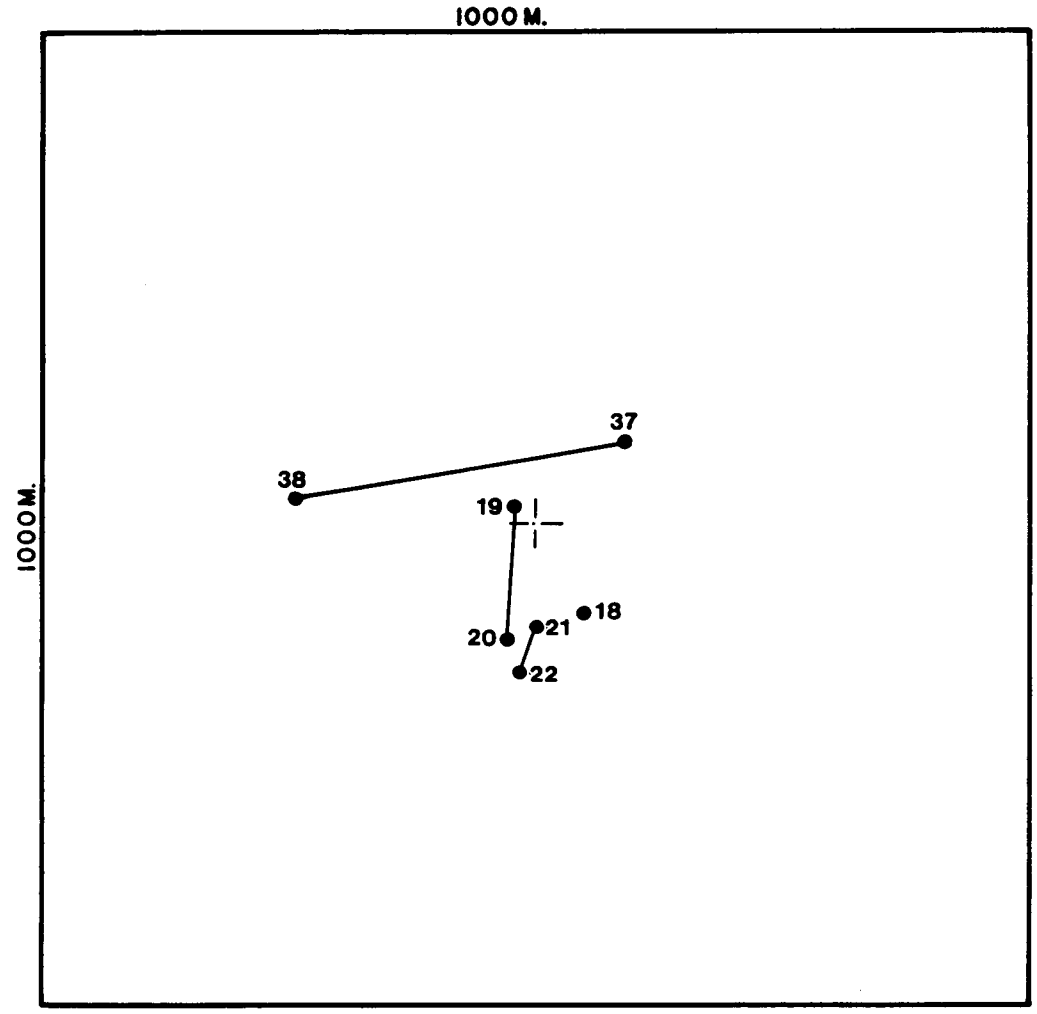
46	END TRANSMISSOMETER PROFILE
46	END PHOTOMETER PROFILE
47	HYDROCAST
48	BEGIN HYDROLAB PROFILE
49	END HYDROLAB PROFILE

= LAT. 25°16.90'
LONG. 83°43.18'

STATION 24- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



LEGEND

FIXMARK	EVENT
18	HYDROCAST
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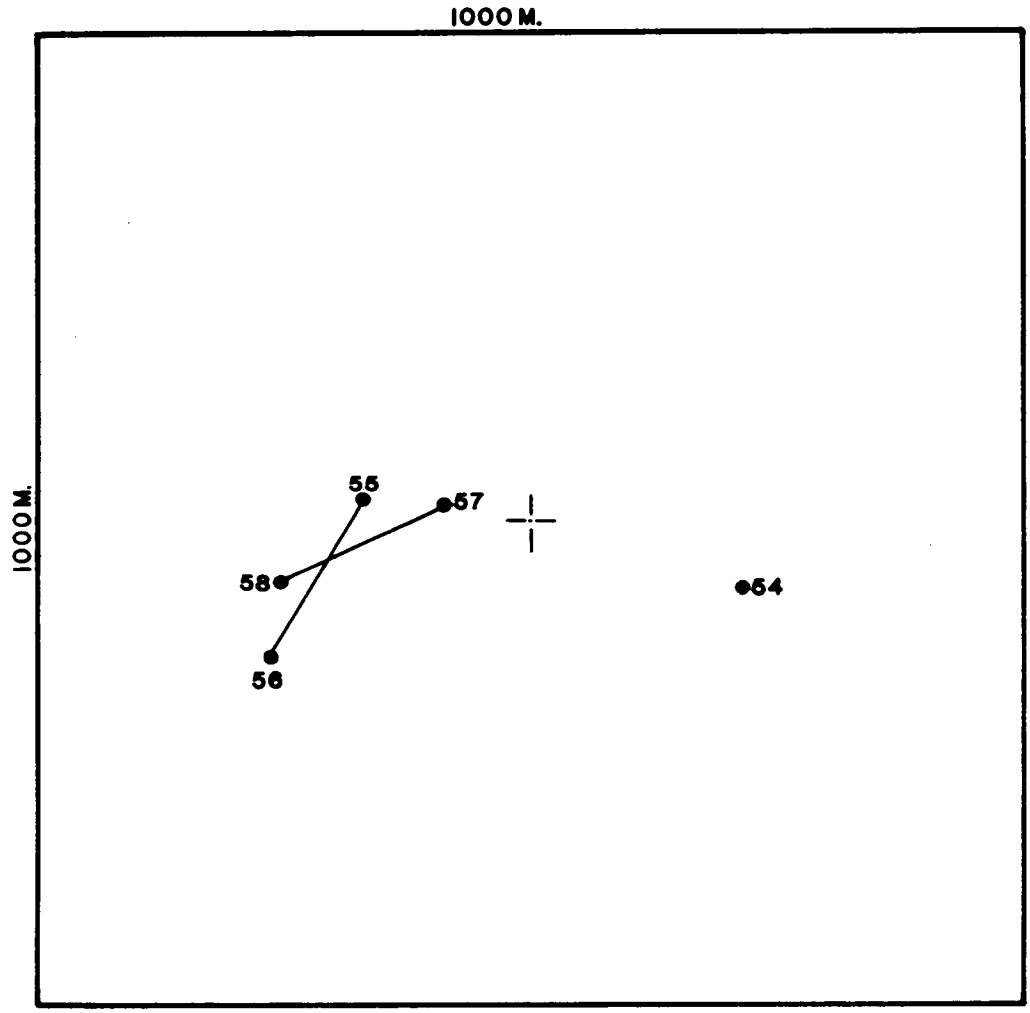
20	END HYDROLAB PROFILE
21	BEGIN TRANSMISSOMETER PROFILE
22	END TRANSMISSOMETER PROFILE
37	BEGIN PHOTOMETER PROFILE
38	END PHOTOMETER PROFILE

= LAT. 24°47.95'
LONG. 82°13.26'

STATION 25- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE III



LEGEND

FIXMARK	EVENT
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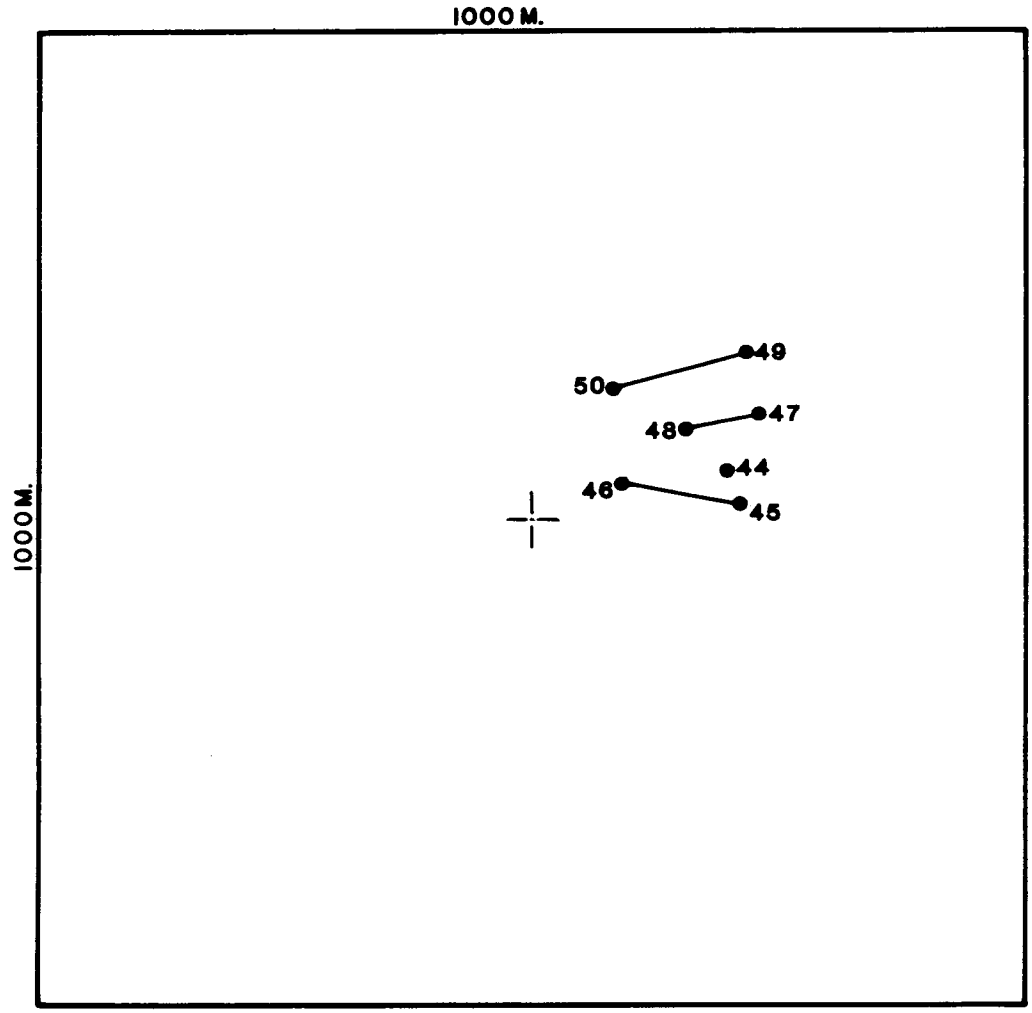
55	BEGIN HYDROLAB PROFILE
56	END HYDROLAB PROFILE
57	BEGIN TRANSMISSOMETER PROFILE
58	END TRANSMISSOMETER PROFILE

= LAT. 24°47.82′
LONG. 82°52.07′

STATION 26- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE III



LEGEND

FIXMARK	EVENT
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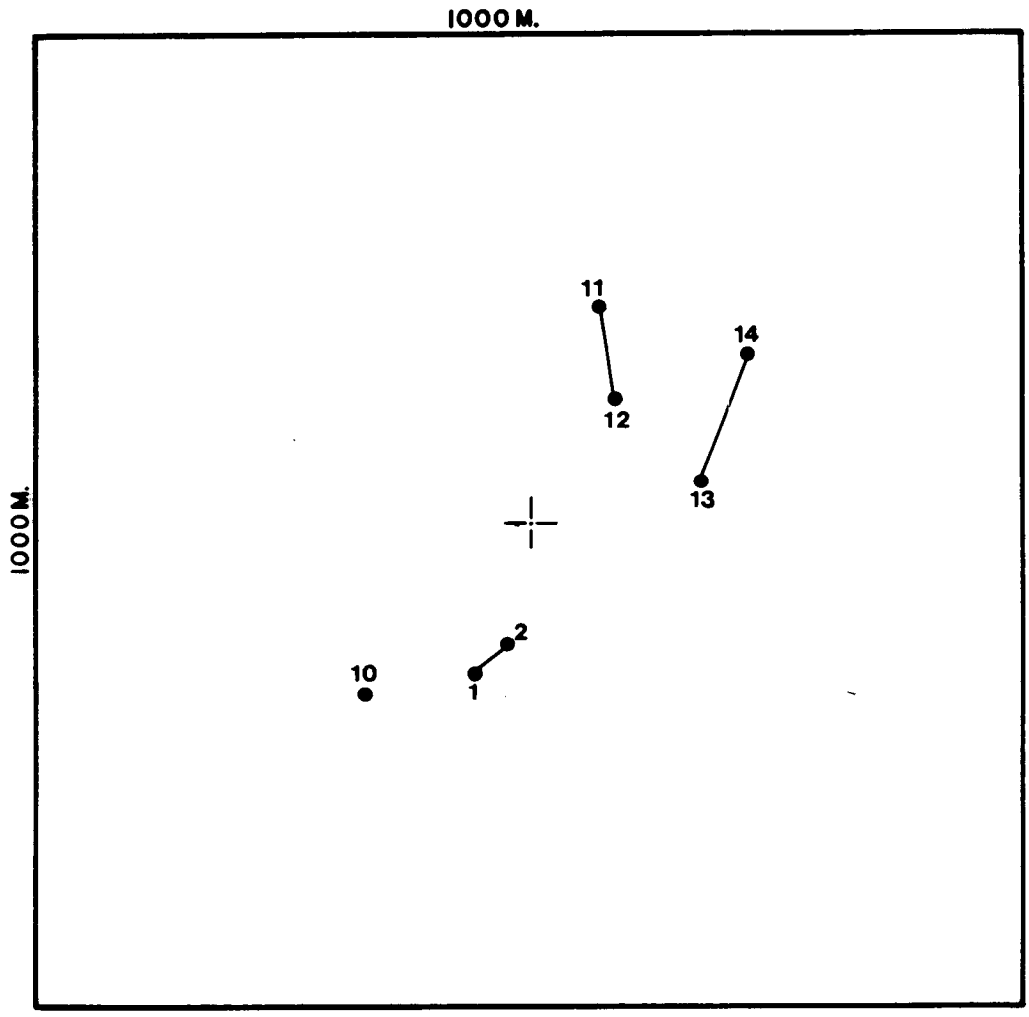
46	END HYDROLAB PROFILE
47	BEGIN TRANSMISSOMETER PROFILE
48	END TRANSMISSOMETER PROFILE
49	BEGIN PHOTOMETER PROFILE
50	END PHOTOMETER PROFILE

= LAT. 24°47.76'
LONG. 83°08.01'

STATION 27- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE III



LEGEND

FIXMARK	EVENT
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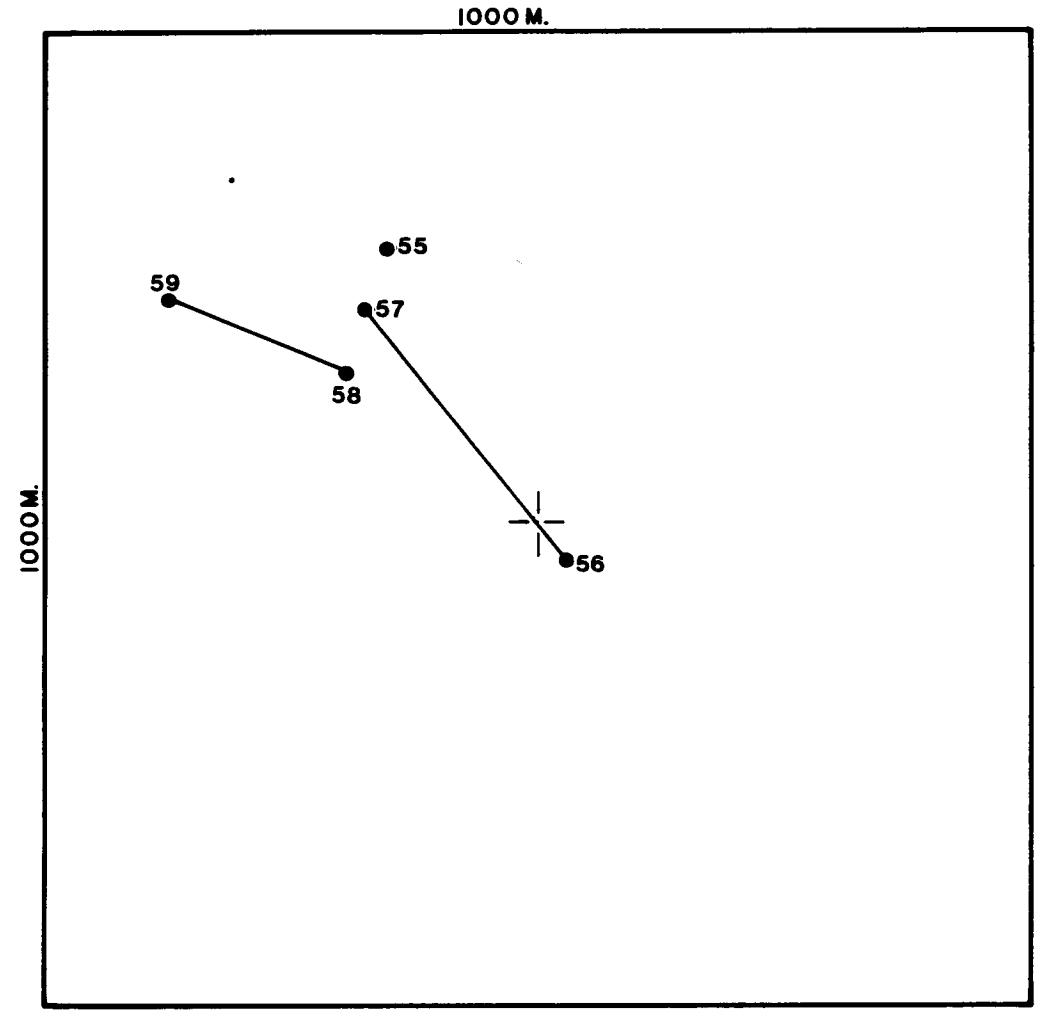
2	END PHOTOMETER PROFILE
10	HYDROCAST
11	BEGIN HYDROLAB PROFILE
12	END HYDROLAB PROFILE
13	BEGIN TRANSMISSOMETER PROFILE
14	END TRANSMISSOMETER PROFILE

= LAT. 24°47.11'
LONG. 83°13.08'

STATION 28- WATER COLUMN DATA AND SAMPLE LOCATIONS- CRUISE III



LEGEND

FIXMARK	EVENT
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58	BEGIN TRANSMISSOMETER PROFILE
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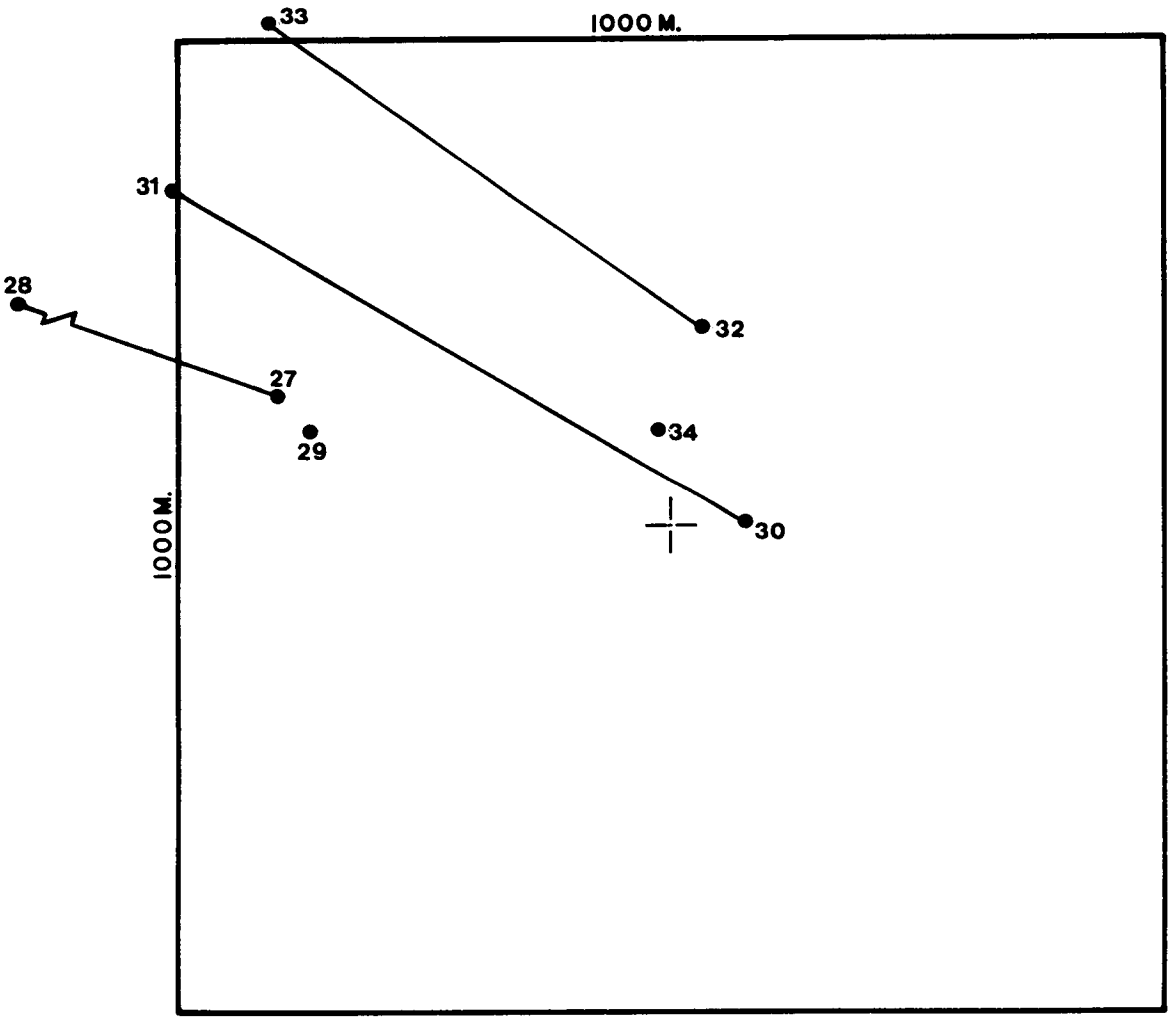
LONG. 83°41.19'

STATION 29- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III



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FIXMARK	EVENT
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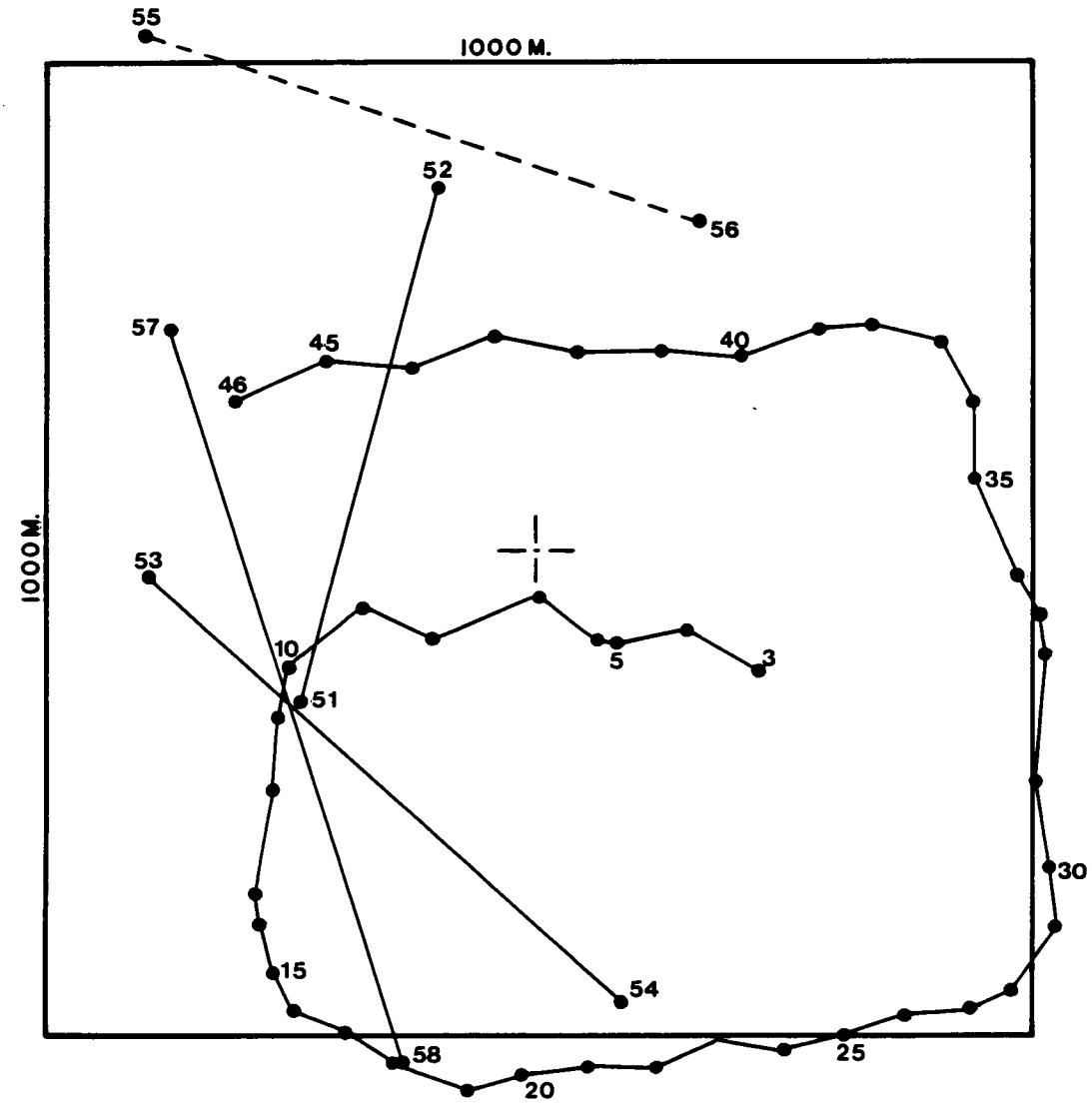
29	HYDROCAST A
30	BEGIN HYDROLAB PROFILE
31	END HYDROLAB PROFILE
32	BEGIN TRANSMISSOMETER PROFILE
33	END TRANSMISSOMETER PROFILE
34	HYDROCAST B

= LAT. 24°47.41′
LONG. 83°51.15′

STATION 30- WATER COLUMN DATA AND SAMPLE LOCATIONS-CRUISE III

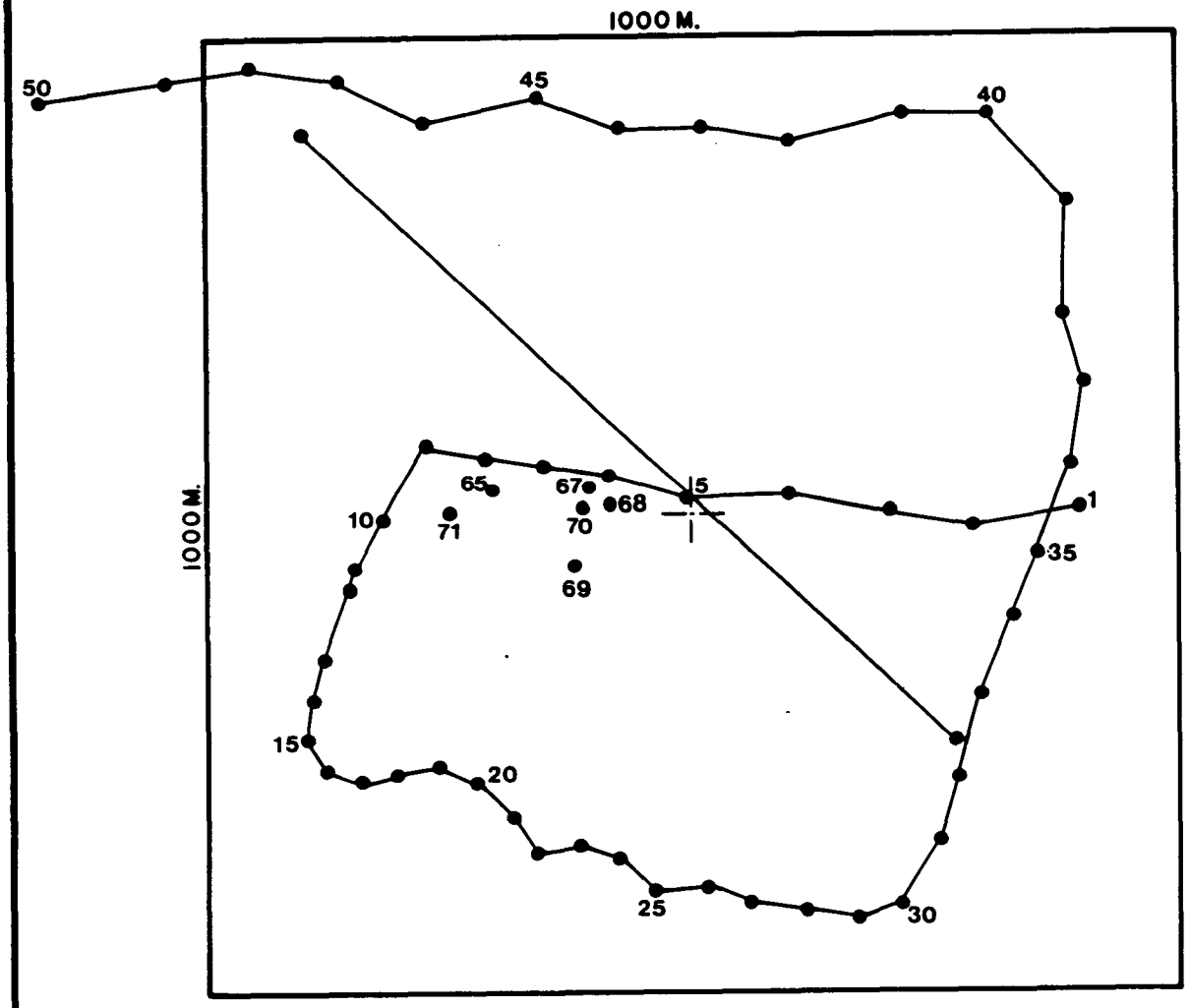


LEGEND

FIXMARK	EVENT
3-46	TV/STILL CAMERA LINE
51/52	DREDGE A
53/54	DREDGE B
55/56	DREDGE C
57/58	TRAWL

= LAT. 26°45.77'
LONG. 82°43.11'

STATION 1- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

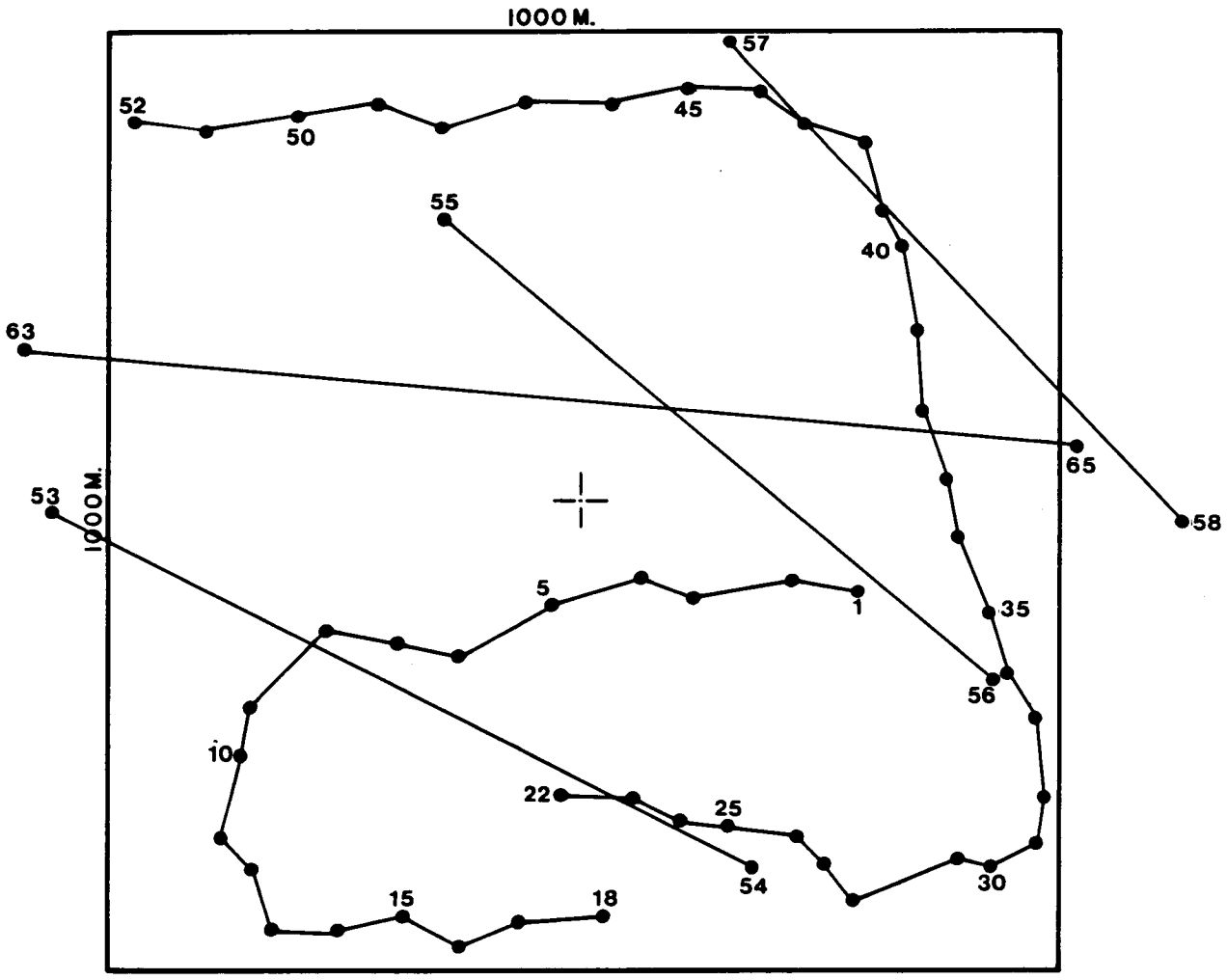


LEGEND

FIXMARK	EVENT
1-50	TV/STILL CAMERA LINE
62/63	TRAWL
65	BOX CORE SAMPLE A
67	BOX CORE SAMPLE B
68	BOX CORE SAMPLE C
69	BOX CORE SAMPLE D
70	BOX CORE SAMPLE E
71	BOX CORE SAMPLE F

= LAT. 26°45.84'
LONG. 82°45.18'

STATION 2- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

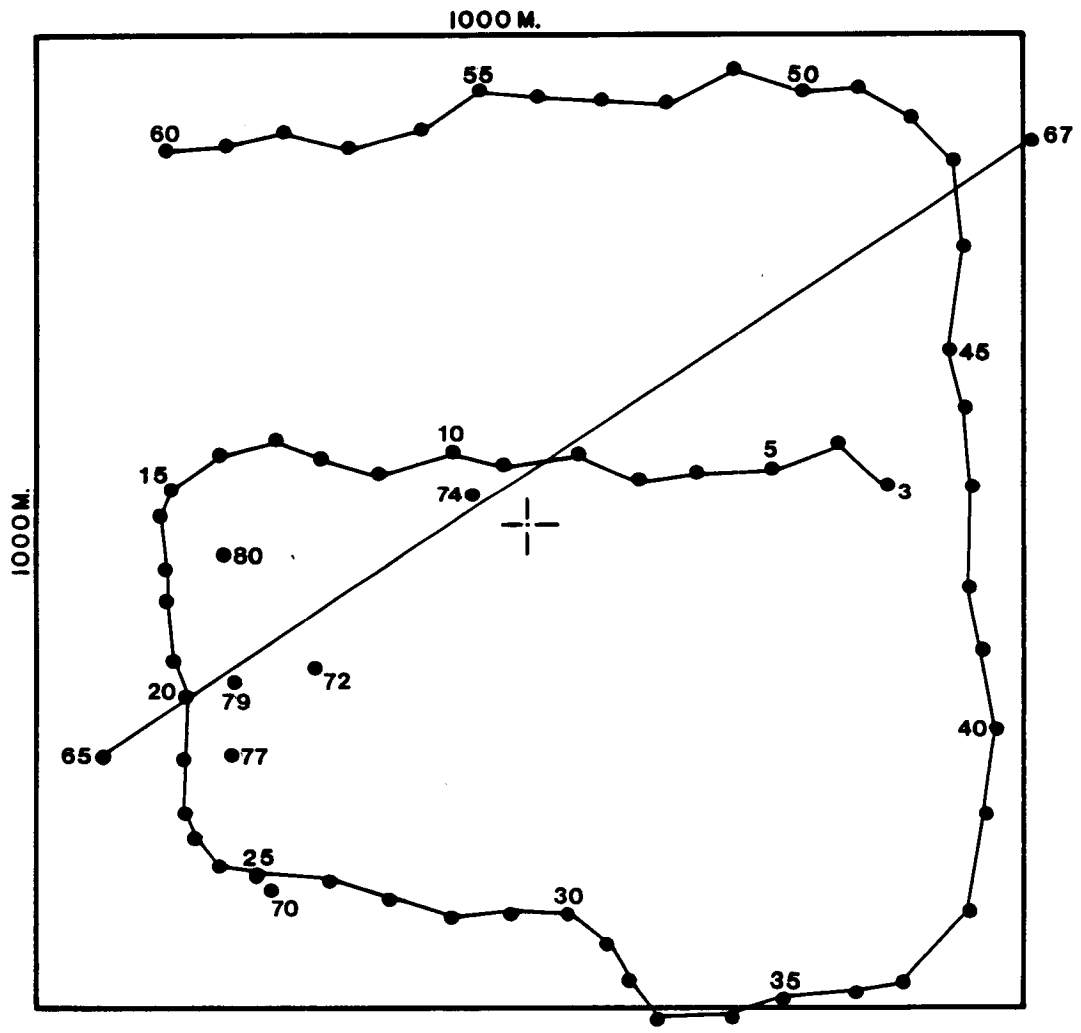


LEGEND

FIXMARK	EVENT
1-18	TV/STILL CAMERA LINE
22-52	TV/STILL CAMERA LINE
53/54	DREDGE A
55/56	DREDGE B
57/58	DREDGE C
63-65	TRAWL

= LAT. 26°45.86'
LONG. 83°21.44'

STATION 3- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

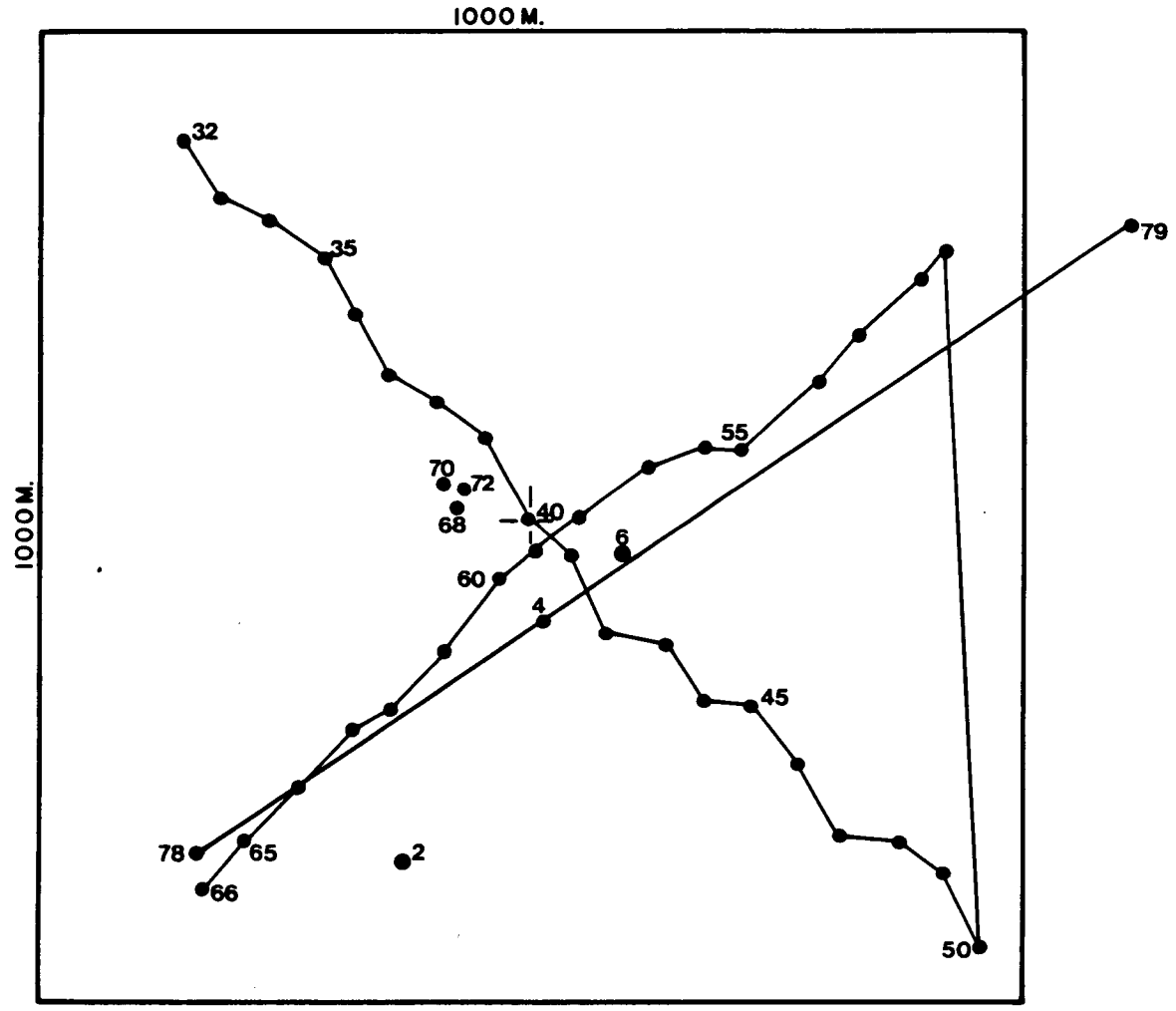


LEGEND

FIXMARK	EVENT
3-60	TV/STILL CAMERA LINE
65-67	TRAWL
70	BOX CORE SAMPLE A
72	BOX CORE SAMPLE B
74	BOX CORE SAMPLE C
77	BOX CORE SAMPLE D
79	BOX CORE SAMPLE E
80	BOX CORE SAMPLE F

= LAT. 26°45.81′
LONG. 83°32.12′

STATION 4- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

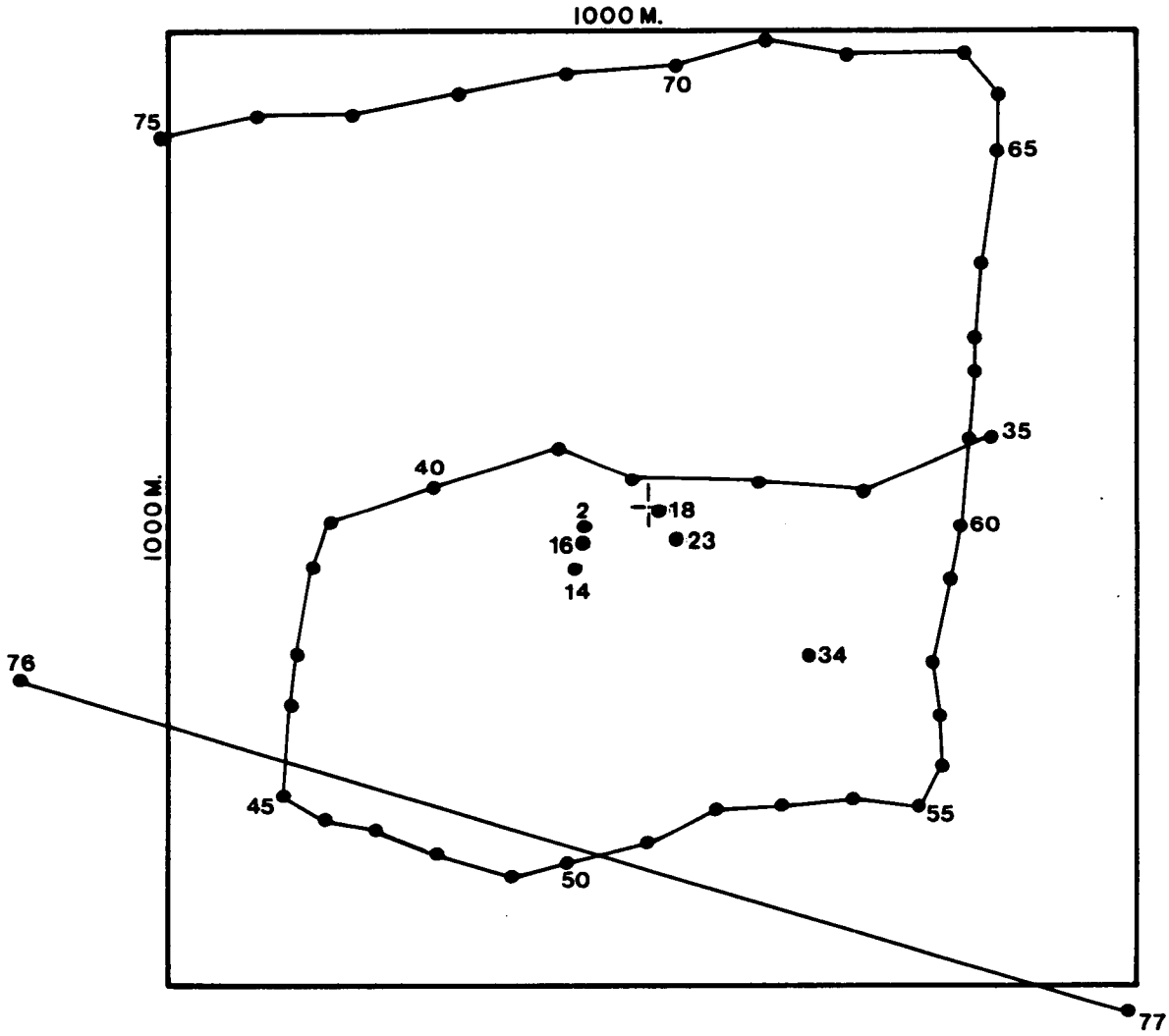


LEGEND

FIXMARK	EVENT
2	BOX CORE SAMPLE A
4	BOX CORE SAMPLE B
6	BOX CORE SAMPLE C
32-66	TV/STILL CAMERA LINE
68	BOX CORE SAMPLE D
70	BOX CORE SAMPLE E
72	BOX CORE SAMPLE F
78/79	TRAWL

= LAT. 26°45.70′
LONG. 84°00.13′

STATION 5- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE III

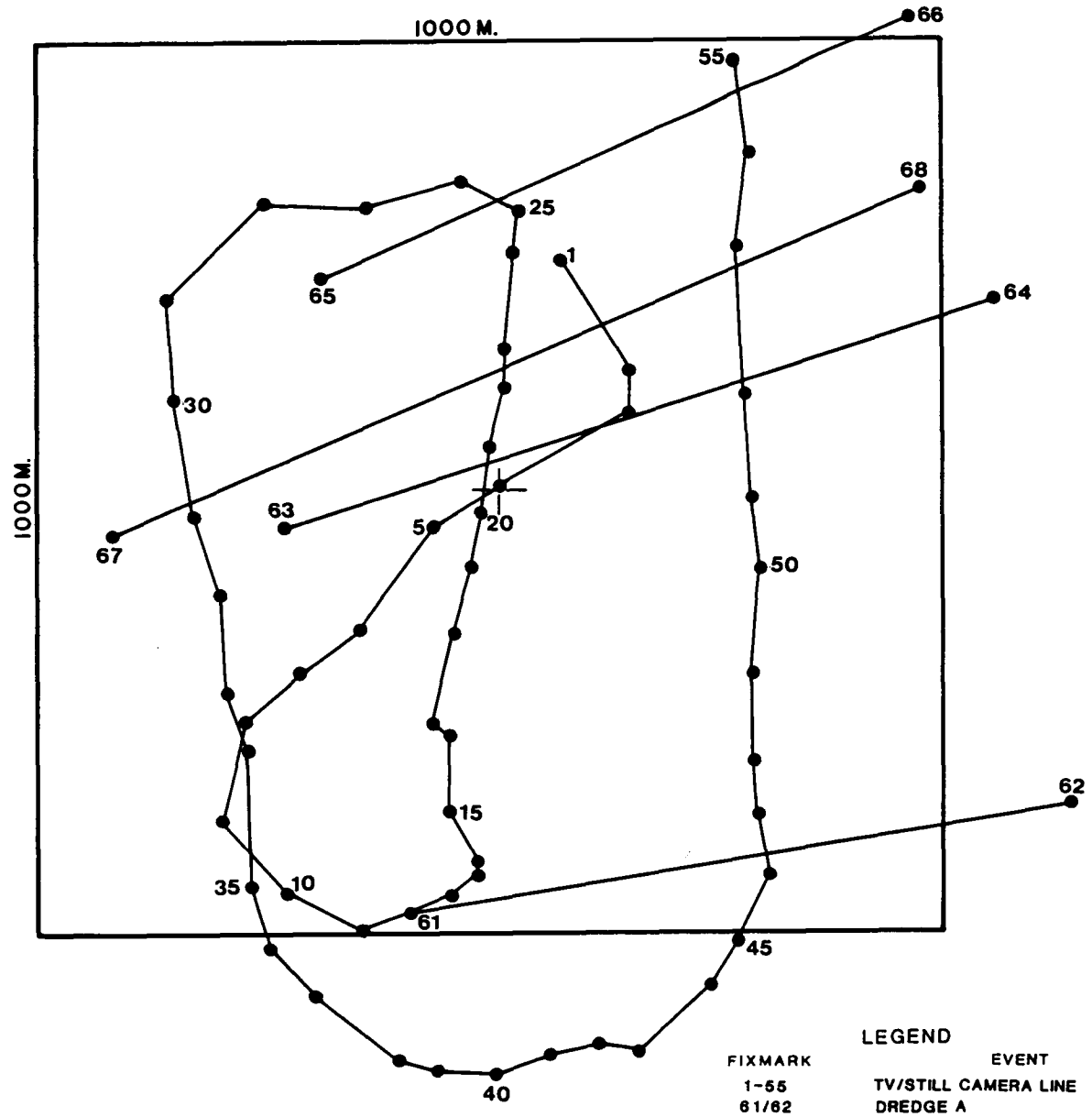


LEGEND

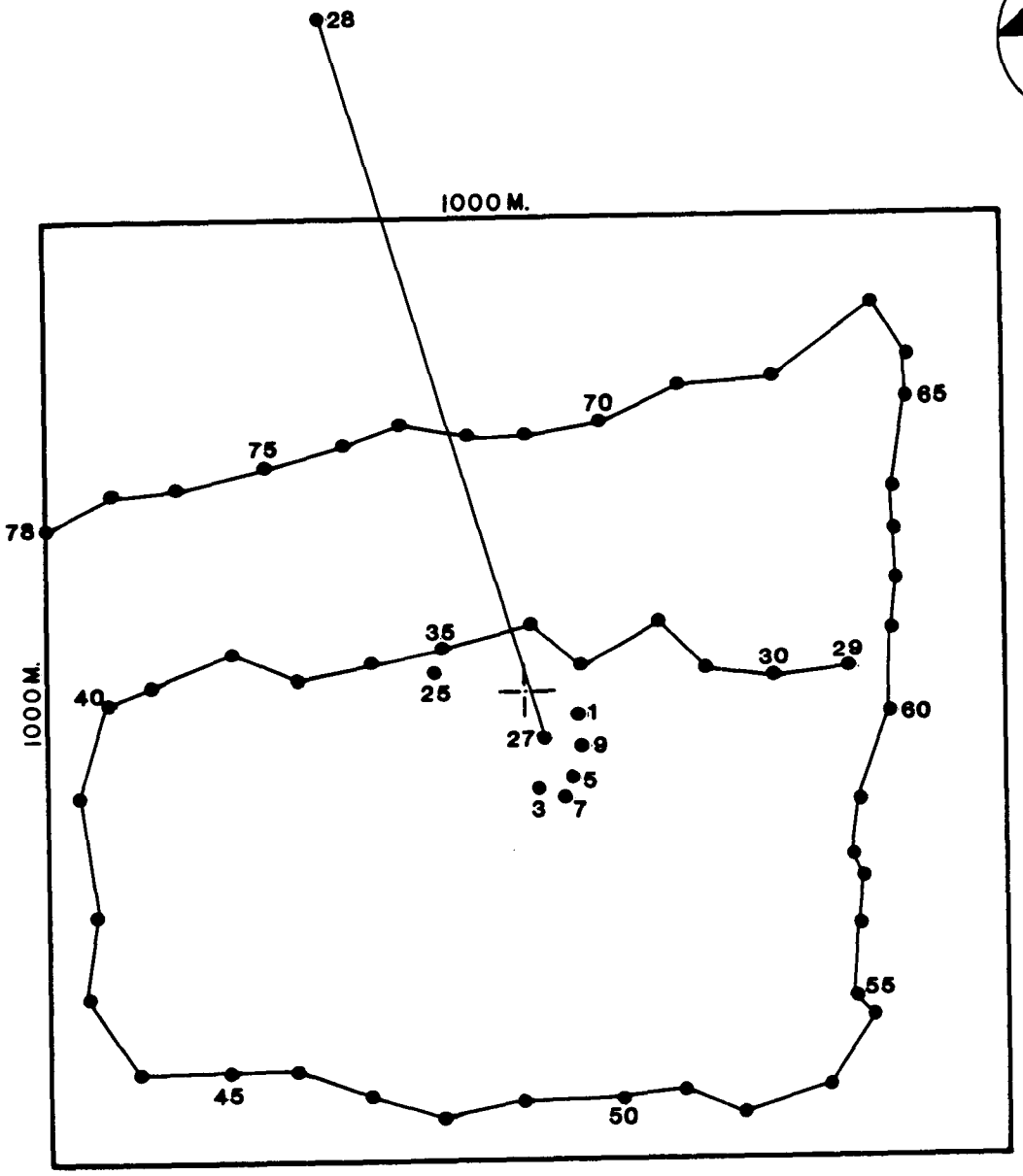
FIXMARK	EVENT
2	BOX CORE SAMPLE A
14	BOX CORE SAMPLE B
16	BOX CORE SAMPLE C
18	BOX CORE SAMPLE D
23	BOX CORE SAMPLE E
34	BOX CORE SAMPLE F
35-75	TV/STILL CAMERA LINE
76/77	TRAWL

= LAT. 26°16.79′
LONG. 82°38.35′

STATION 6- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III



STATION 7- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

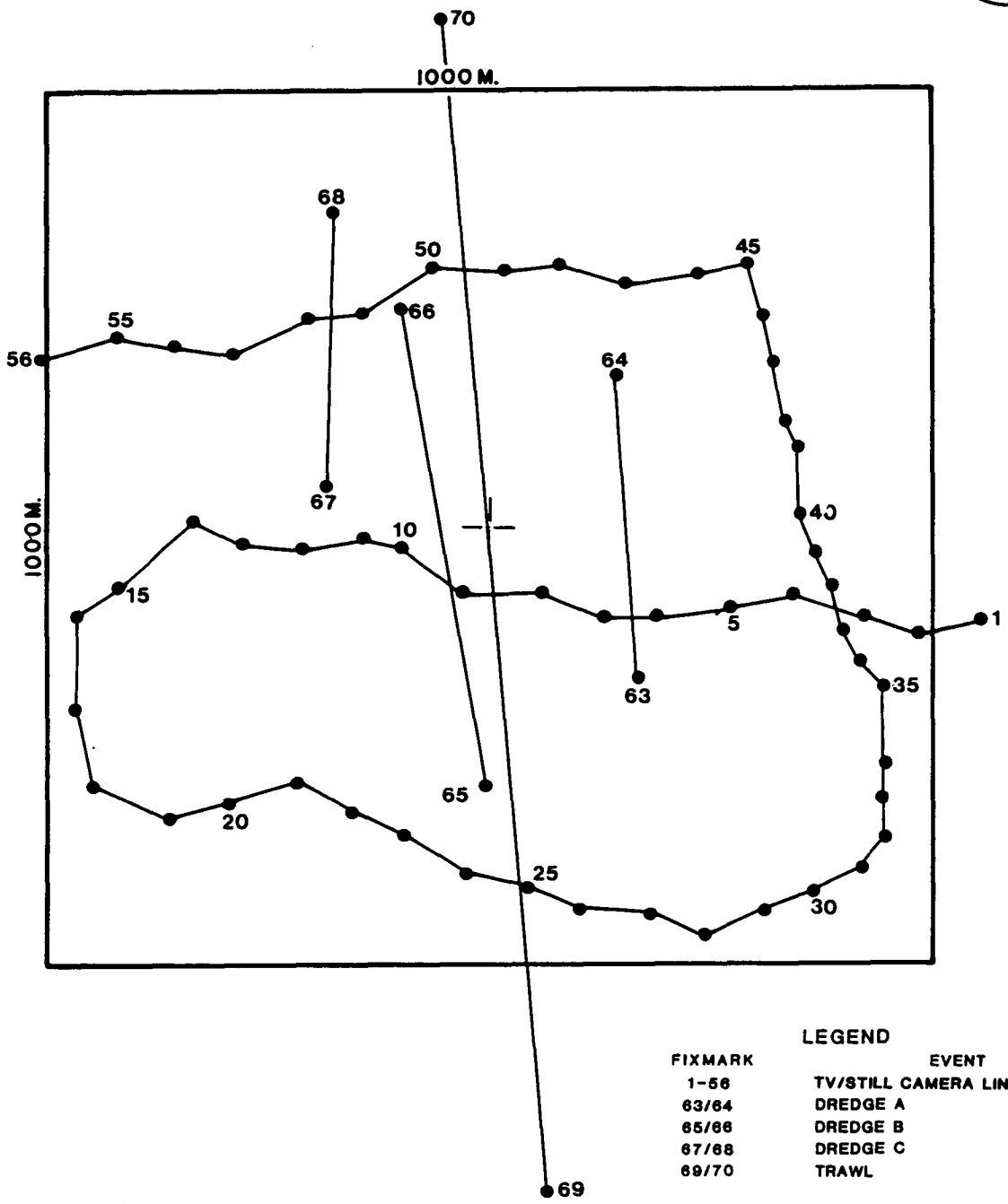


LEGEND

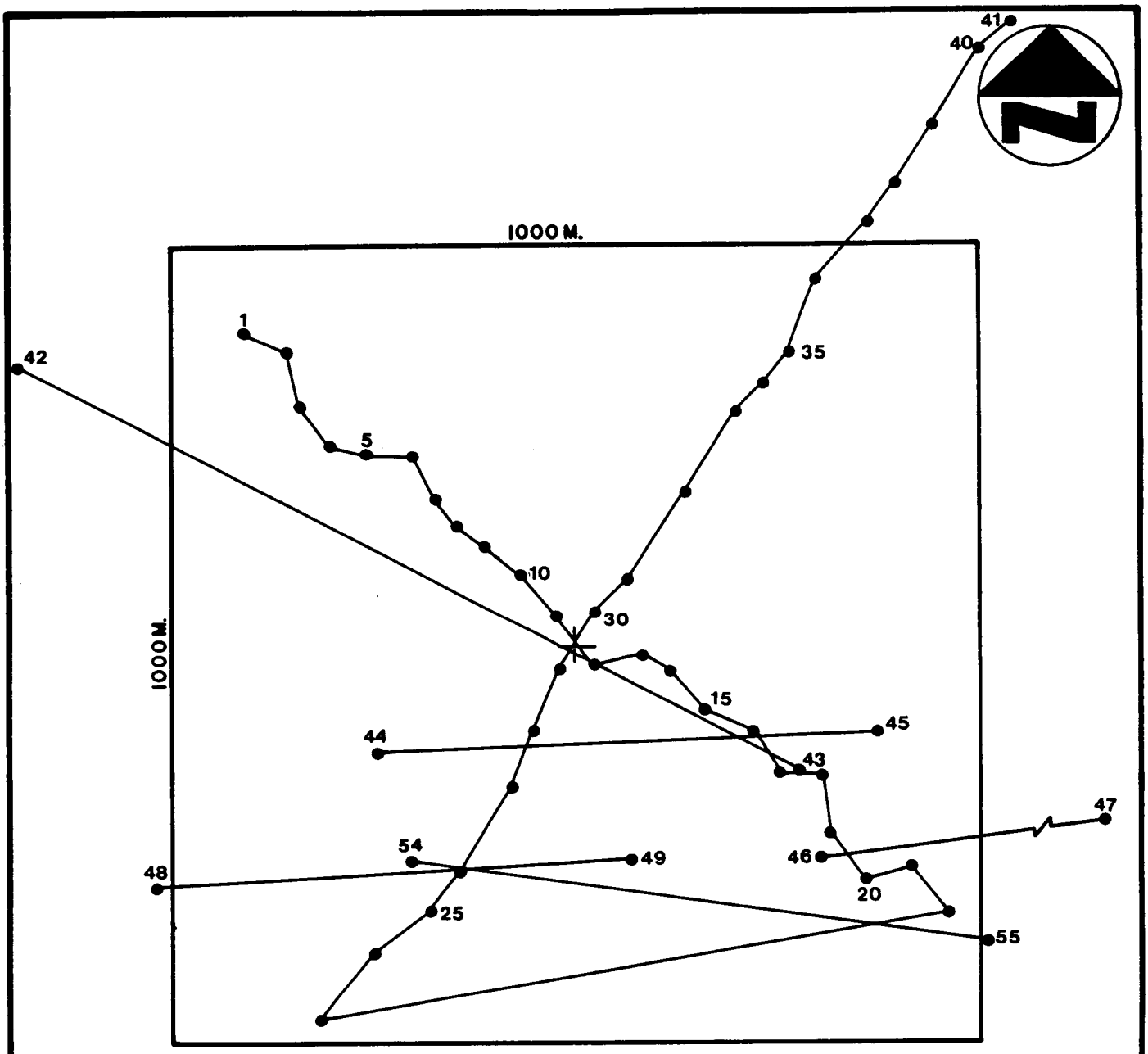
FIXMARK	EVENT
1	BOX CORE SAMPLE A
3	BOX CORE SAMPLE B
5	BOX CORE SAMPLE C
7	BOX CORE SAMPLE D
9	BOX CORE SAMPLE E
25	BOX CORE SAMPLE F
27/28	TRAWL
29-78	TV/STILL CAMERA LINE

= LAT. 26°16.72'
LONG. 83°12.81'

STATION 8- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III



STATION 9- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

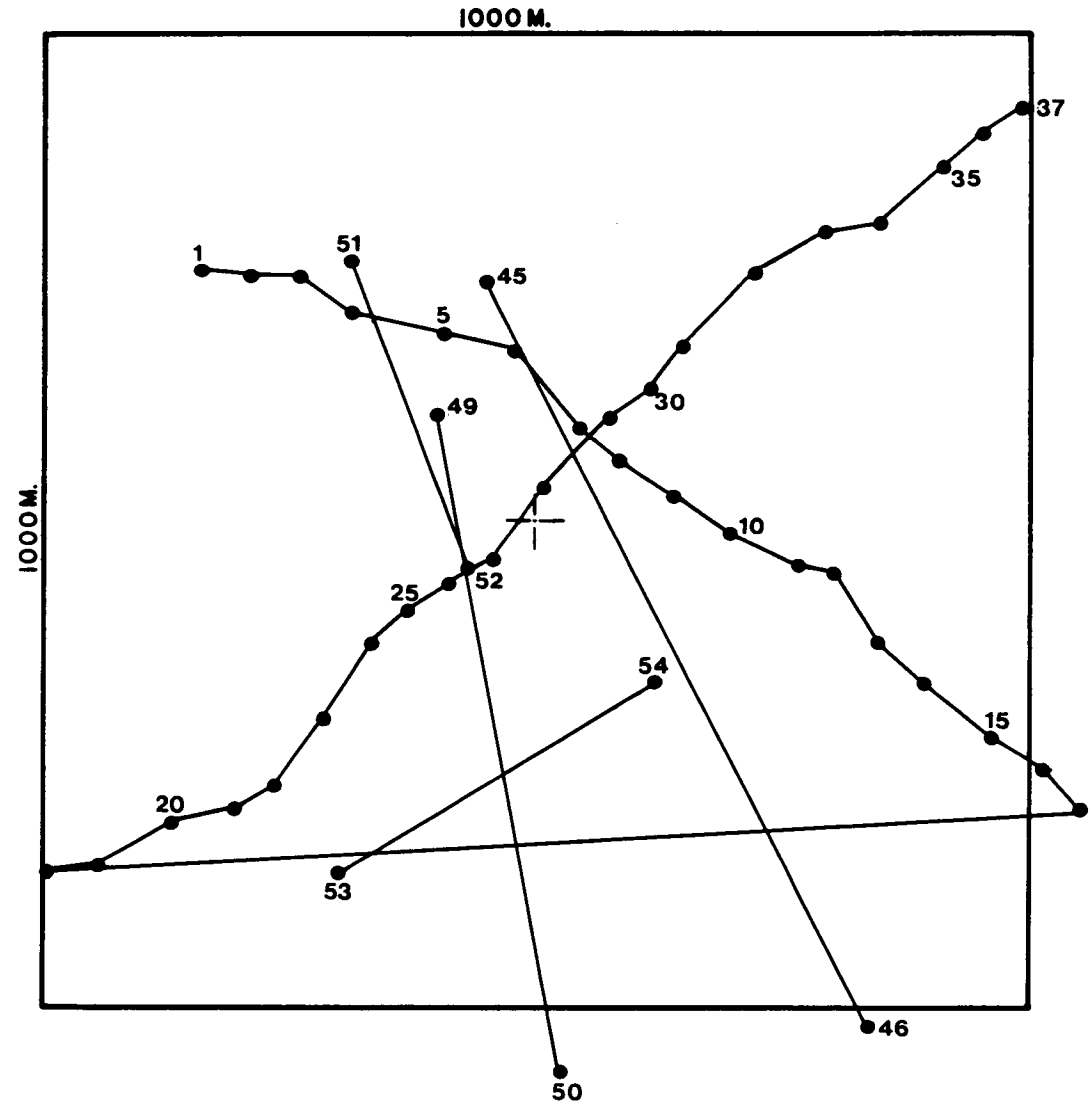


LEGEND

FIXMARK	EVENT
1-41	TV/STILL CAMERA LINE
42/43	DREDGE A
44/45	DREDGE B
46/47	DREDGE C
48/49	DREDGE D
54/55	TRAWL

= LAT. 26°16.73′
LONG. 83°42.81′

STATION 10- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS- CRUISE III

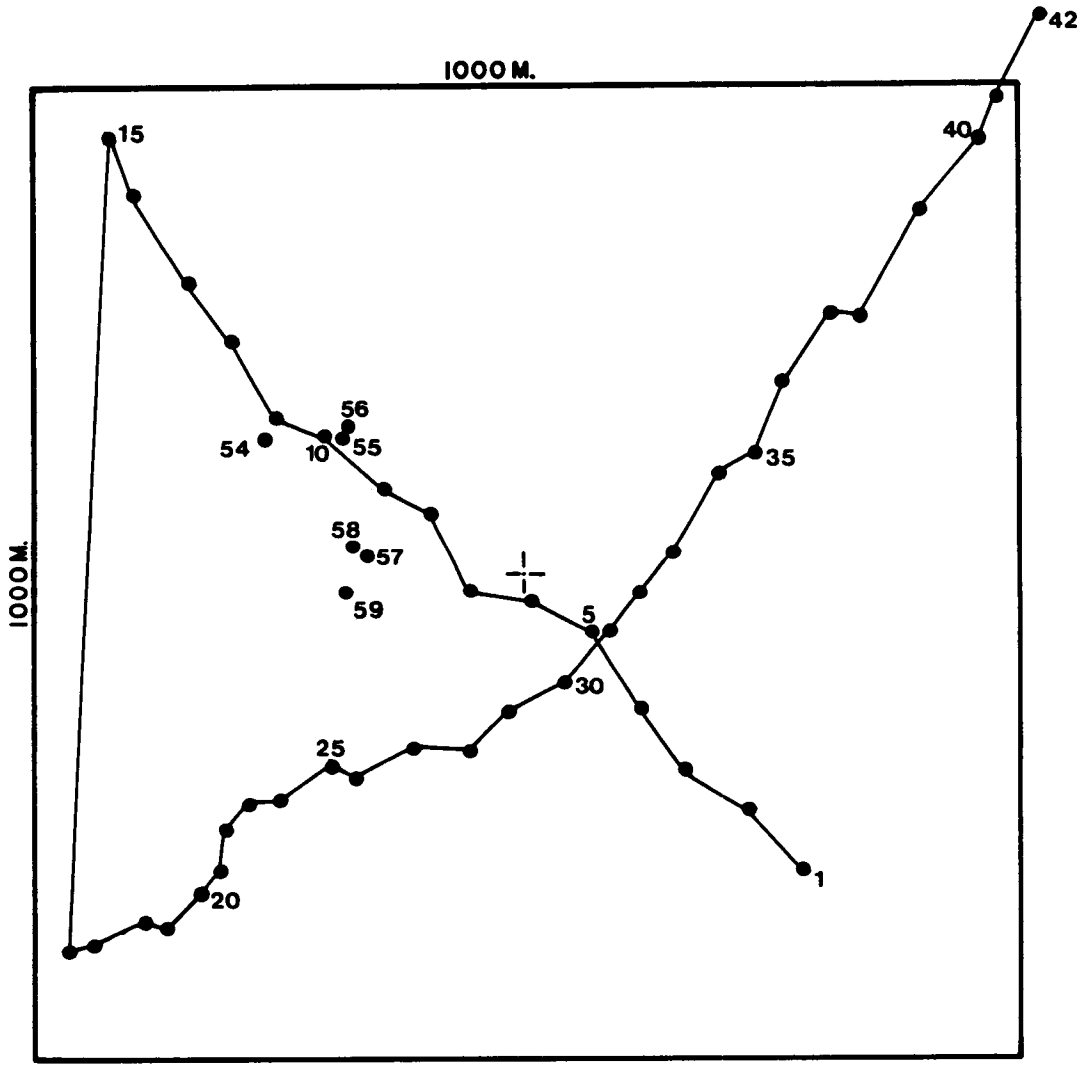


LEGEND

FIXMARK	EVENT
1-37	TV/STILL CAMERA LINE
45/46	TRAWL
49/50	DREDGE A
51/52	DREDGE B
53/54	DREDGE C

= LAT. 26°16.72′
LONG. 83°46.82′

STATION 11- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

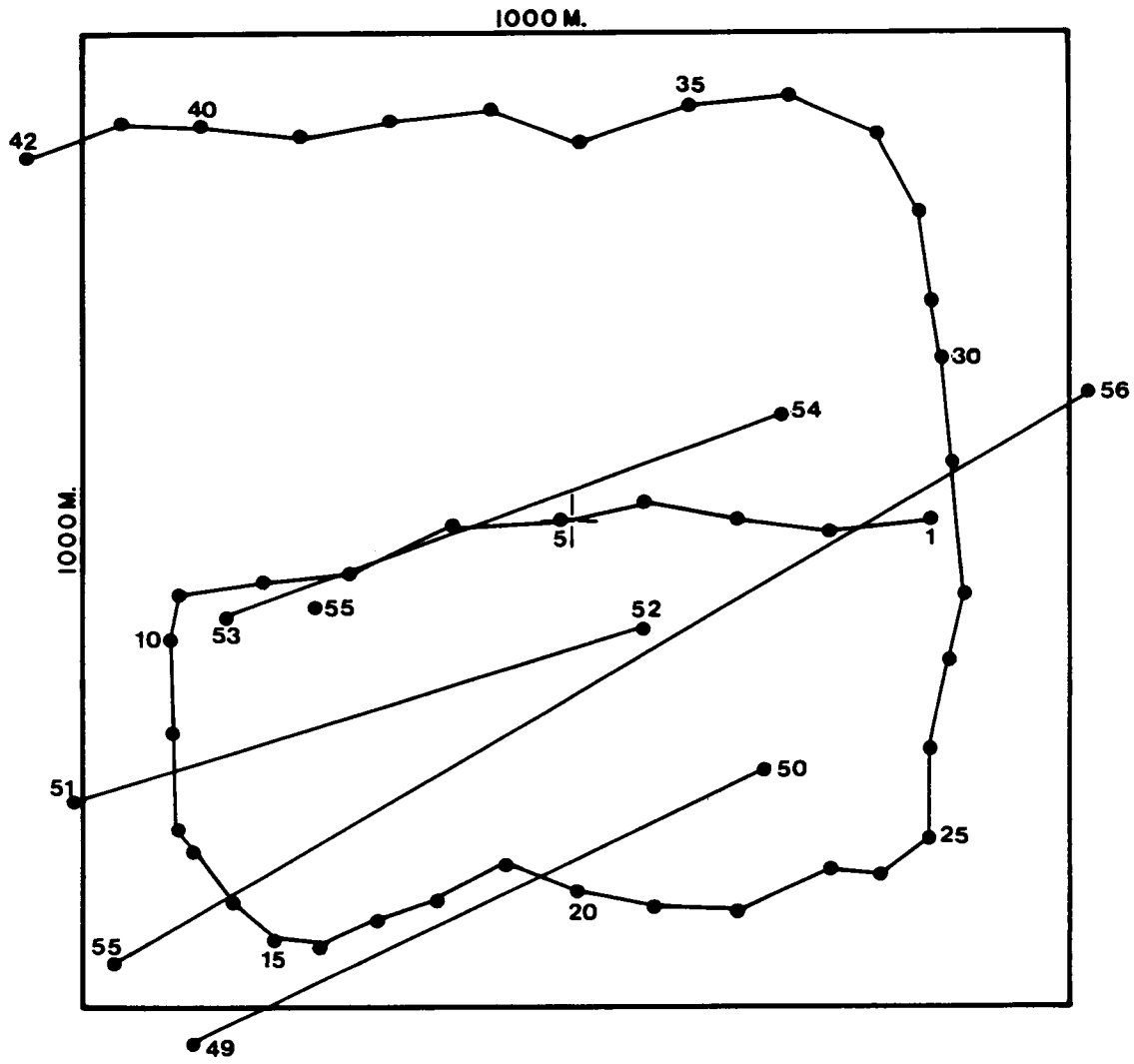


LEGEND

FIXMARK	EVENT
1-42	TV/STILL CAMERA LINE
54	BOX CORE SAMPLE A
55	BOX CORE SAMPLE B
56	BOX CORE SAMPLE C
57	BOX CORE SAMPLE D
58	BOX CORE SAMPLE E
59	BOX CORE SAMPLE F

= LAT. 26°16.72′
LONG. 83°47.67′

STATION 12- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

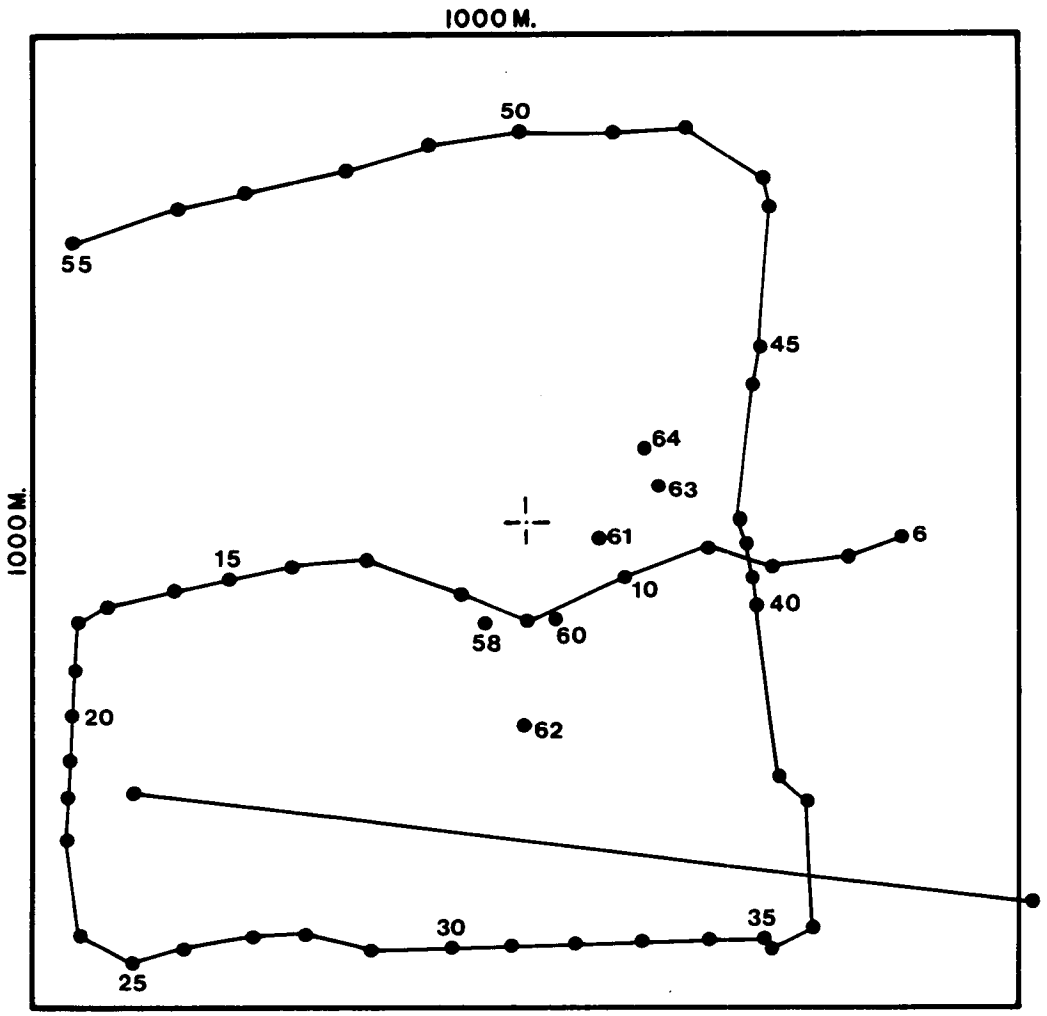


LEGEND

FIXMARK	EVENT
1-42	TV/STILL CAMERA LINE
49/50	DREDGE A
51/52	DREDGE B
53/54	DREDGE C
55/56	TRAWL

= LAT. 25°45.93'
LONG. 82°09.35'

STATION 13- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS - CRUISE III

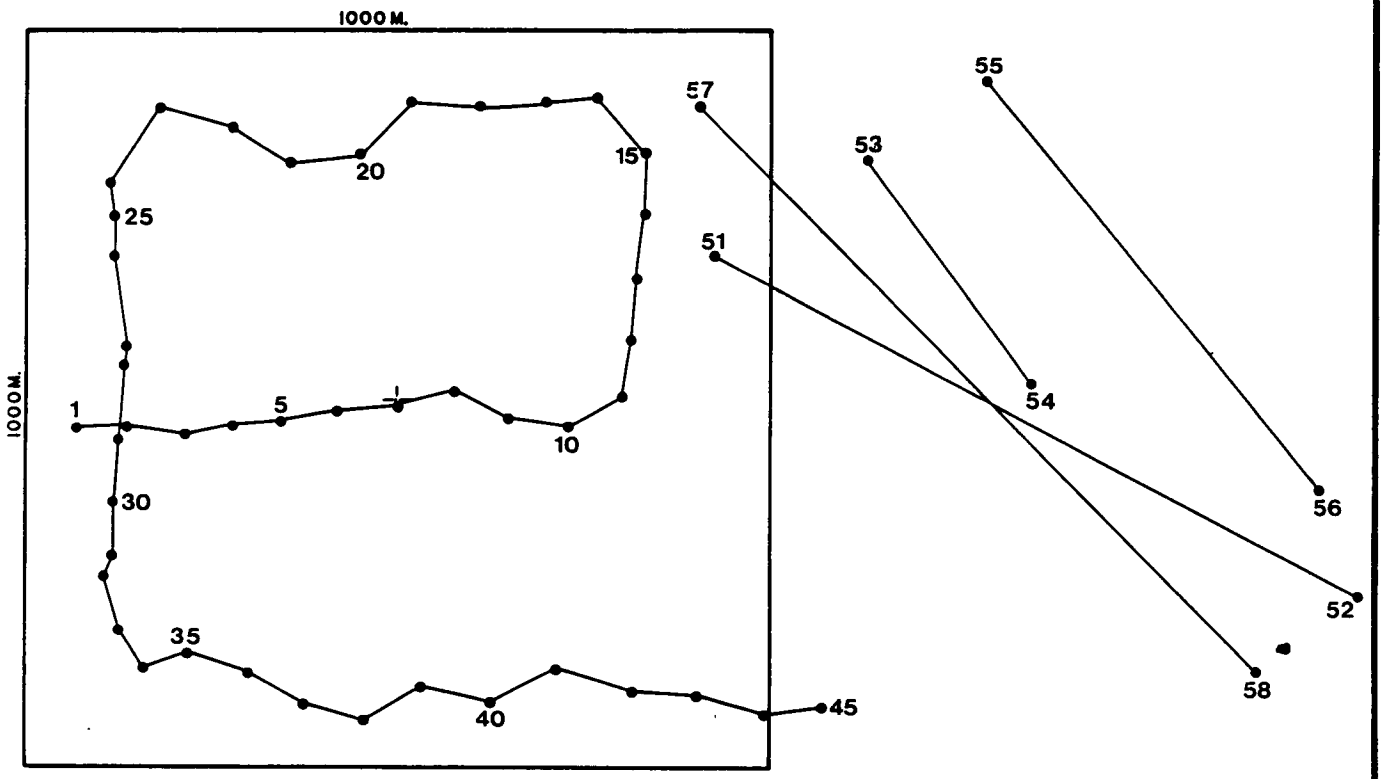


LEGEND

FIXMARK	EVENT
6-55	TV/STILL CAMERA LINE
56/57	TRAWL
58	BOX CORE SAMPLE A
60	BOX CORE SAMPLE B
61	BOX CORE SAMPLE C
62	BOX CORE SAMPLE D
63	BOX CORE SAMPLE E
64	BOX CORE SAMPLE F

= LAT. 25°46.01′
LONG. 82°23.82′

STATION 14- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

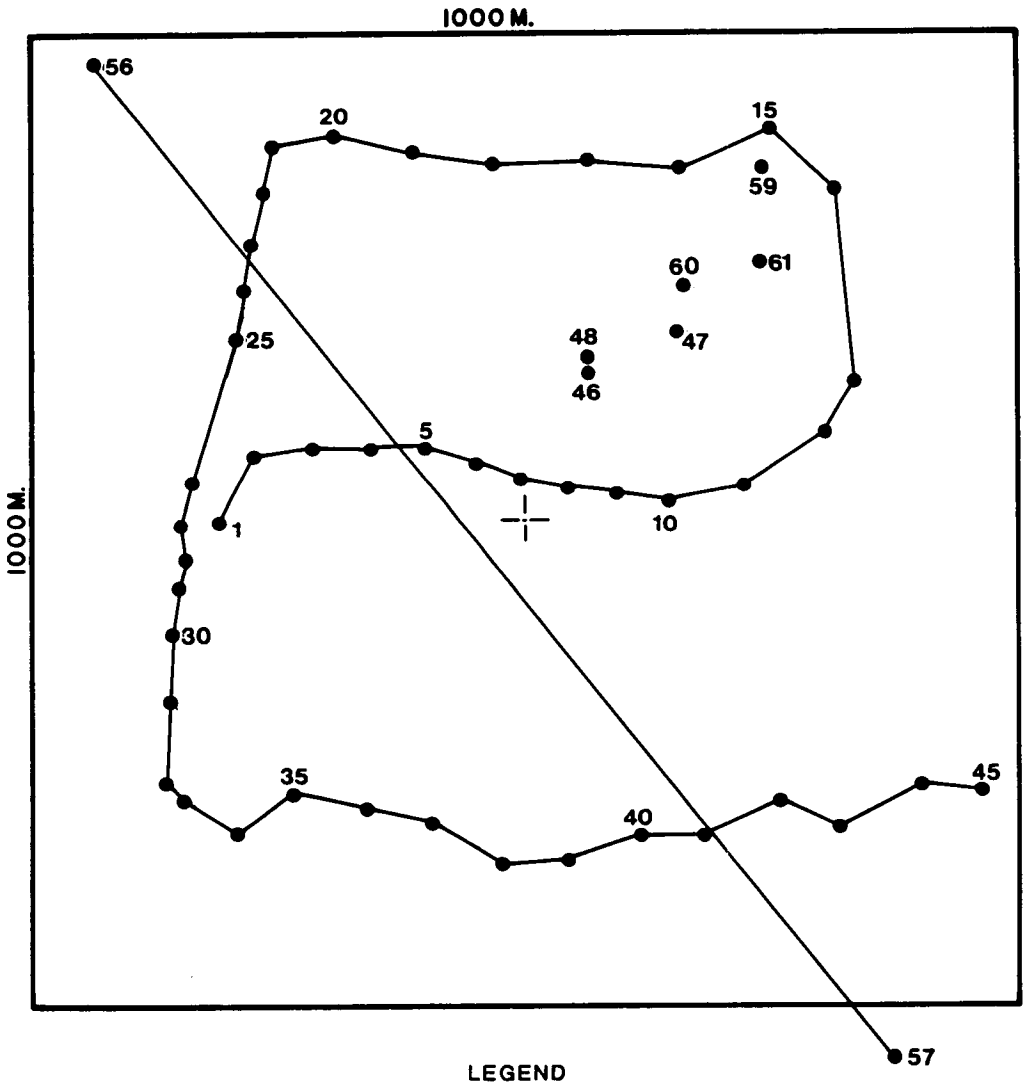


LEGEND

FIXMARK	EVENT
1-45	TV/STILL CAMERA LINE
51/52	DREDGE A
53/54	DREDGE B
55/56	DREDGE C
57/58	TRAWL

= LAT. 25°45.89'
LONG. 82°31.62'

STATION 15- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

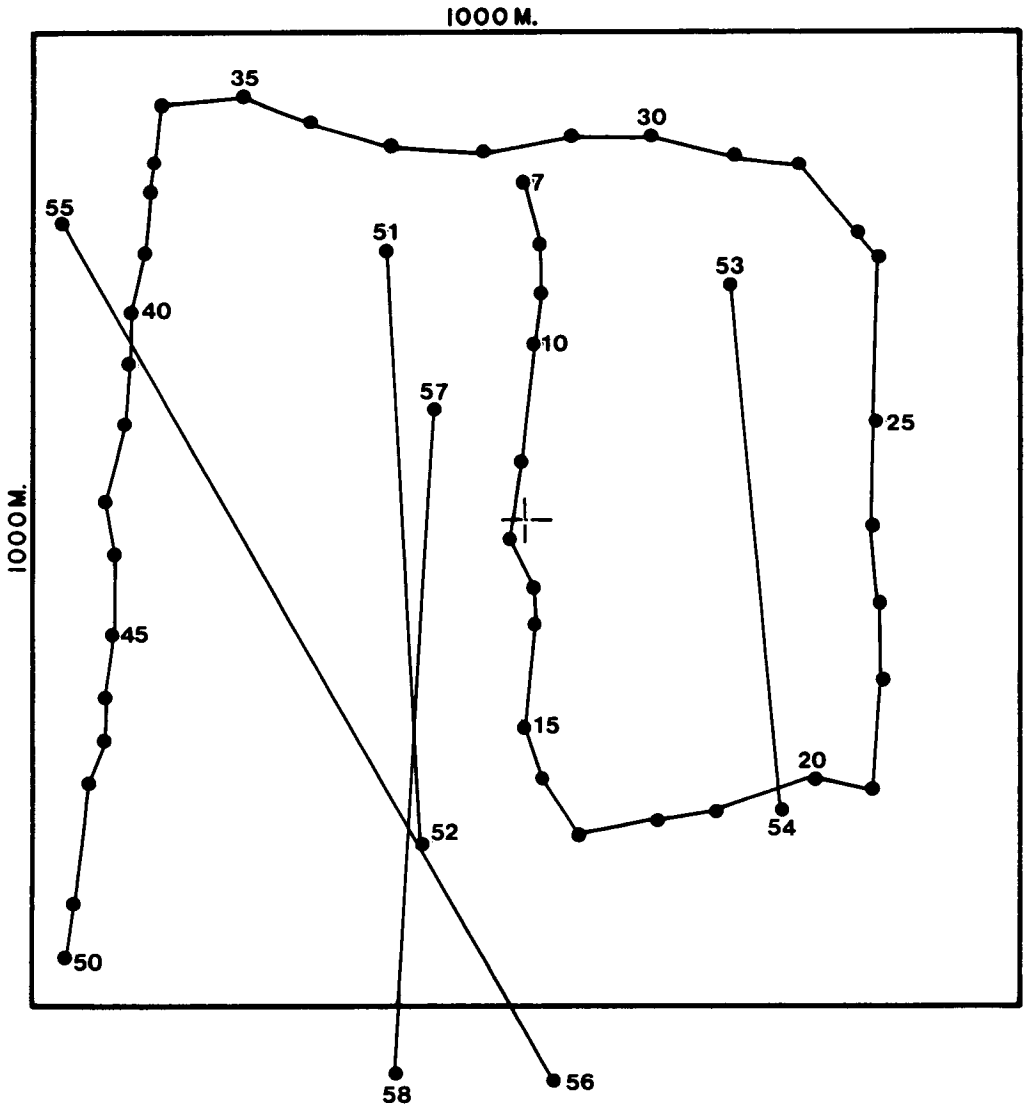


LEGEND

FIXMARK	EVENT
1-45	TV/STILL CAMERA LINE
46	BOX CORE SAMPLE A
47	BOX CORE SAMPLE B
48	BOX CORE SAMPLE C
56/57	TRAWL
59	BOX CORE SAMPLE D
60	BOX CORE SAMPLE E
61	BOX CORE SAMPLE F

= LAT. 25°45.70'
LONG. 83°11.07'

STATION 16- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

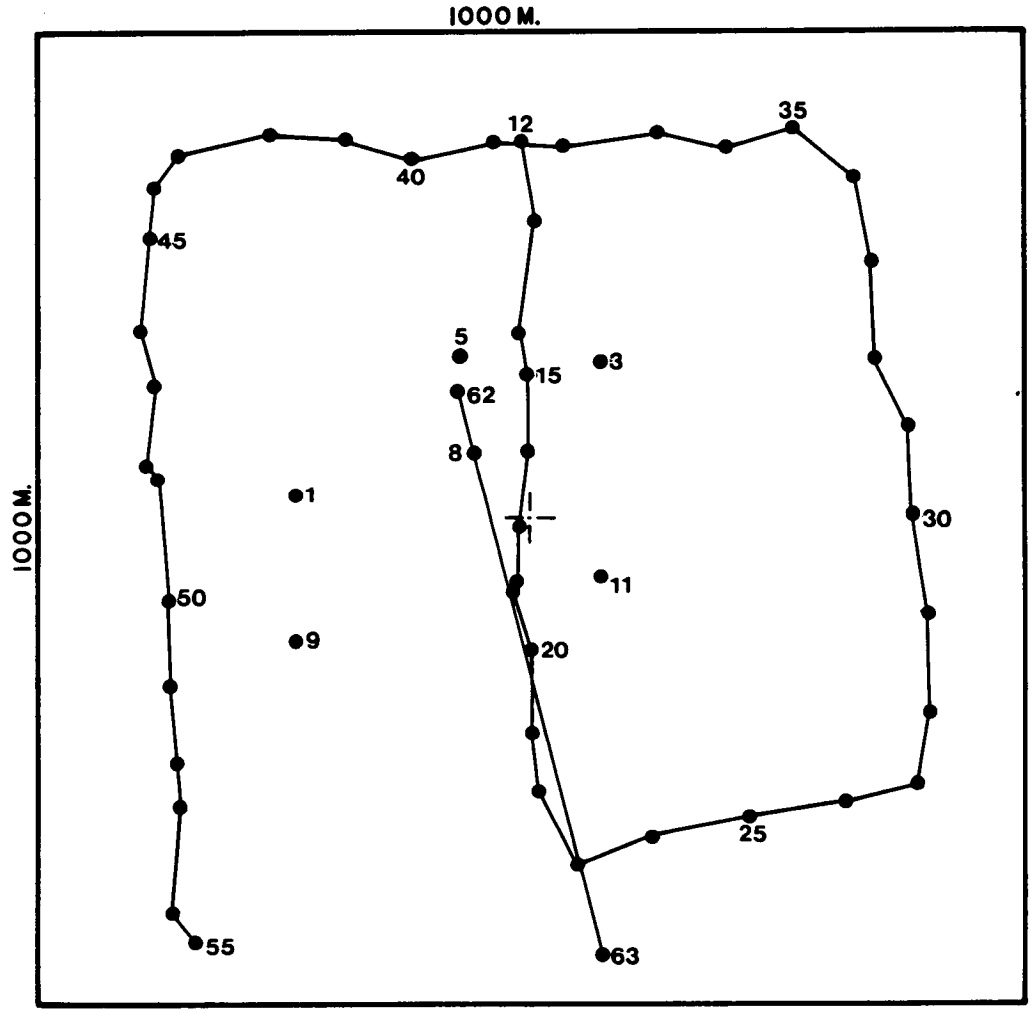


LEGEND

FIXMARK	EVENT
7-50	TV/STILL CAMERA LINE
51/52	DREDGE A
53/54	DREDGE B
55/56	DREDGE C
57/58	TRAWL

= LAT. 25°45.58'
LONG. 83°20.24'

STATION 17- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

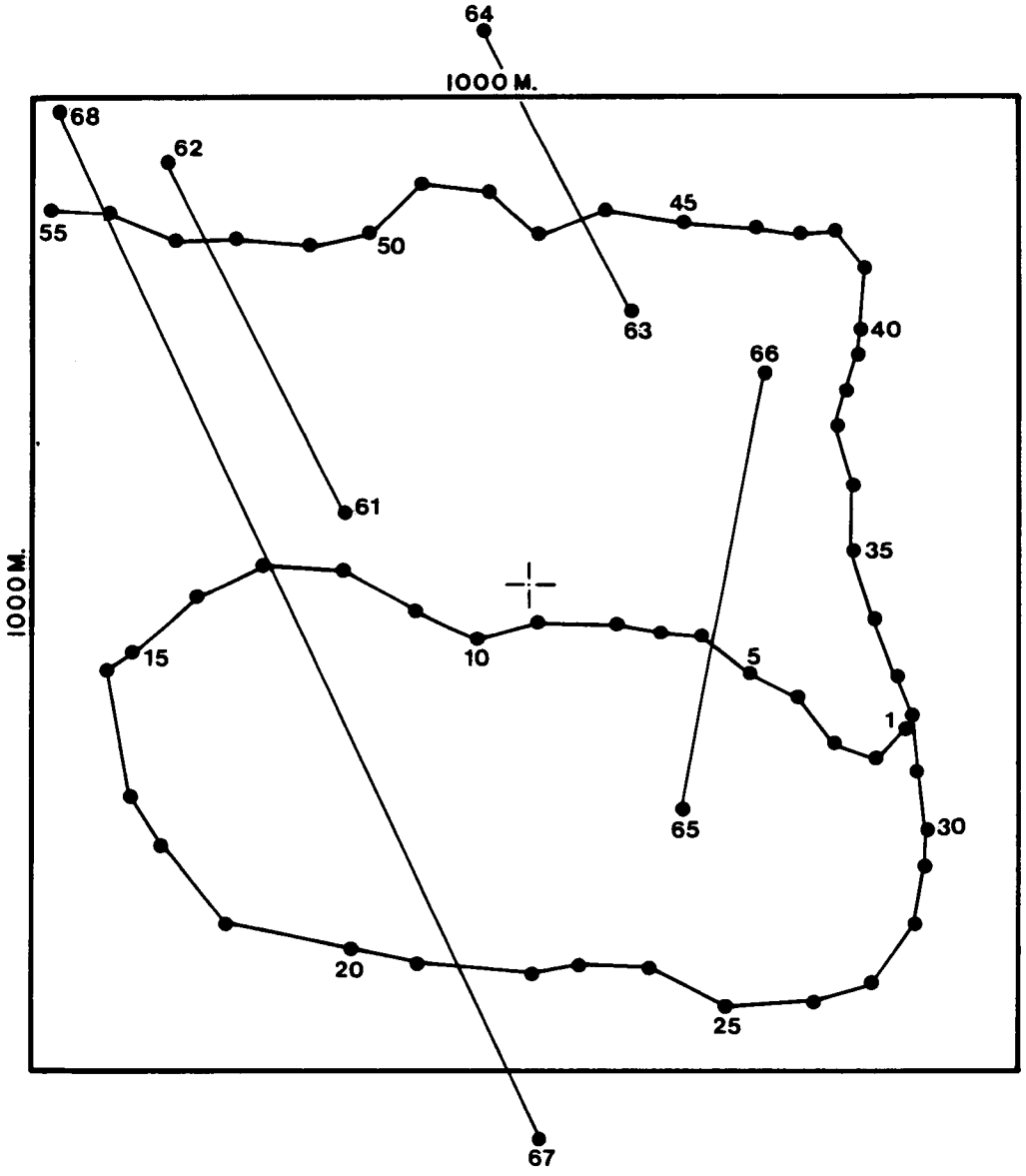


LEGEND

FIXMARK	EVENT
1	BOX CORE SAMPLE A
3	BOX CORE SAMPLE B
5	BOX CORE SAMPLE C
8	BOX CORE SAMPLE D
9	BOX CORE SAMPLE E
11	BOX CORE SAMPLE F
12-55	TV/STILL CAMERA LINE
62/63	TRAWL

= LAT. 25°45.37'
LONG. 83°42.22'

STATION 18- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

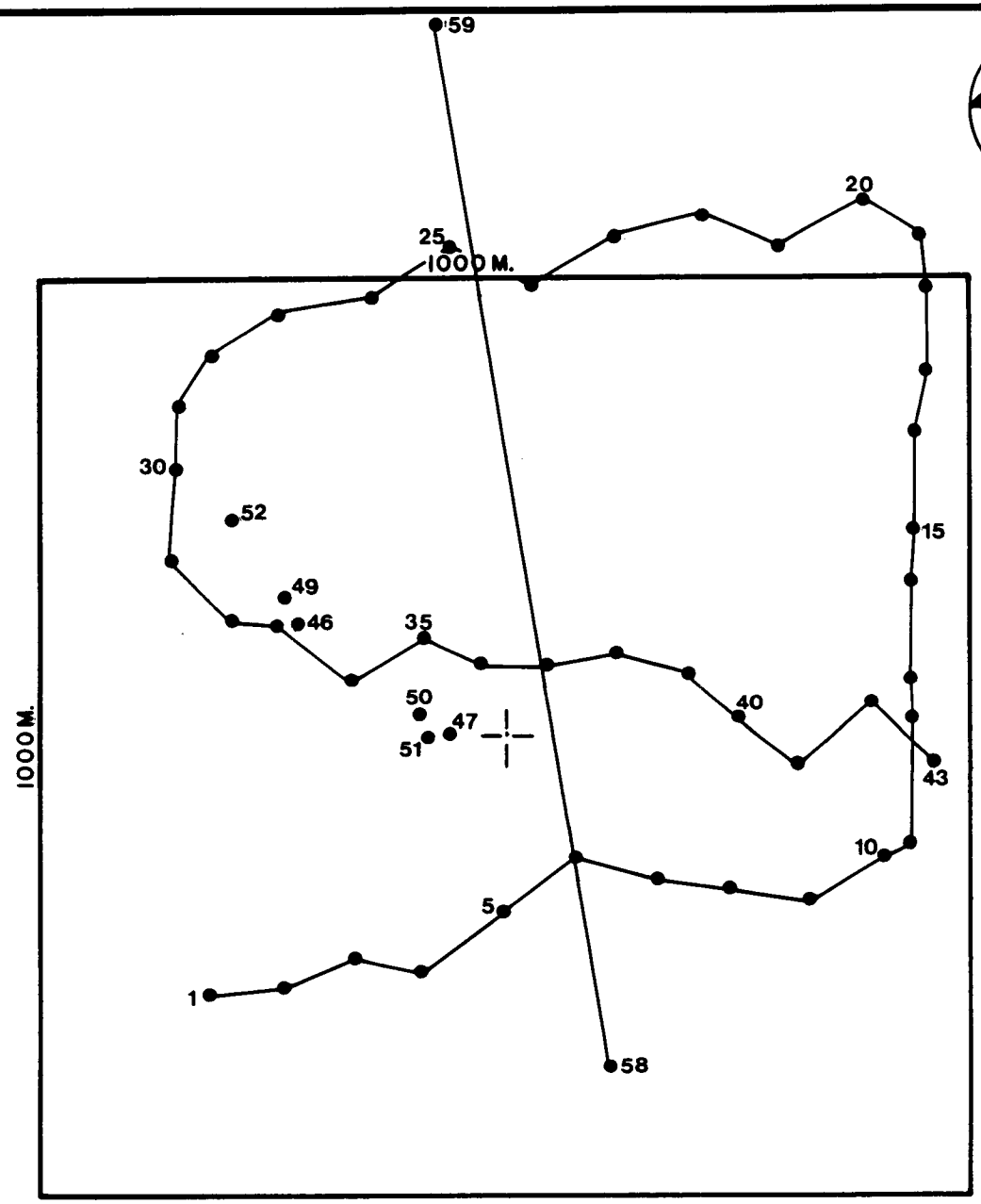


LEGEND

FIXMARK	EVENT
1-55	TV/STILL CAMERA LINE
61/62	DREDGE A
63/64	DREDGE B
65/66	DREDGE C
67/68	TRAWL

= LAT. 25°17.36'
LONG. 82°09.00'

STATION 19- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

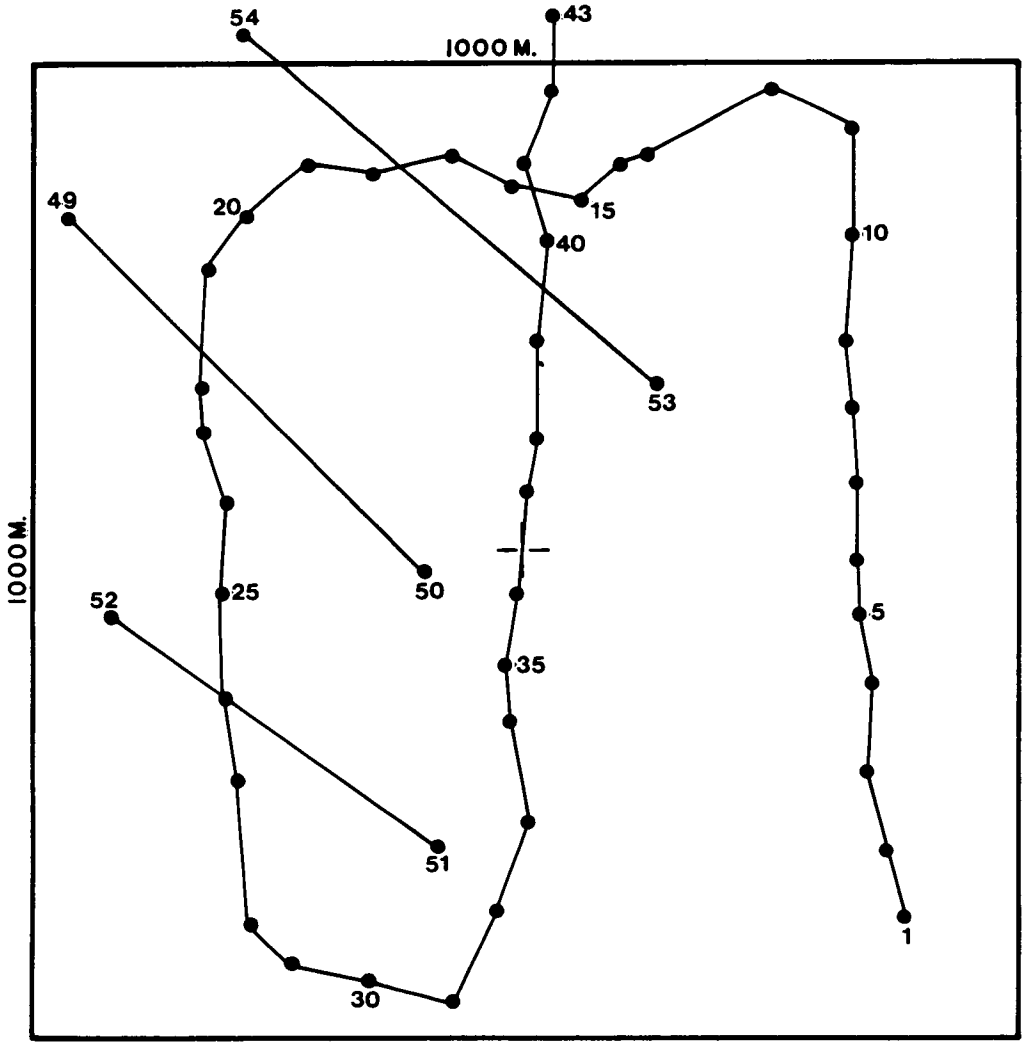


LEGEND

FIXMARK	EVENT
1-43	TV/STILL CAMERA LINE
46	BOX CORE SAMPLE A
47	BOX CORE SAMPLE B
49	BOX CORE SAMPLE C
50	BOX CORE SAMPLE D
51	BOX CORE SAMPLE E
52	BOX CORE SAMPLE F
58/59	TRAWL

= LAT. 25°17.34'
LONG. 82°09.73'

STATION 20- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS--CRUISE III

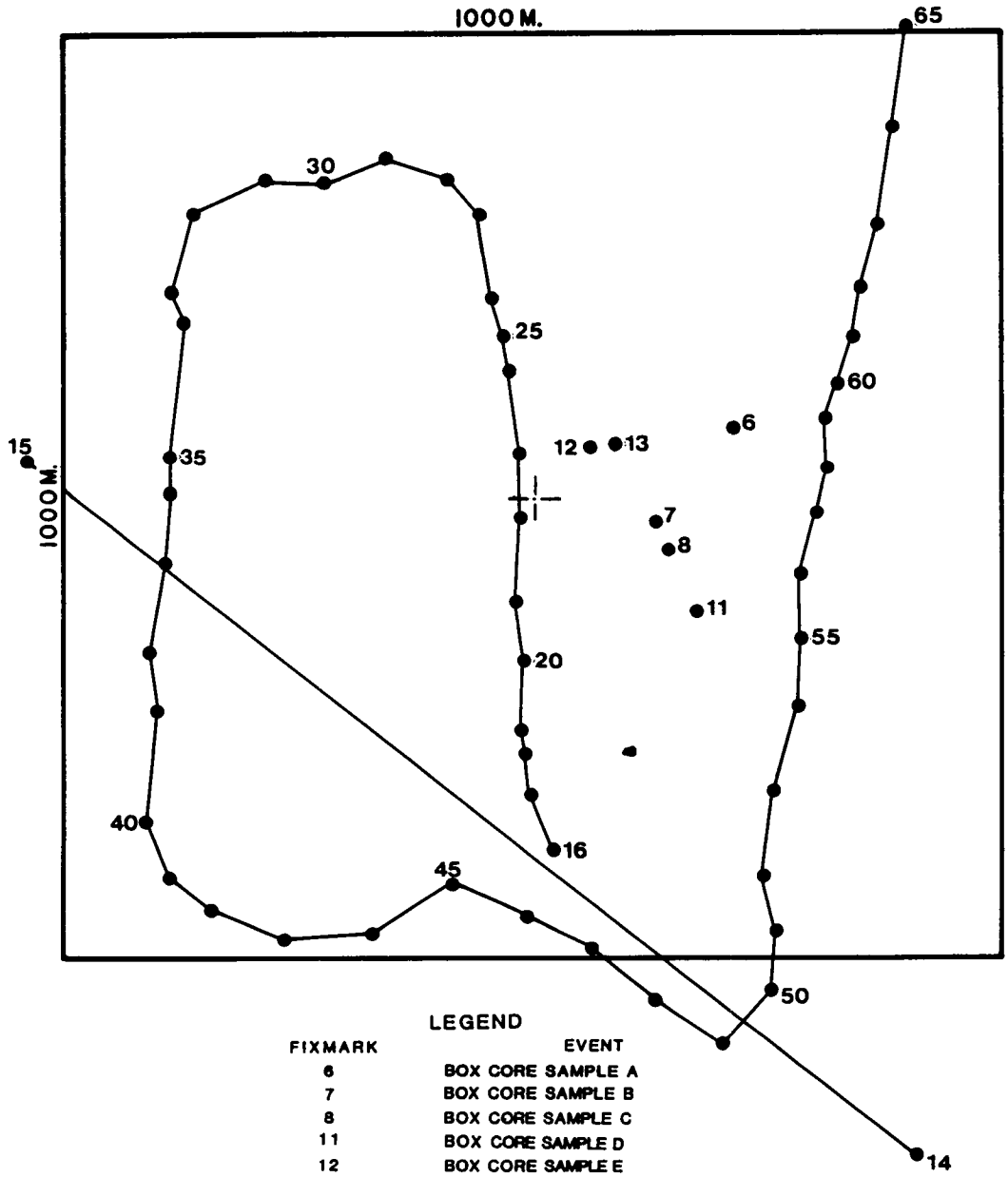


LEGEND

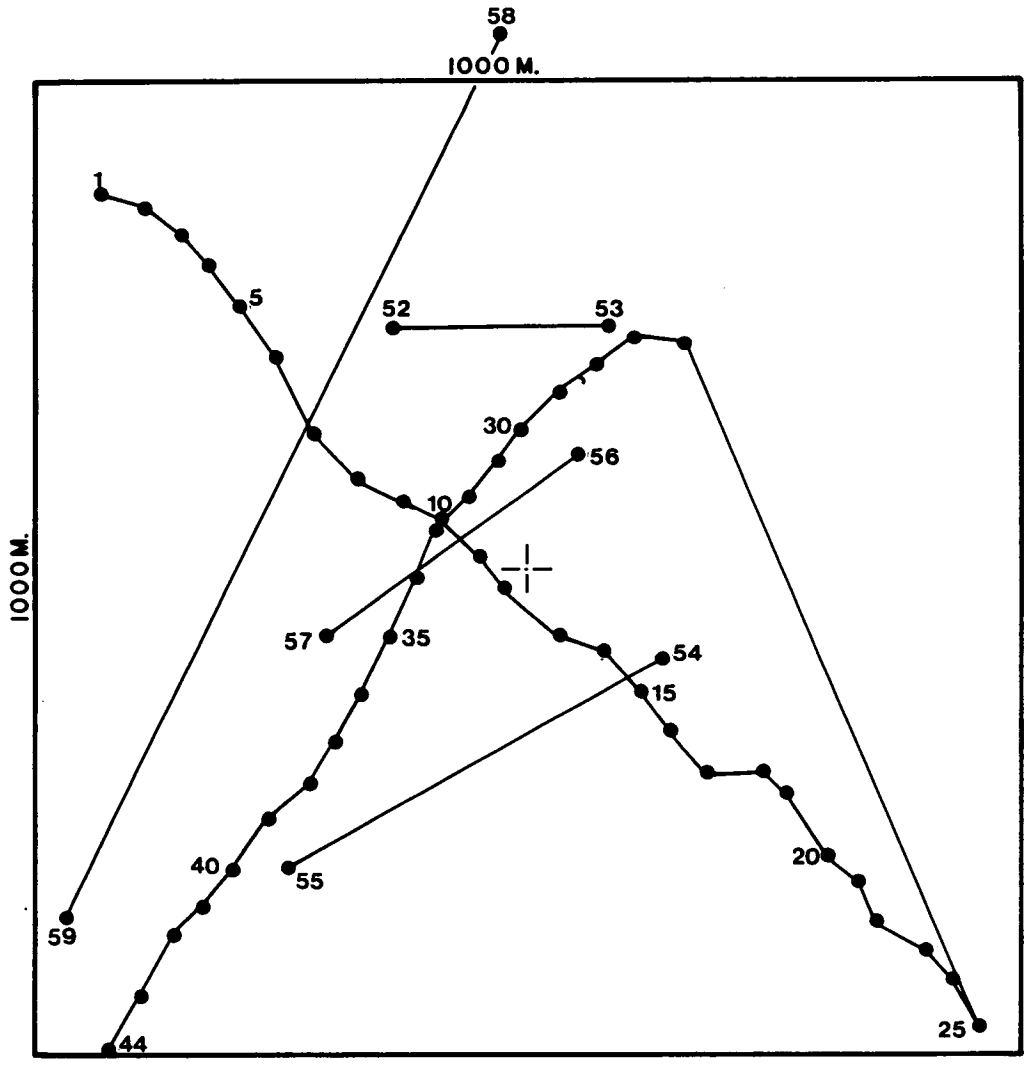
FIXMARK	EVENT
1-43	TV/STILL CAMERA LINE
49/50	DREDGE A
51/52	DREDGE B
53/54	DREDGE C

= LAT. 25°17.26'
LONG. 82°52.16'

STATION 21- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III



STATION 22- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS - CRUISE III

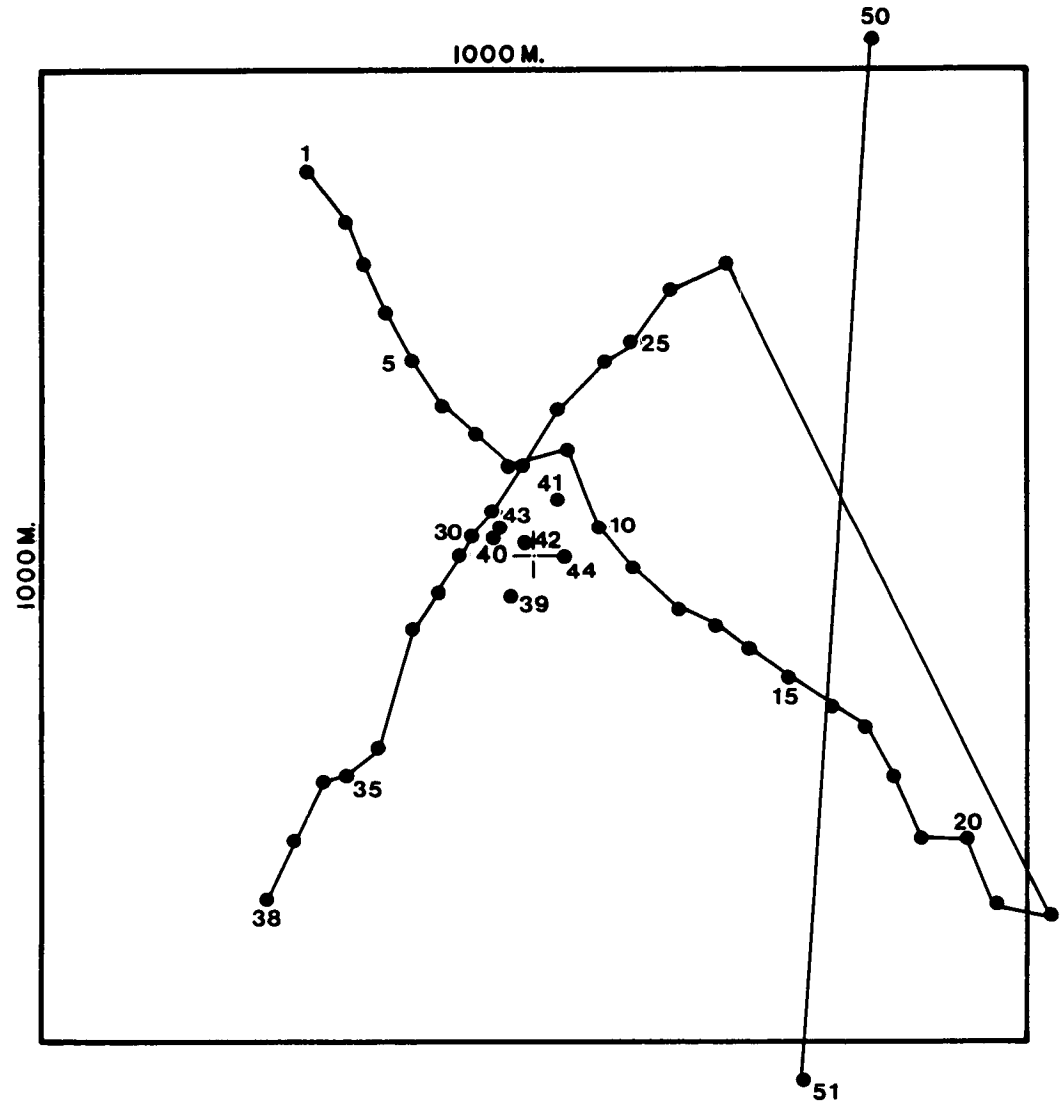


LEGEND

FIXMARK	EVENT
1-44	TV/STILL CAMERA LINE
52/53	DREDGE A
54/55	DREDGE B
56/57	DREDGE C
58/59	TRAWL

= LAT. 25°16.89'
LONG. 83°37.79'

STATION 23- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

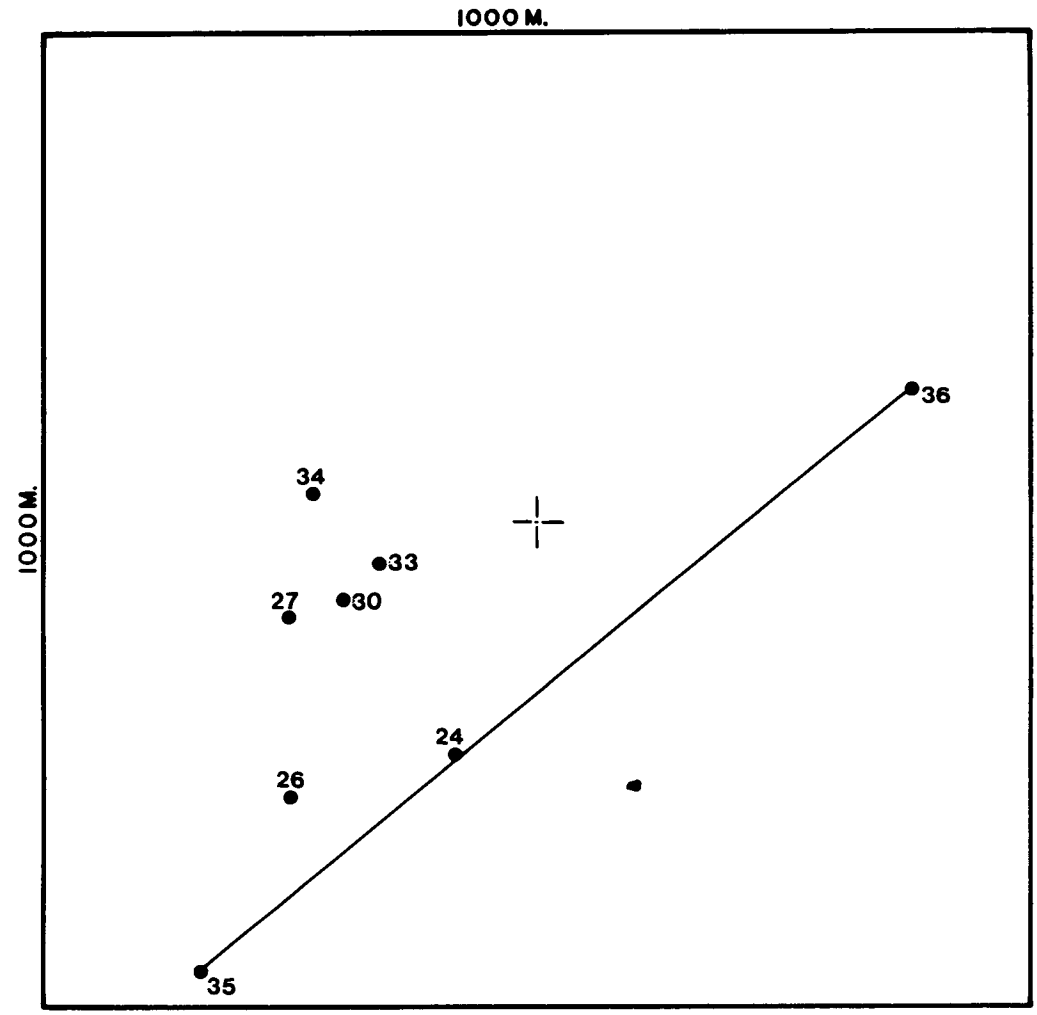


LEGEND

FIXMARK	EVENT
1-38	TV/STILL CAMERA LINE
39	BOX CORE SAMPLE A
40	BOX CORE SAMPLE B
41	BOX CORE SAMPLE C
42	BOX CORE SAMPLE D
43	BOX CORE SAMPLE E
44	BOX CORE SAMPLE F
50/51	TRAWL

= LAT. 25°16.90'
LONG. 83°43.18'

STATION 24- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

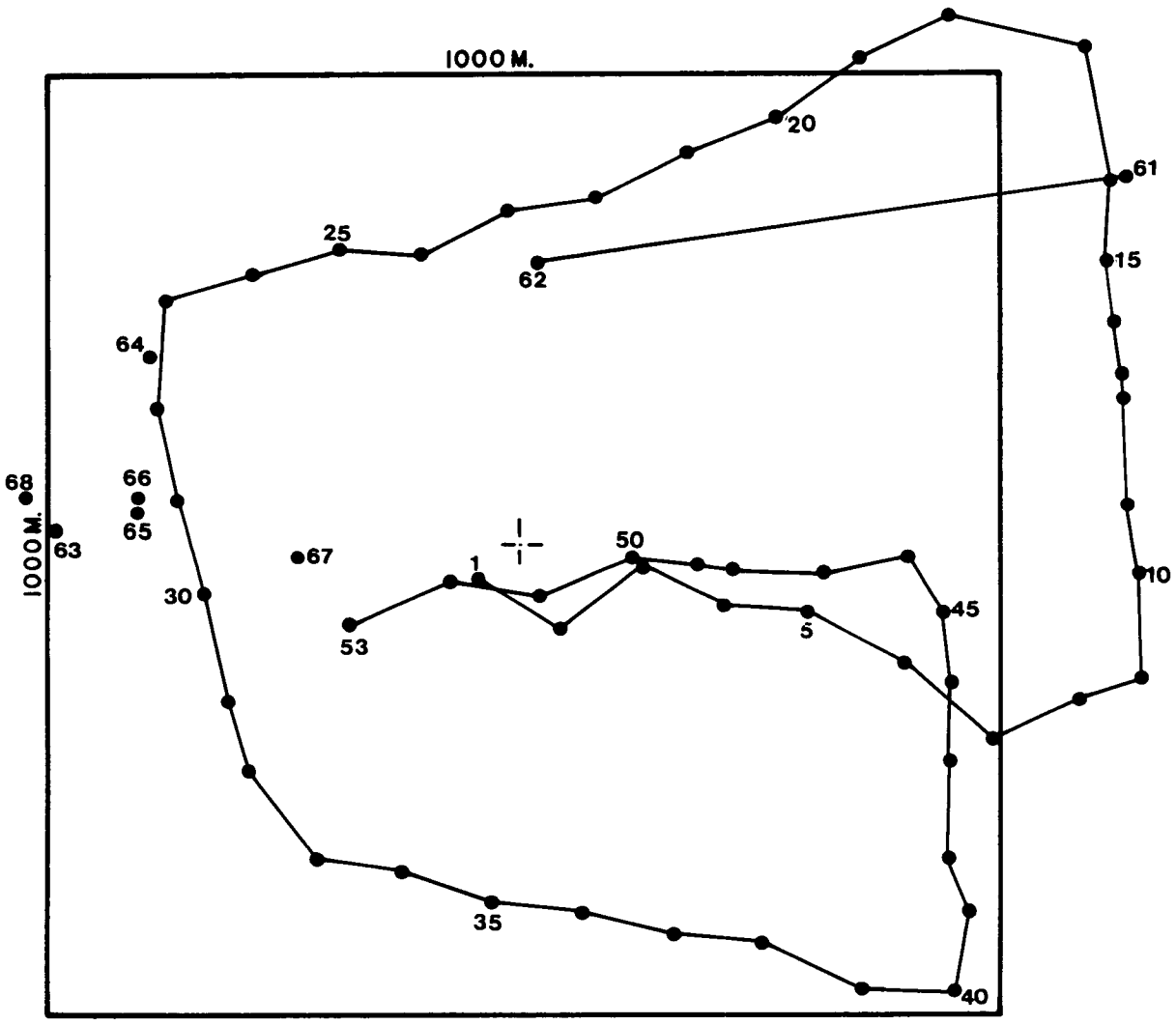


LEGEND

FIXMARK	EVENT
24	BOX CORE SAMPLE A
26	BOX CORE SAMPLE B
27	BOX CORE SAMPLE C
30	BOX CORE SAMPLE D
33	BOX CORE SAMPLE E
34	BOX CORE SAMPLE F
35/36	TRAWL

= LAT. 24°47.95'
LONG. 82°13.26'

STATION 25- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

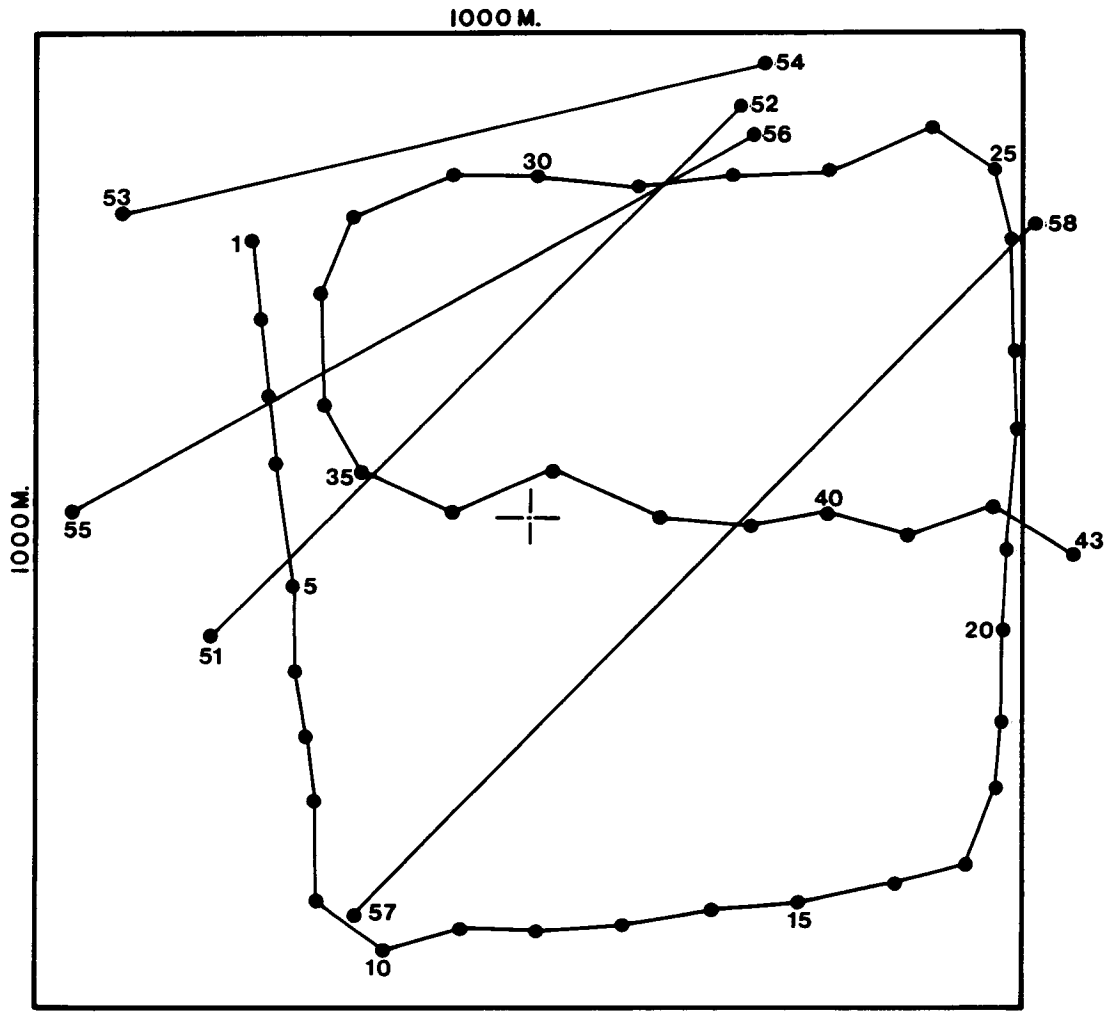


LEGEND

FIXMARK	EVENT
1-53	TV/STILL CAMERA LINE
61/62	TRAWL
63	BOX CORE SAMPLE A
64	BOX CORE SAMPLE B
65	BOX CORE SAMPLE C
66	BOX CORE SAMPLE D
67	BOX CORE SAMPLE E
68	BOX CORE SAMPLE F

= LAT. 24°47.82'
LONG. 82°52.07'

STATION 26- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

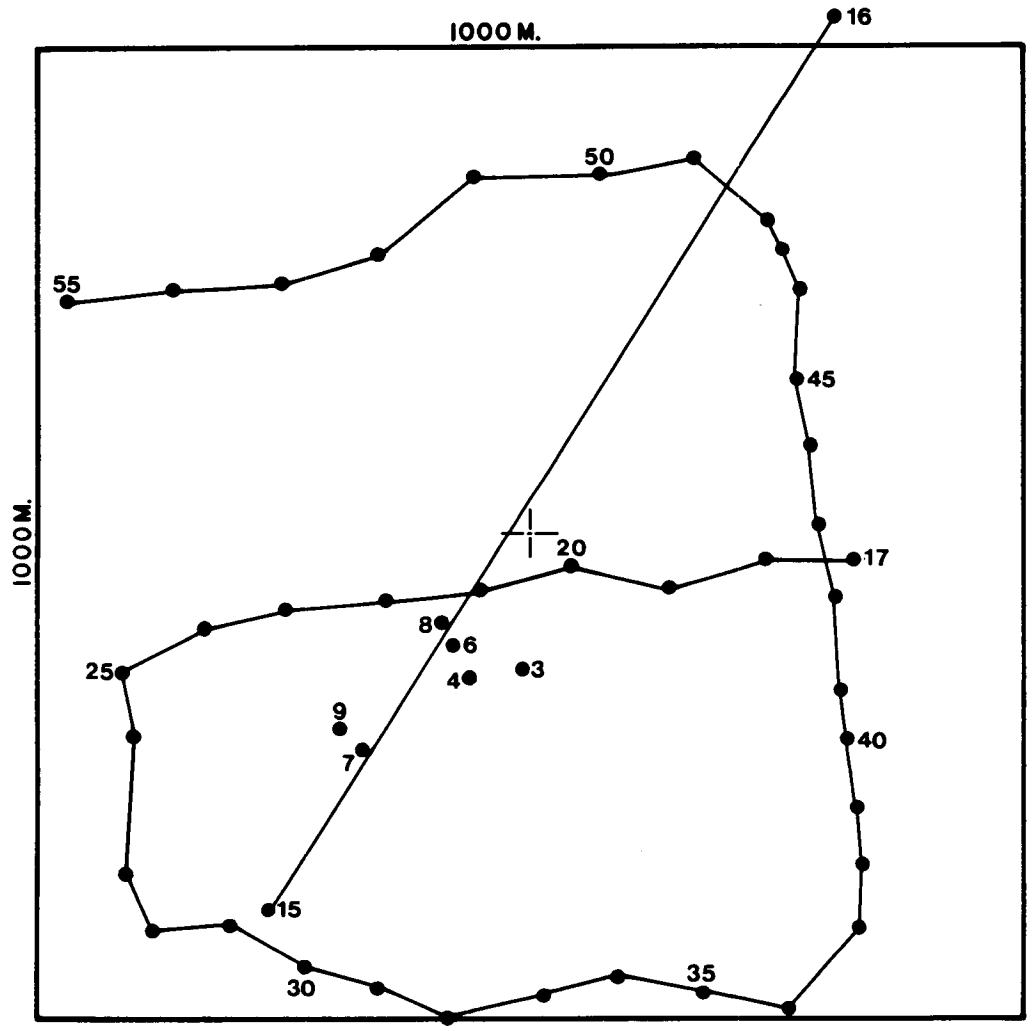


LEGEND

FIXMARK	EVENT
1-43	TV/STILL CAMERA LINE
51/52	DREDGE A
53/54	DREDGE B
55/56	DREDGE C
57/58	TRAWL

= LAT. 24°47.76'
LONG. 83°08.01'

STATION 27- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

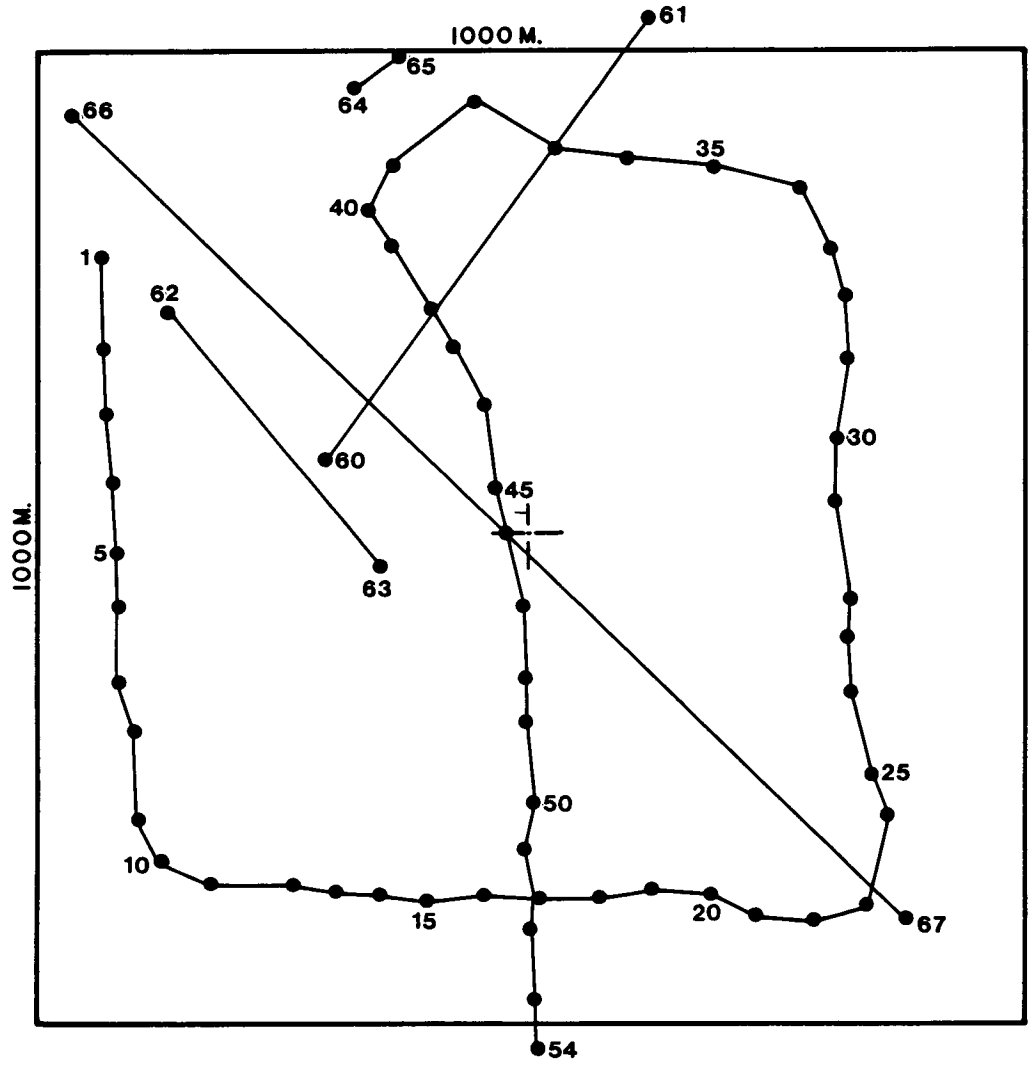


LEGEND

FIXMARK	EVENT
3	BOX CORE SAMPLE A
4	BOX CORE SAMPLE B
6	BOX CORE SAMPLE C
7	BOX CORE SAMPLE D
8	BOX CORE SAMPLE E
9	BOX CORE SAMPLE F
15/16	TRAWL
17-55	TV/STILL CAMERA LINE

= LAT. 24°47.11′
LONG. 83°13.08′

STATION 28- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

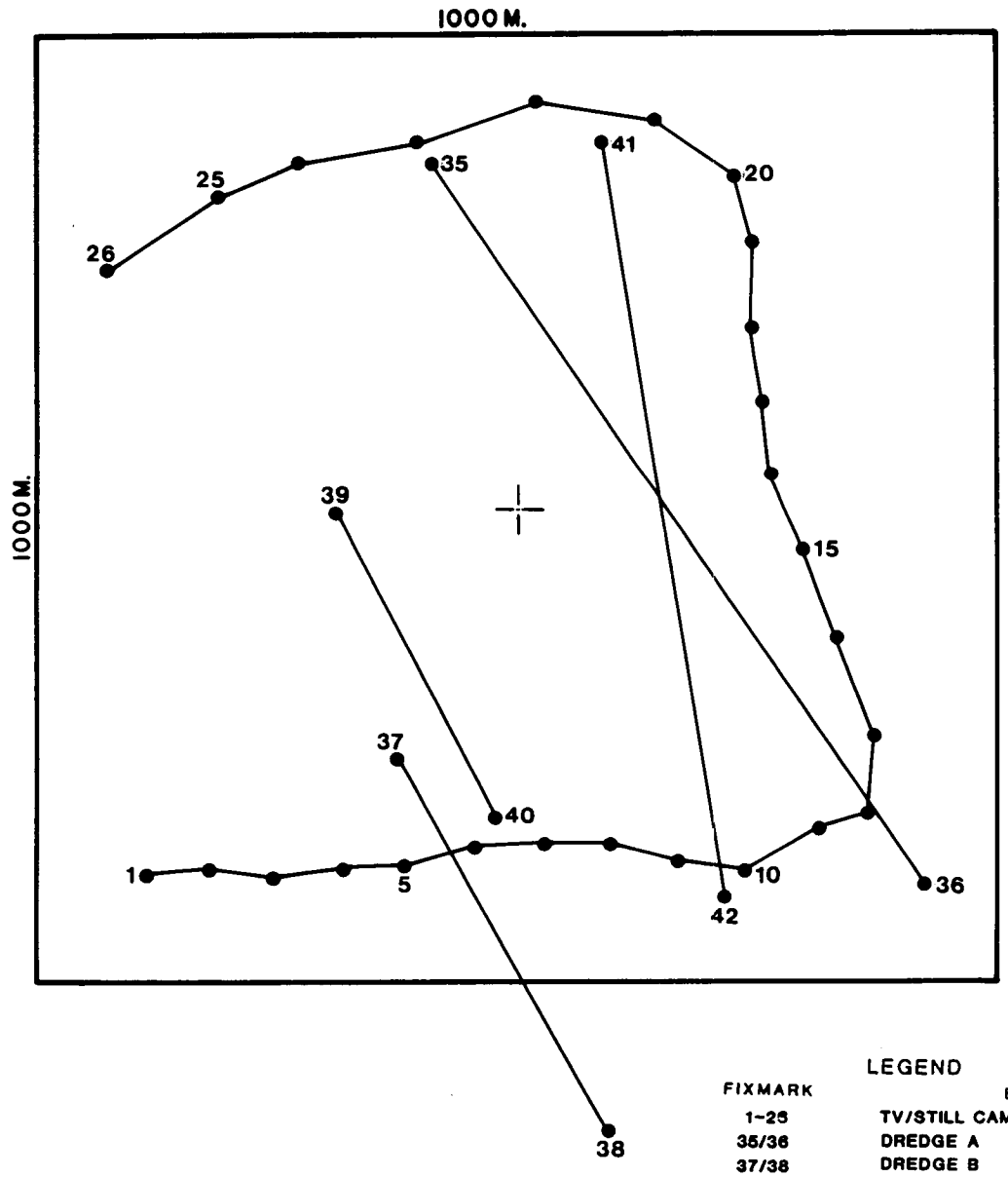


LEGEND

FIXMARK	EVENT
1-54	TV/STILL CAMERA LINE
60/61	DREDGE A
62/63	DREDGE B
64/65	DREDGE C
66/67	TRAWL

= LAT. 24°47.51'
LONG. 83°41.19'

STATION 29- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

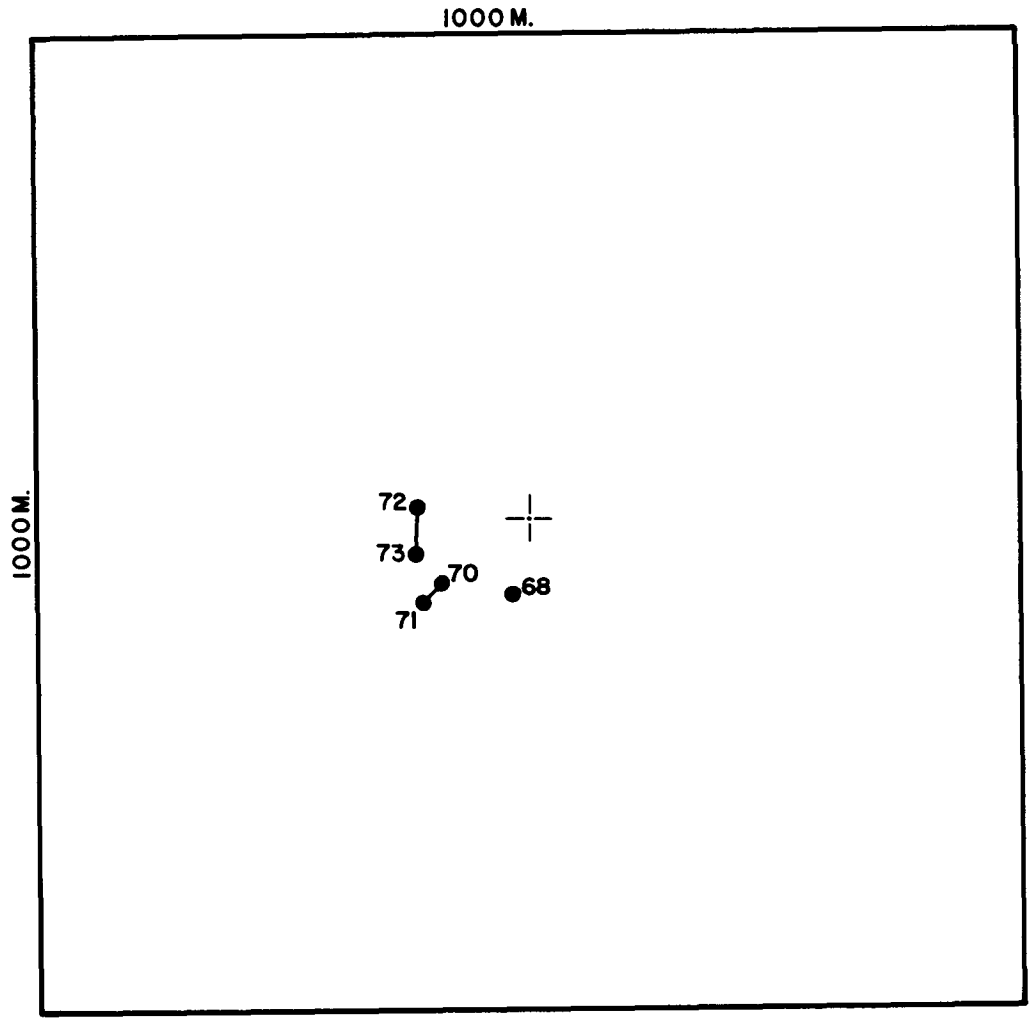


LEGEND

FIXMARK	EVENT
1-26	TV/STILL CAMERA LINE
35/36	DREDGE A
37/38	DREDGE B
39/40	DREDGE C
41/42	TRAWL

= LAT. 24°47.41'
LONG. 83°51.15'

STATION 30- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE III

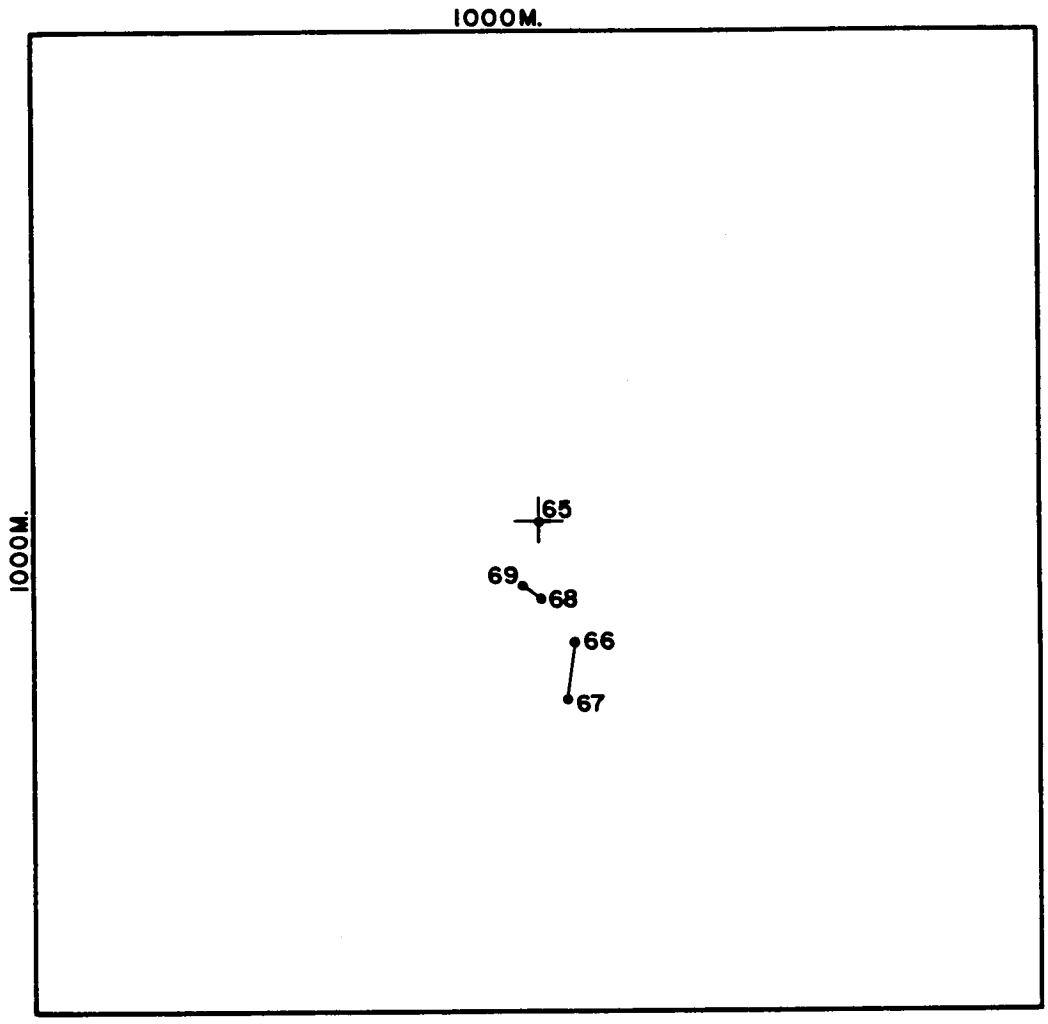


LEGEND

FIXMARK	EVENT
68	HYDROCAST
70	BEGIN HYDROLAB PROFILE
71	END HYDROLAB PROFILE
72	BEGIN TRANSMISSOMETER PROFILE
73	END TRANSMISSOMETER PROFILE

+ = LAT. 26°45.77'
LONG. 82°43.11'

STATION 1- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE IV

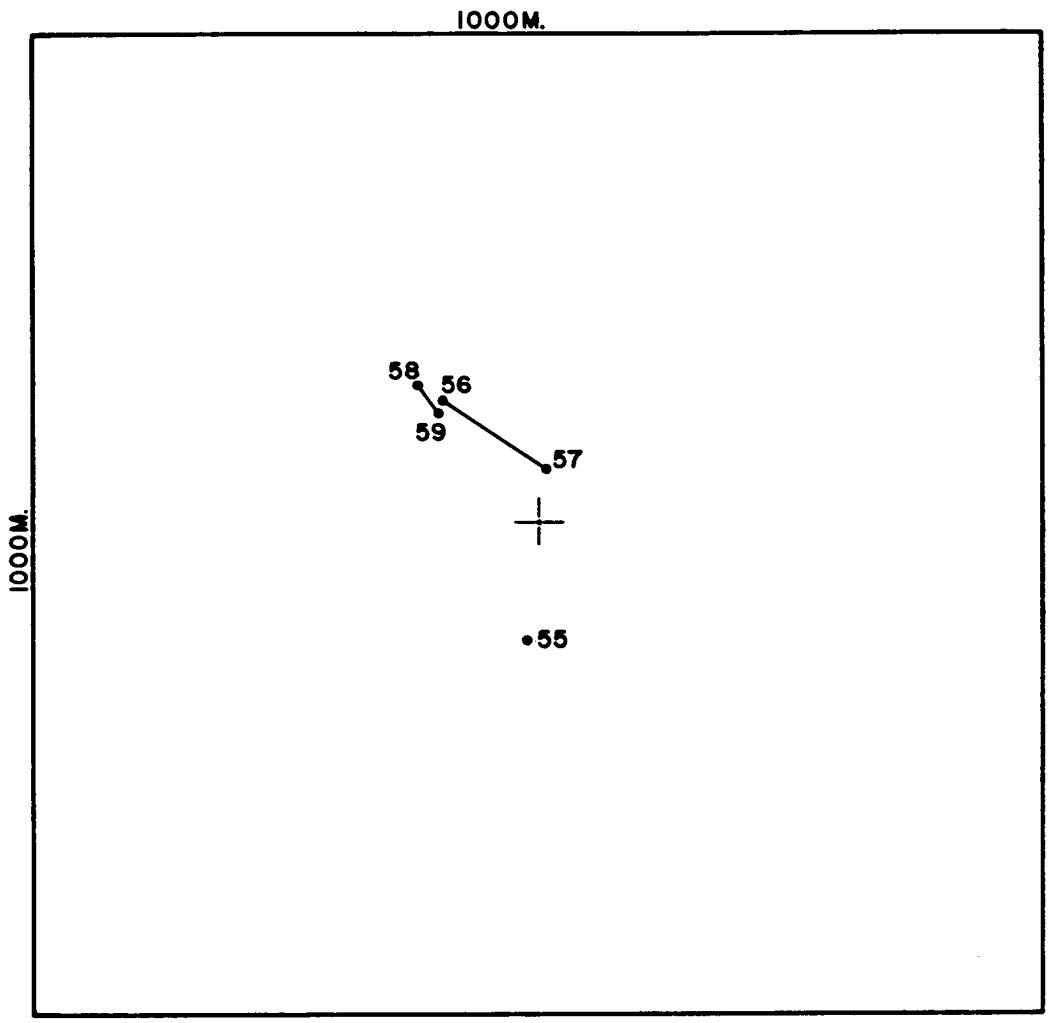


LEGEND

FIXMARK	EVENT
65	HYDROCAST
66	BEGIN HYDROLAB PROFILE
67	END HYDROLAB PROFILE
68	BEGIN TRANSMISSOMETER PROFILE
69	END TRANSMISSOMETER PROFILE

= LAT. 26°45.84′
LONG. 82°45.18′

STATION 2- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

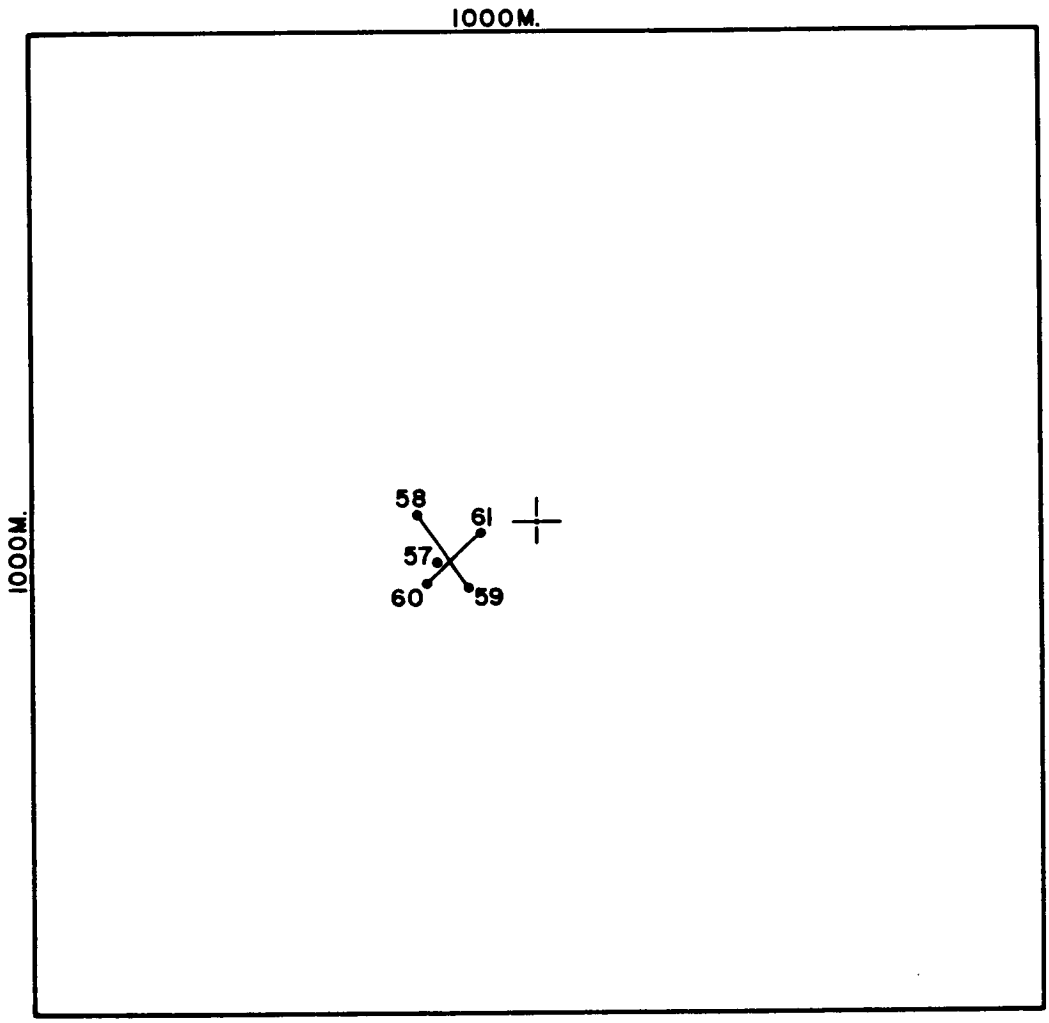


LEGEND

FIXMARK	EVENT
55	HYDROCAST
56	BEGIN HYDROLAB PROFILE
57	END HYDROLAB PROFILE
58	BEGIN TRANSMISSOMETER PROFILE
59	END TRANSMISSOMETER PROFILE

= LAT. 26°45.86'
LONG. 83°21.44'

STATION 3- WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE IV

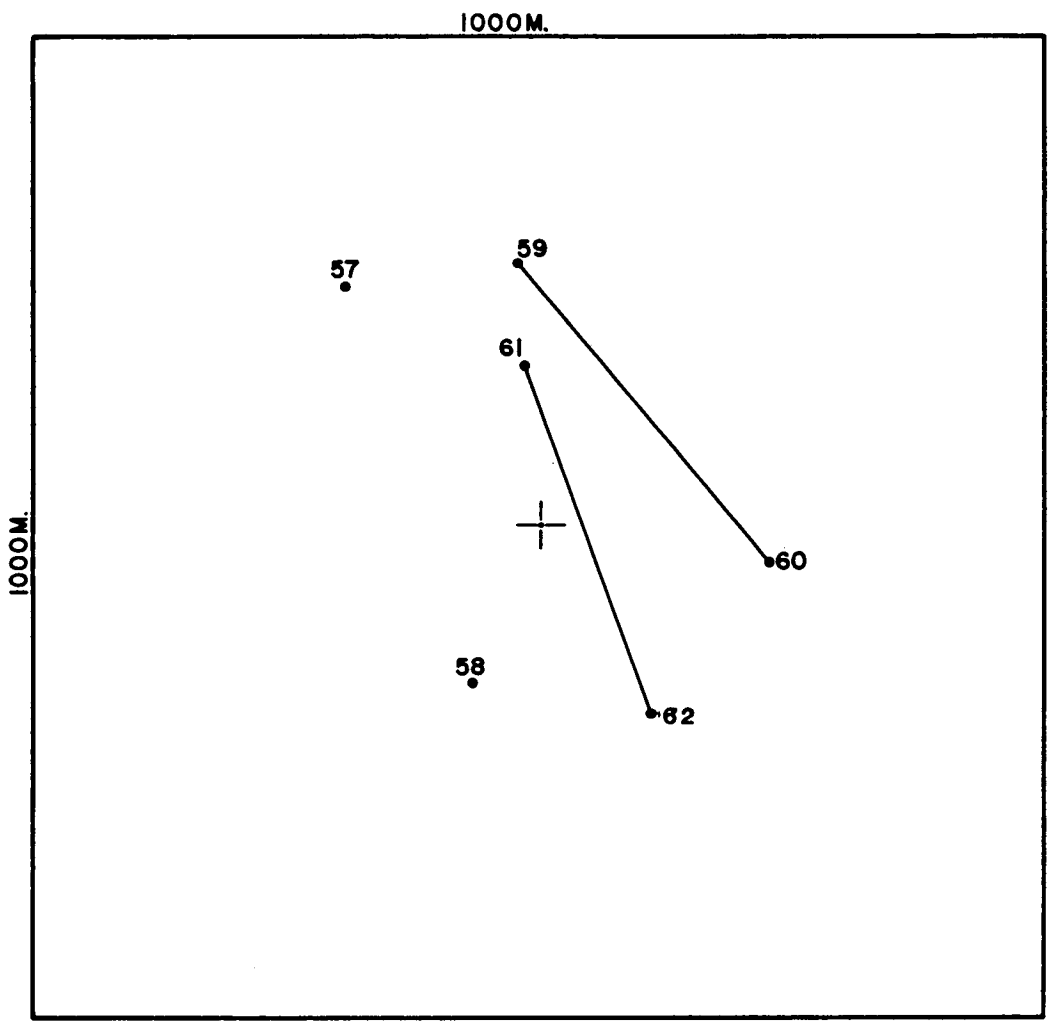


LEGEND

FIXMARK	EVENT
57	HYDROCAST
58	BEGIN HYDROLAB PROFILE
59	END HYDROLAB PROFILE
60	BEGIN TRANSMISSOMETER PROFILE
61	END TRANSMISSOMETER PROFILE

= LAT. 26°45.81′
LONG. 83°32.12′

STATION 4- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

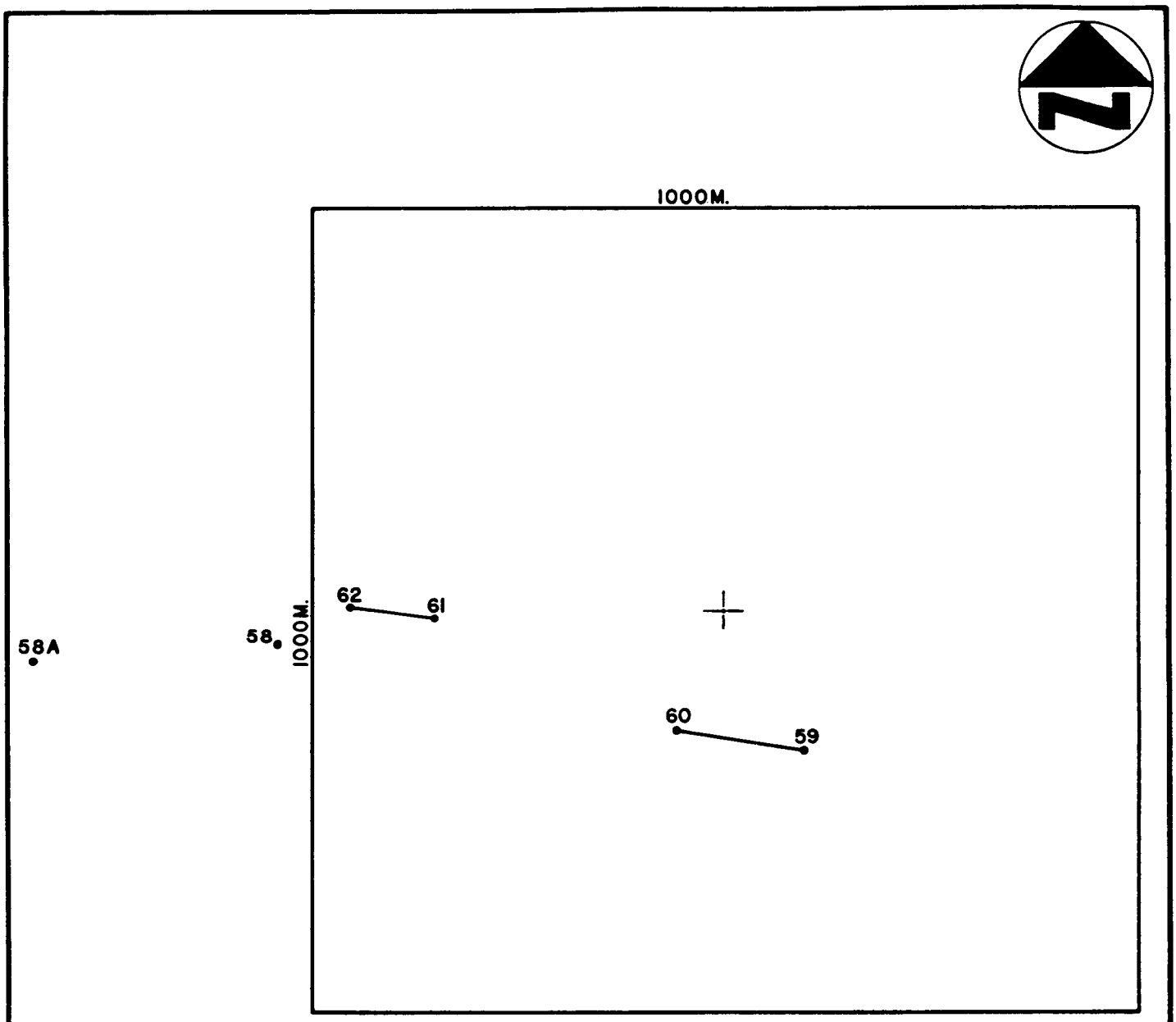


LEGEND

FIXMARK	EVENT	FIXMARK	EVENT
57	HYDROCAST A	60	END HYDROLAB PROFILE
58	HYDROCAST B	61	BEGIN TRANSMISSOMETER PROFILE
59	BEGIN HYDROLAB PROFILE	62	END TRANSMISSOMETER PROFILE

= LAT. 26°45.70'
LONG. 84°00.13'

STATION 5- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

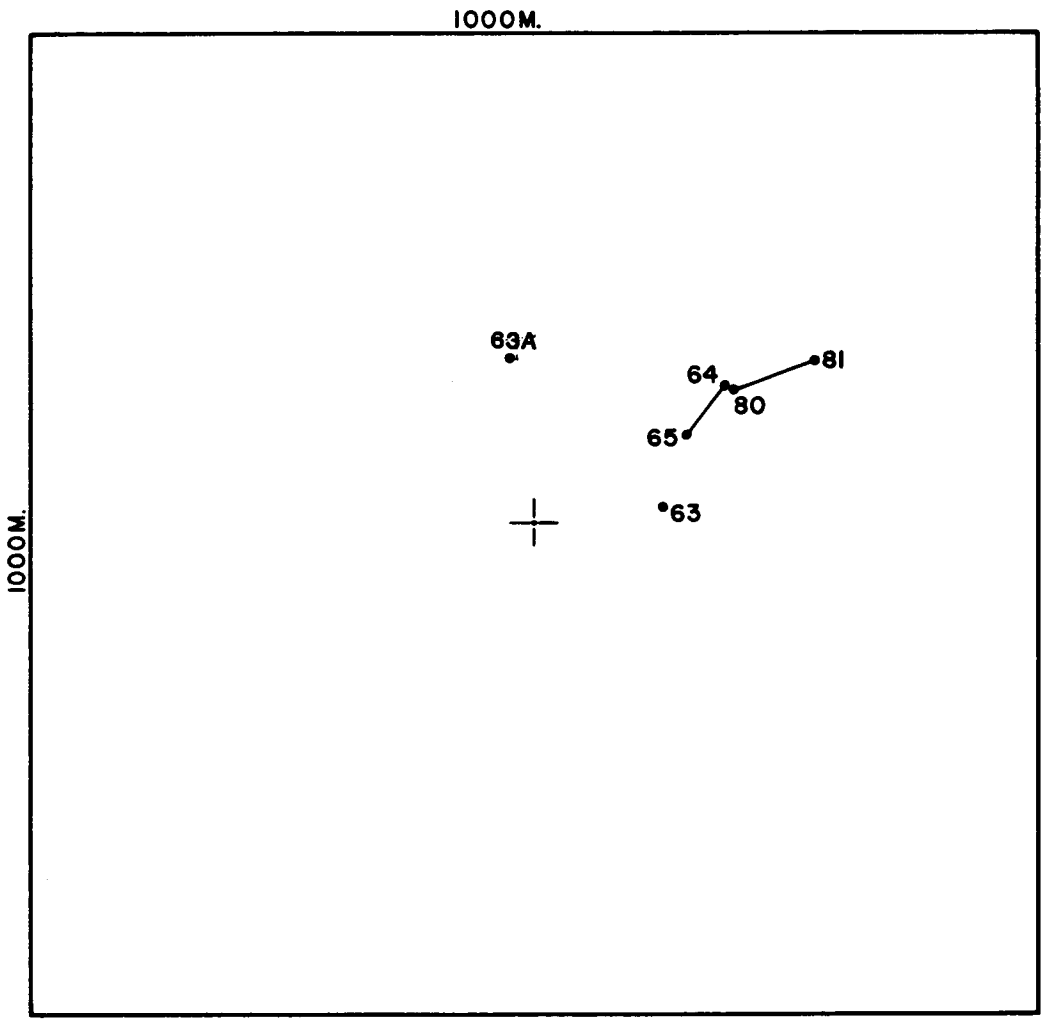


LEGEND

FIXMARK	EVENT	FIXMARK	EVENT
58	HYDROCAST A	60	END HYDROLAB PROFILE
58A	HYDROCAST B	61	BEGIN TRANSMISSOMETER PROFILE
59	BEGIN HYDROLAB PROFILE	62	END TRANSMISSOMETER PROFILE

= LAT. 26°16.79'
LONG. 82°38.35'

STATION ● WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

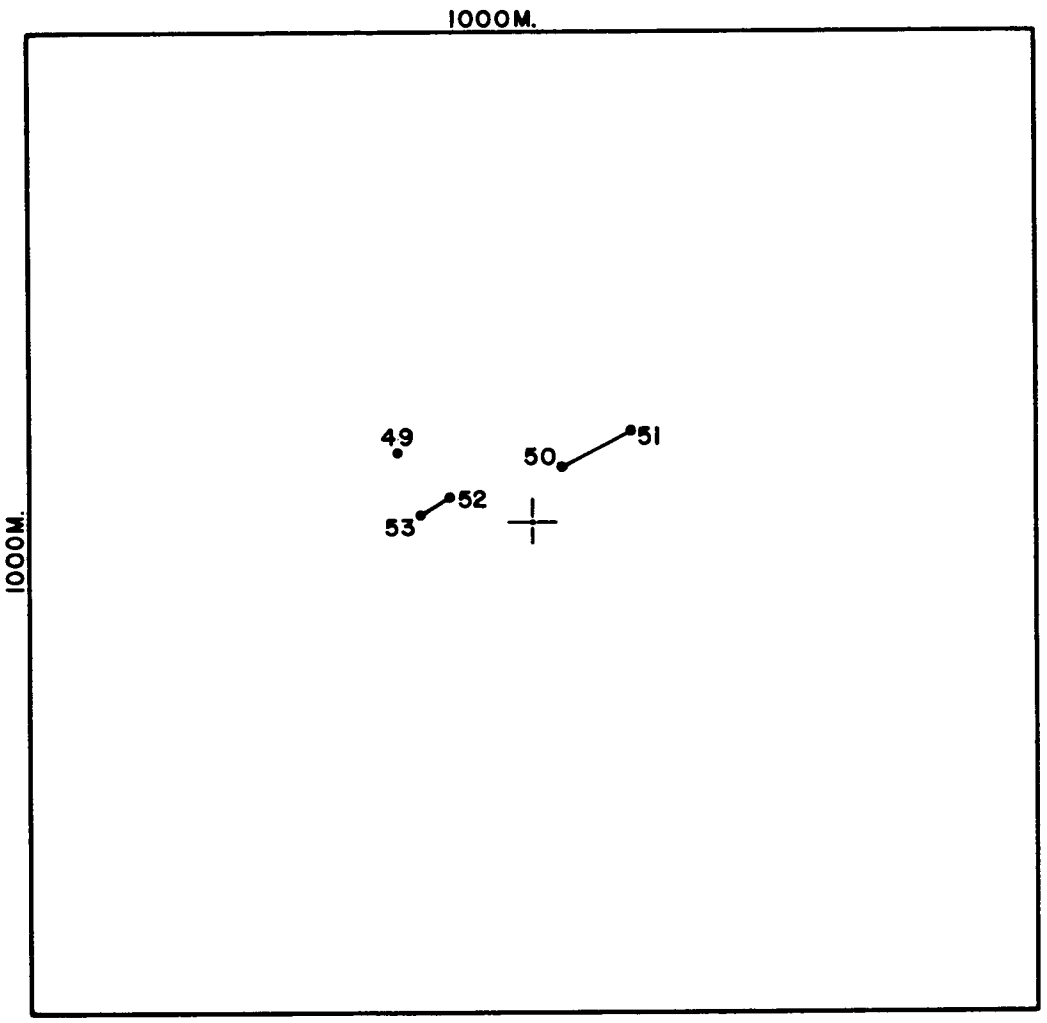


LEGEND

FIXMARK	EVENT	FIXMARK	EVENT
63	HYDROCAST A	65	END HYDROLAB PROFILE
63A	HYDROCAST B	80	BEGIN TRANSMISSOMETER PROFILE
64	BEGIN HYDROLAB PROFILE	81	END TRANSMISSOMETER PROFILE

= LAT. 26°16.82'
LONG. 82°44.02'

STATION 7- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

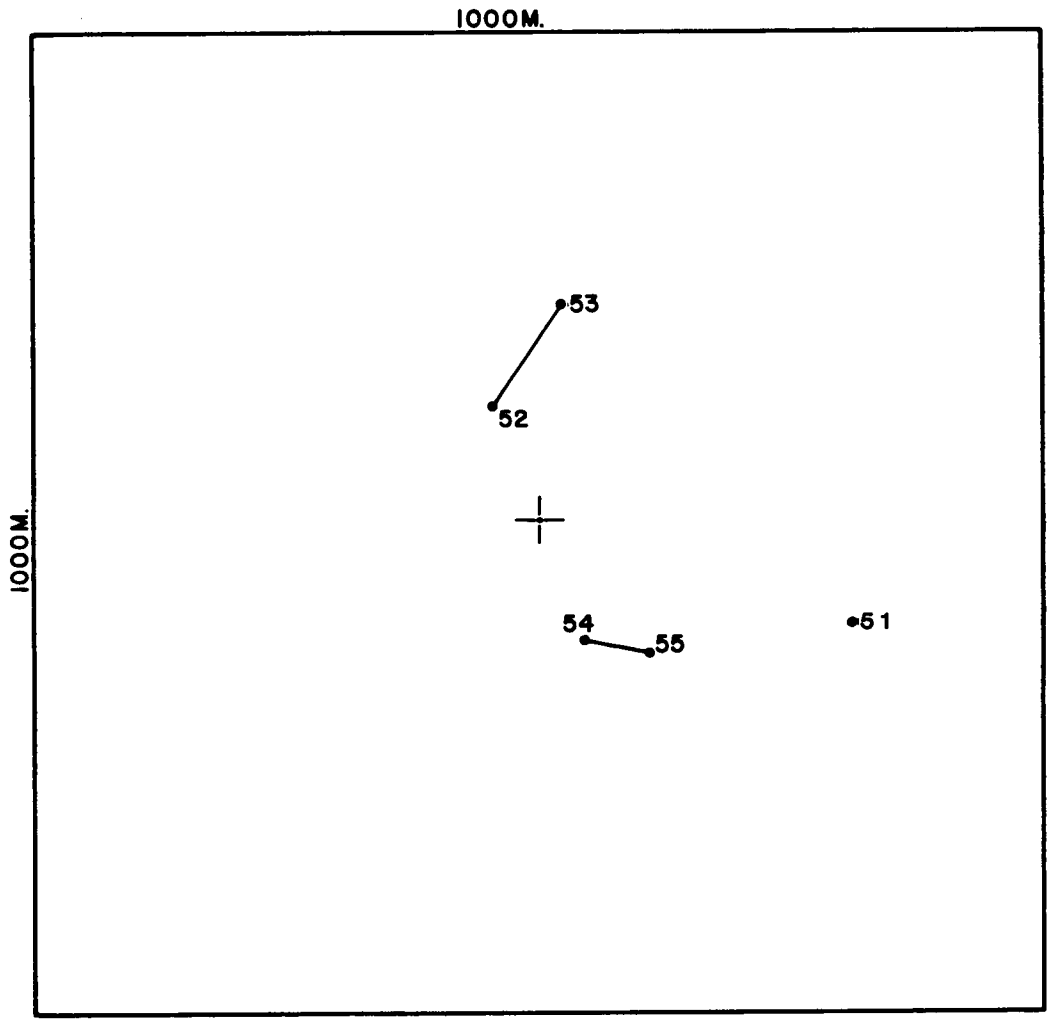


LEGEND

FIXMARK	EVENT
49	HYDROCAST
50	BEGIN HYDROLAB PROFILE
51	END HYDROLAB PROFILE
52	BEGIN TRANSMISSOMETER PROFILE
53	END TRANSMISSOMETER PROFILE

= LAT. 26° 16.72'
LONG. 83° 12.81'

STATION 8- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

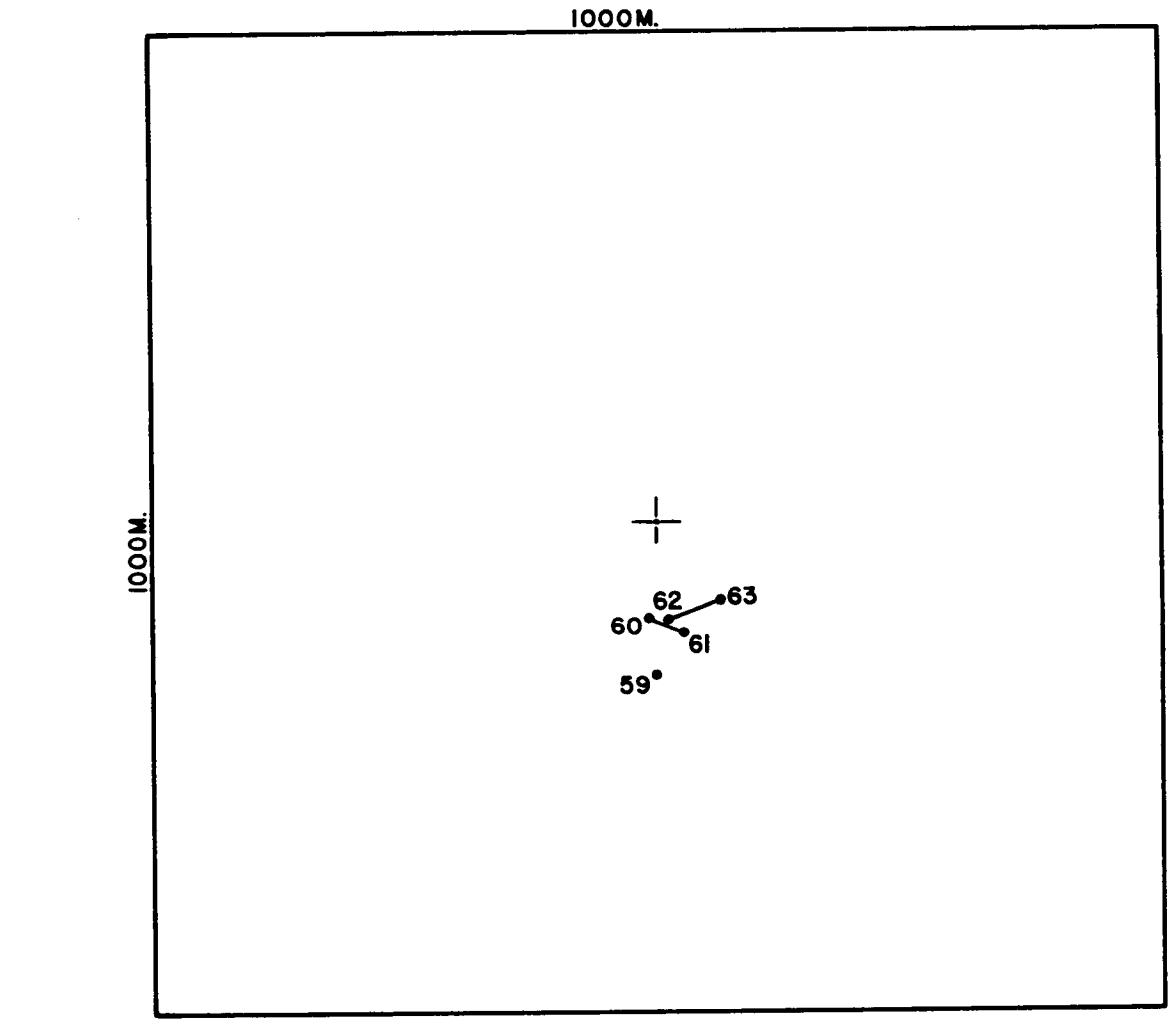


LEGEND

FIXMARK	EVENT
51	HYDROCAST
52	BEGIN HYDROLAB PROFILE
53	END HYDROLAB PROFILE
54	BEGIN TRANSMISSOMETER PROFILE
55	END TRANSMISSOMETER PROFILE

= LAT. 26°16.83'
LONG. 83°23.81'

STATION 9- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

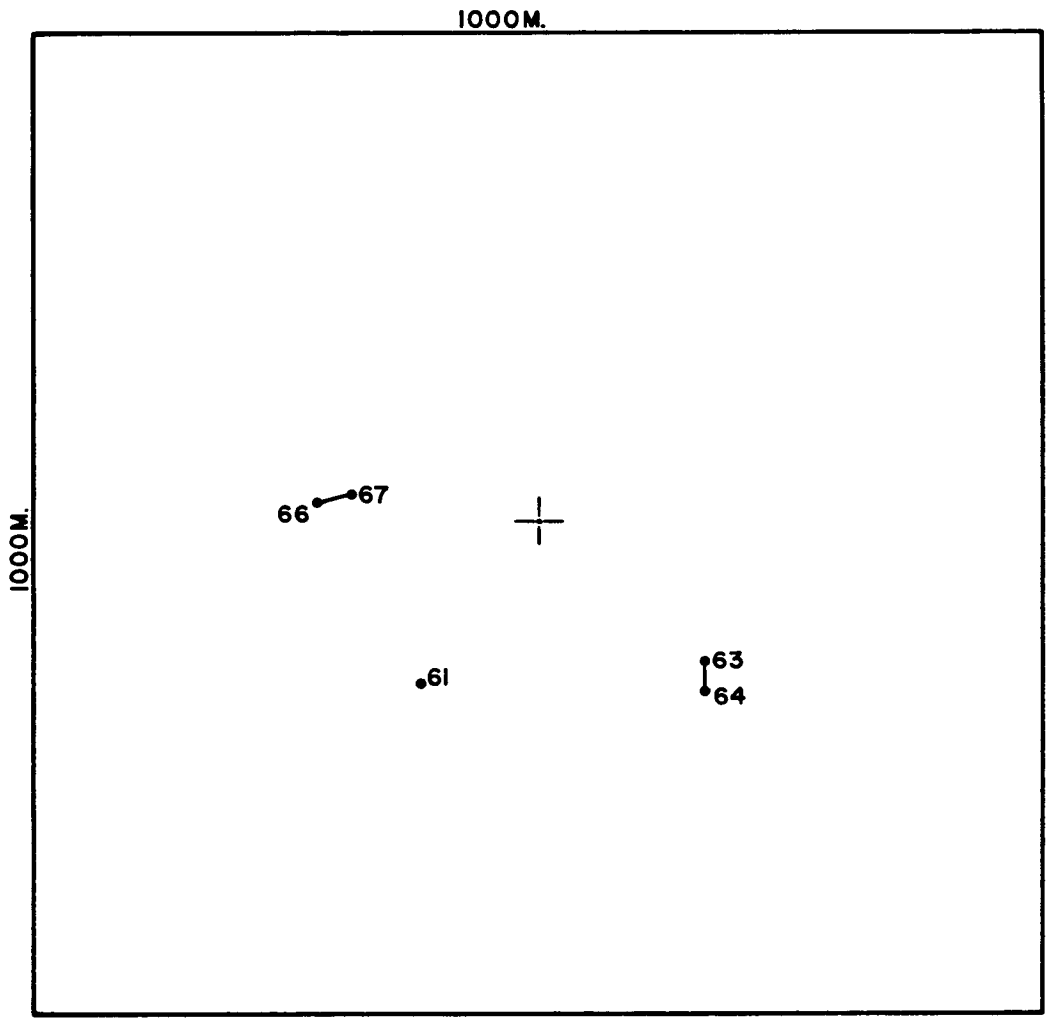


LEGEND

FIXMARK	EVENT
59	HYDROCAST
60	BEGIN HYDROLAB PROFILE
61	END HYDROLAB PROFILE
62	BEGIN TRANSMISSOMETER PROFILE
63	END TRANSMISSOMETER PROFILE

= LAT. 26°16.73'
LONG. 83°42.81'

STATION 10- WATER COLUMN DATA AND SAMPLE LOCATIONS — CRUISE IV

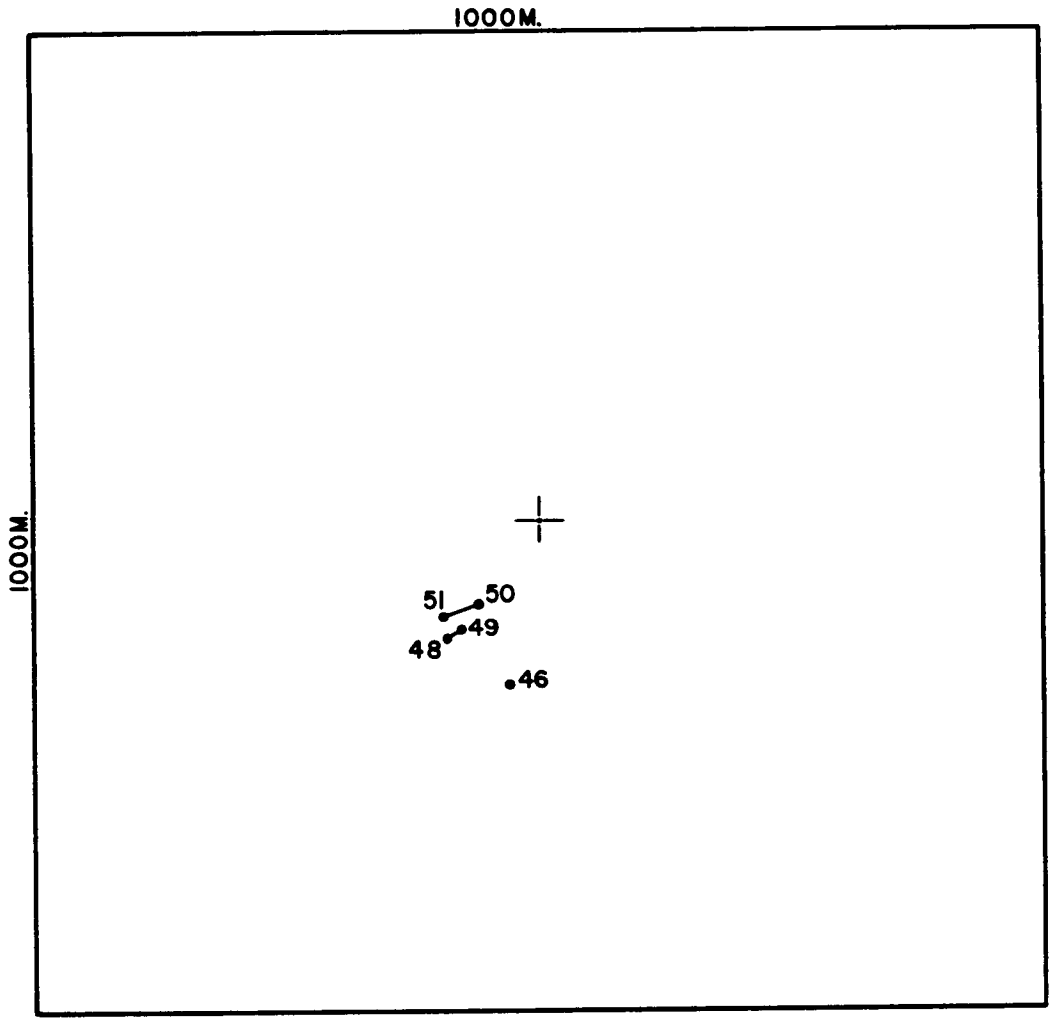


LEGEND

FIXMARK	EVENT
61	HYDROCAST
63	BEGIN HYDROLAB PROFILE
64	END HYDROLAB PROFILE
66	BEGIN TRANSMISSOMETER PROFILE
67	END TRANSMISSOMETER PROFILE

= LAT. 26°16.72'
LONG. 83°46.82'

STATION 11- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

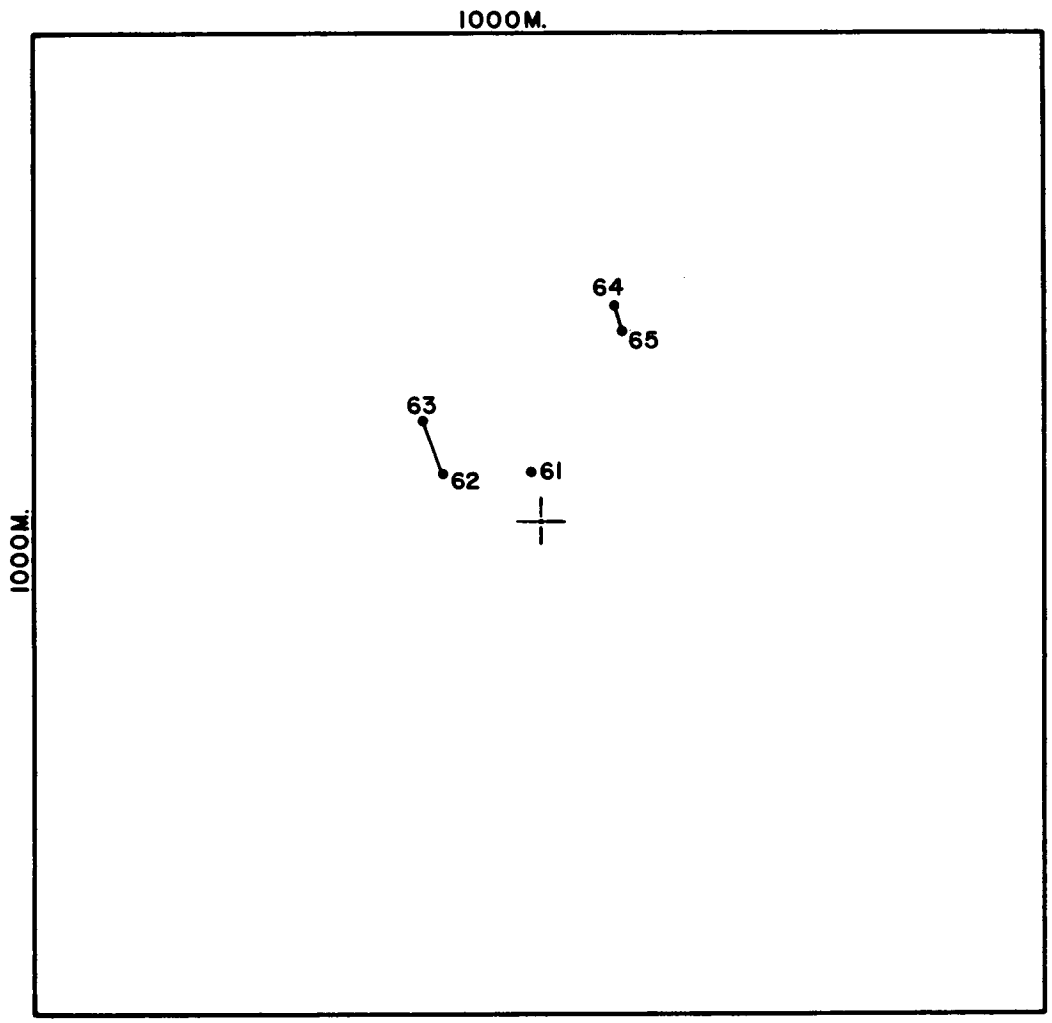


LEGEND

FIXMARK	EVENT
46	HYDROCAST
48	BEGIN HYDROLAB PROFILE
49	END HYDROLAB PROFILE
50	BEGIN TRANSMISSOMETER PROFILE
51	END TRANSMISSOMETER PROFILE

= LAT. 26°16.72′
LONG. 83°47.67′

STATION 12 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

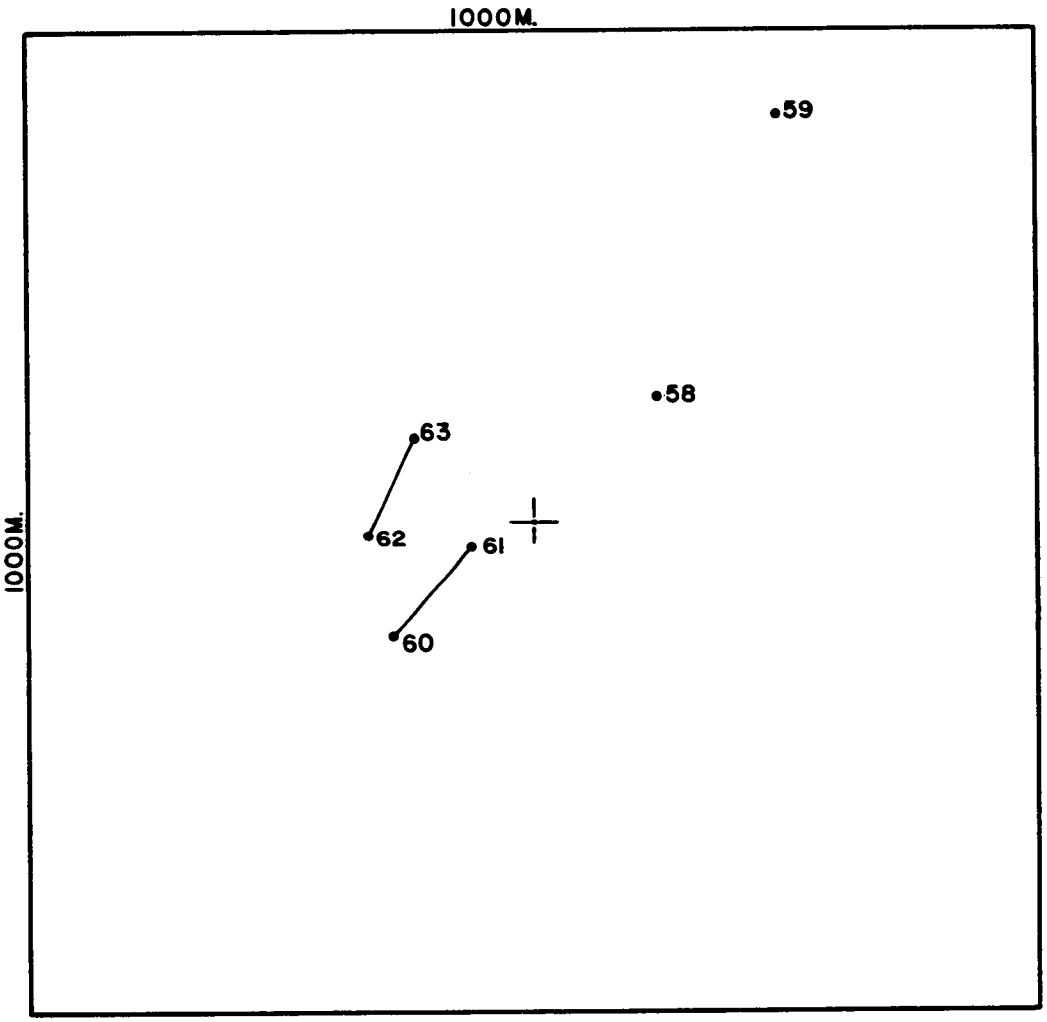


LEGEND

FIXMARK	EVENT
61	HYDROCAST
62	BEGIN HYDROLAB PROFILE
63	END HYDROLAB PROFILE
64	BEGIN TRANSMISSOMETER PROFILE
65	END TRANSMISSOMETER PROFILE

= LAT. 25°45.93′
LONG. 82°09.35′

STATION 18 WATER COLUMN DATA AND SAMPLE LOCATIONS - CRUISE IV

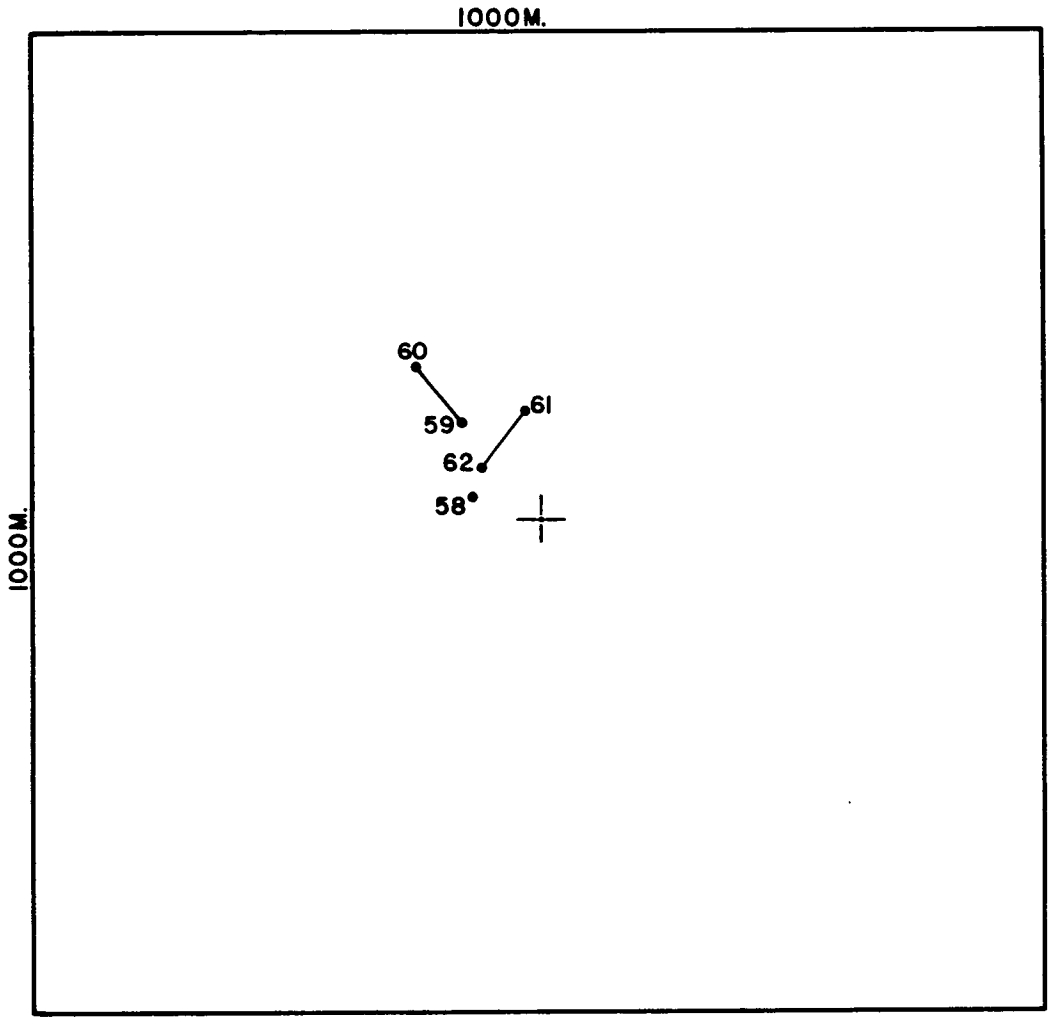


LEGEND

FIXMARK	EVENT	FIXMARK	EVENT
58	HYDROCAST A	61	END HYDROLAB PROFILE
59	HYDROCAST B	62	BEGIN TRANSMISSOMETER PROFILE
60	BEGIN HYDROLAB PROFILE	63	END TRANSMISSOMETER PROFILE

= LAT. 25°46.01'
LONG. 82°23.82'

STATION 14 WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

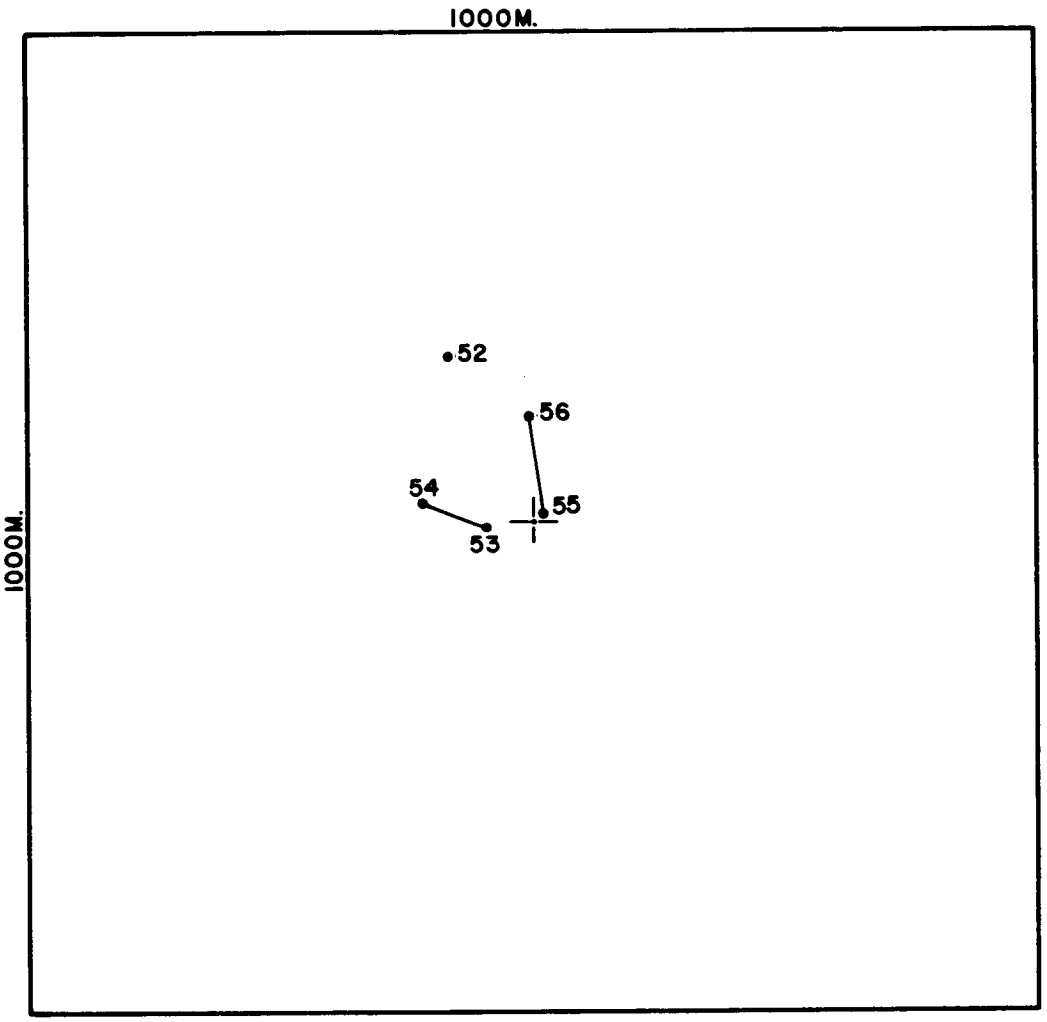


LEGEND

FIXMARK	EVENT
58	HYDROCAST
59	BEGIN HYDROLAB PROFILE
60	END HYDROLAB PROFILE
61	BEGIN TRANSMISSOMETER PROFILE
62	END TRANSMISSOMETER PROFILE

= LAT. 25°45.89'
LONG. 82°31.62'

STATION 15 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

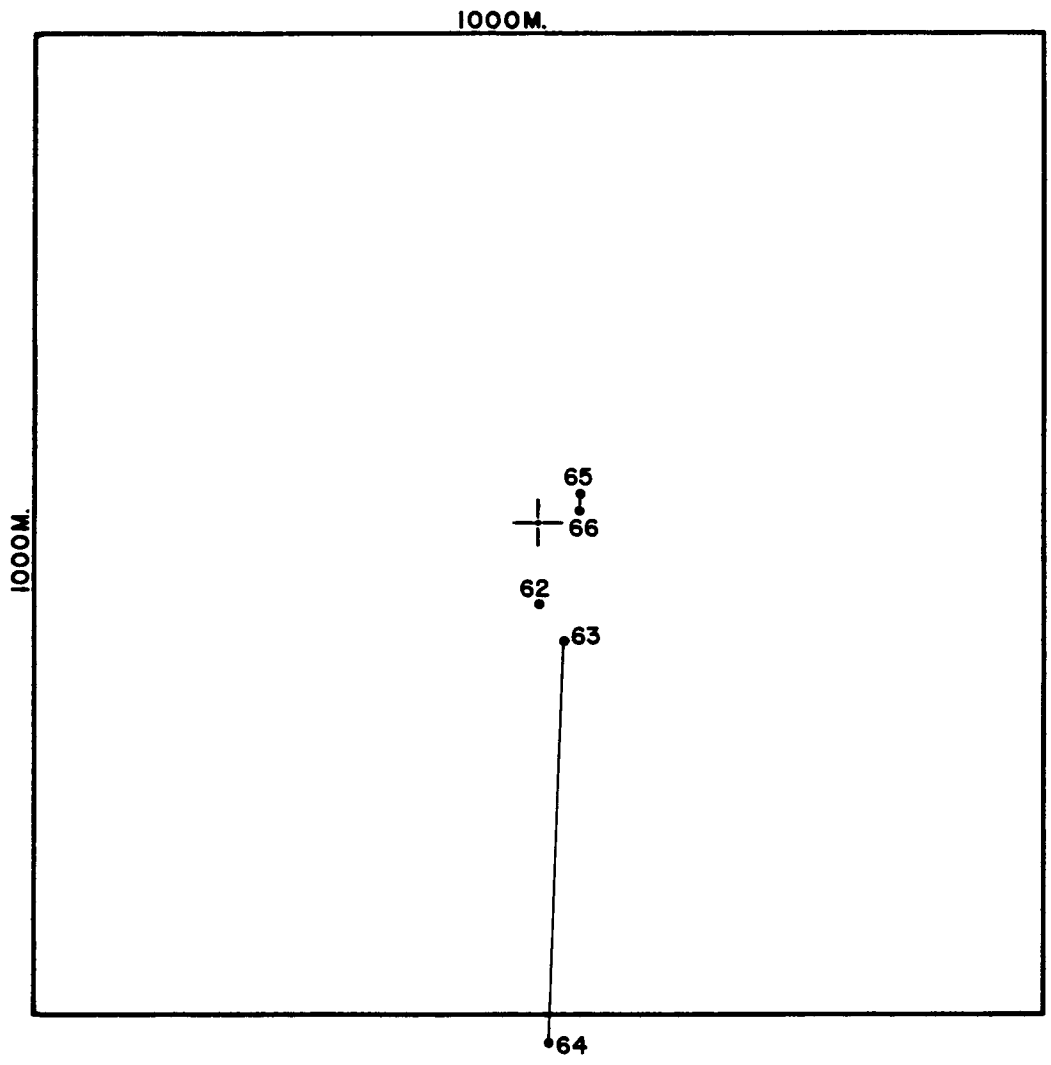


LEGEND

FIXMARK	EVENT
52	HYDROCAST
53	BEGIN HYDROLAB PROFILE
54	END HYDROLAB PROFILE
55	BEGIN TRANSMISSOMETER PROFILE
56	END TRANSMISSOMETER PROFILE

= LAT. 25°45.70'
LONG. 83°11.07'

STATION 10 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

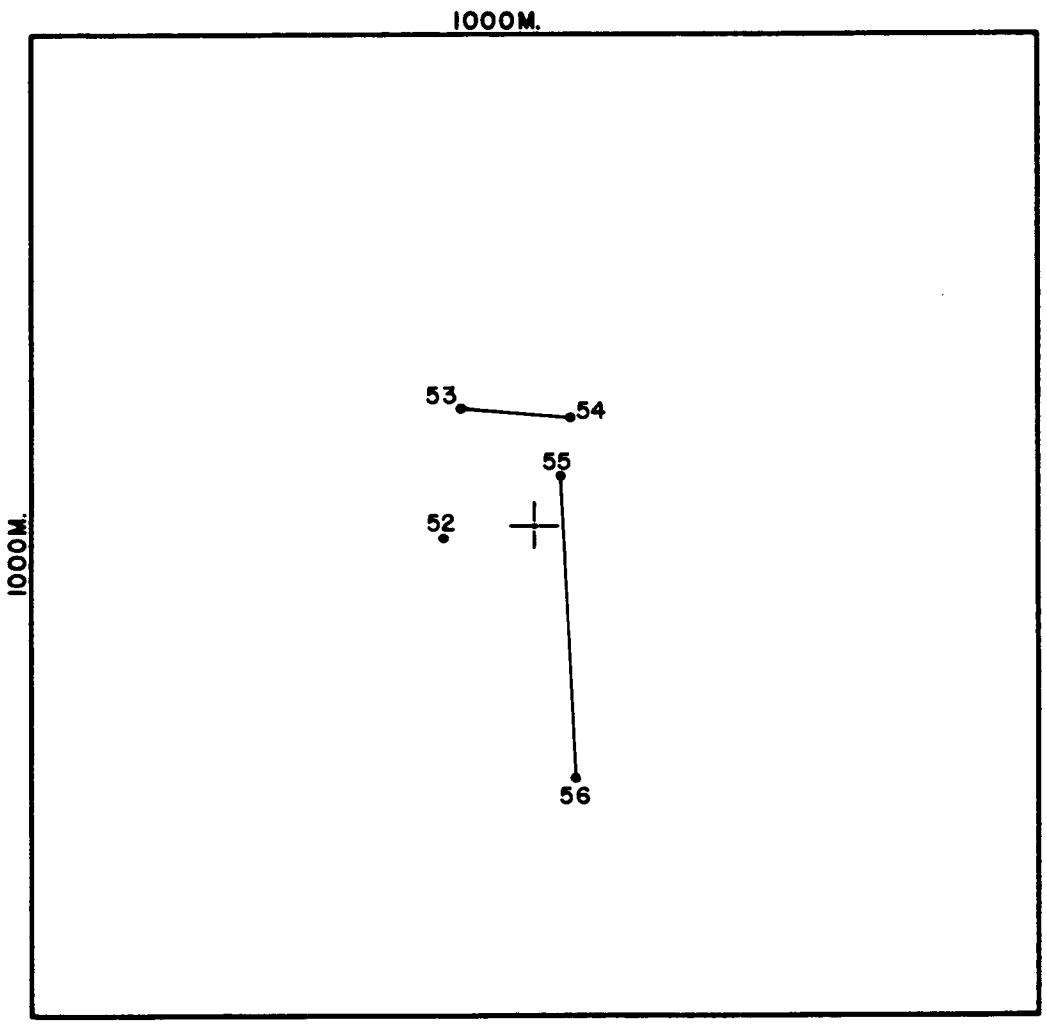


LEGEND

FIXMARK	EVENT
62	HYDROCAST
63	BEGIN HYDROLAB PROFILE
64	END HYDROLAB PROFILE
65	BEGIN TRANSMISSOMETER PROFILE
66	END TRANSMISSOMETER PROFILE

= LAT. 25°45.58'
LONG. 83°20.24'

STATION 17 WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

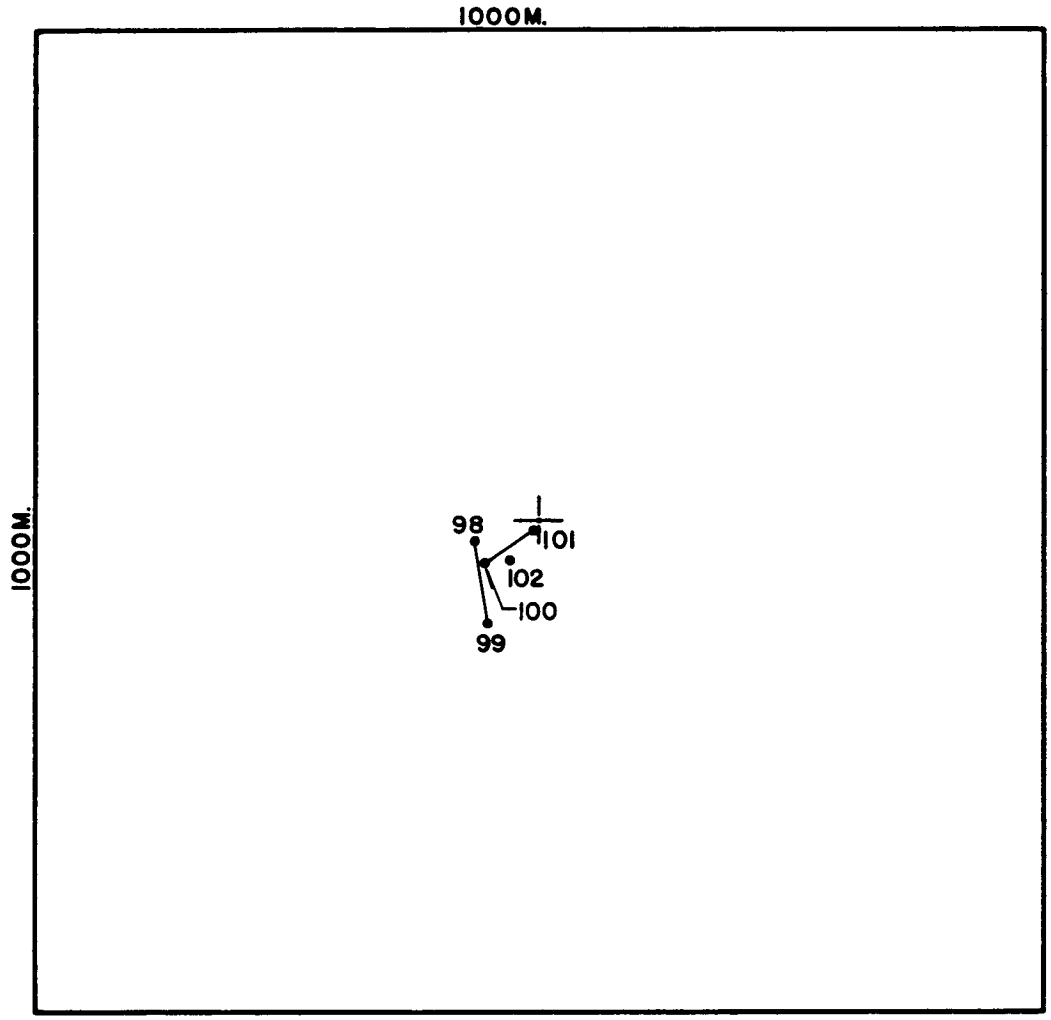


LEGEND

FIXMARK	EVENT
52	HYDROCAST
53	BEGIN HYDROLAB PROFILE
54	END HYDROLAB PROFILE
55	BEGIN TRANSMISSOMETER PROFILE
56	END TRANSMISSOMETER PROFILE

= LAT. 25°45.37′
LONG. 83°42.22′

STATION 1 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

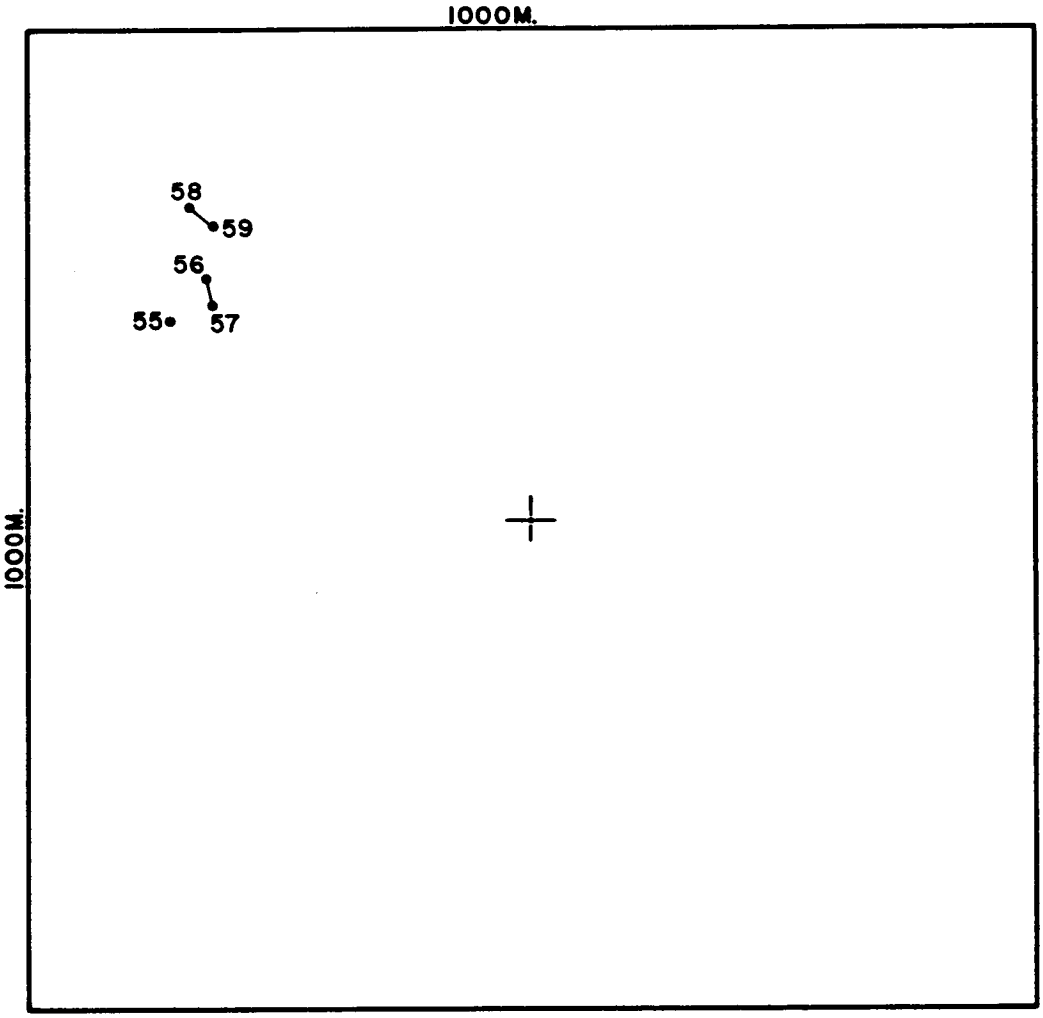


LEGEND

FIXMARK	EVENT
102	HYDROCAST
98	BEGIN HYDROLAB PROFILE
99	END HYDROLAB PROFILE
100	BEGIN TRANSMISSOMETER PROFILE
101	END TRANSMISSOMETER PROFILE

= LAT. 25°17.36'
LONG. 82°09.00'

STATION 19 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

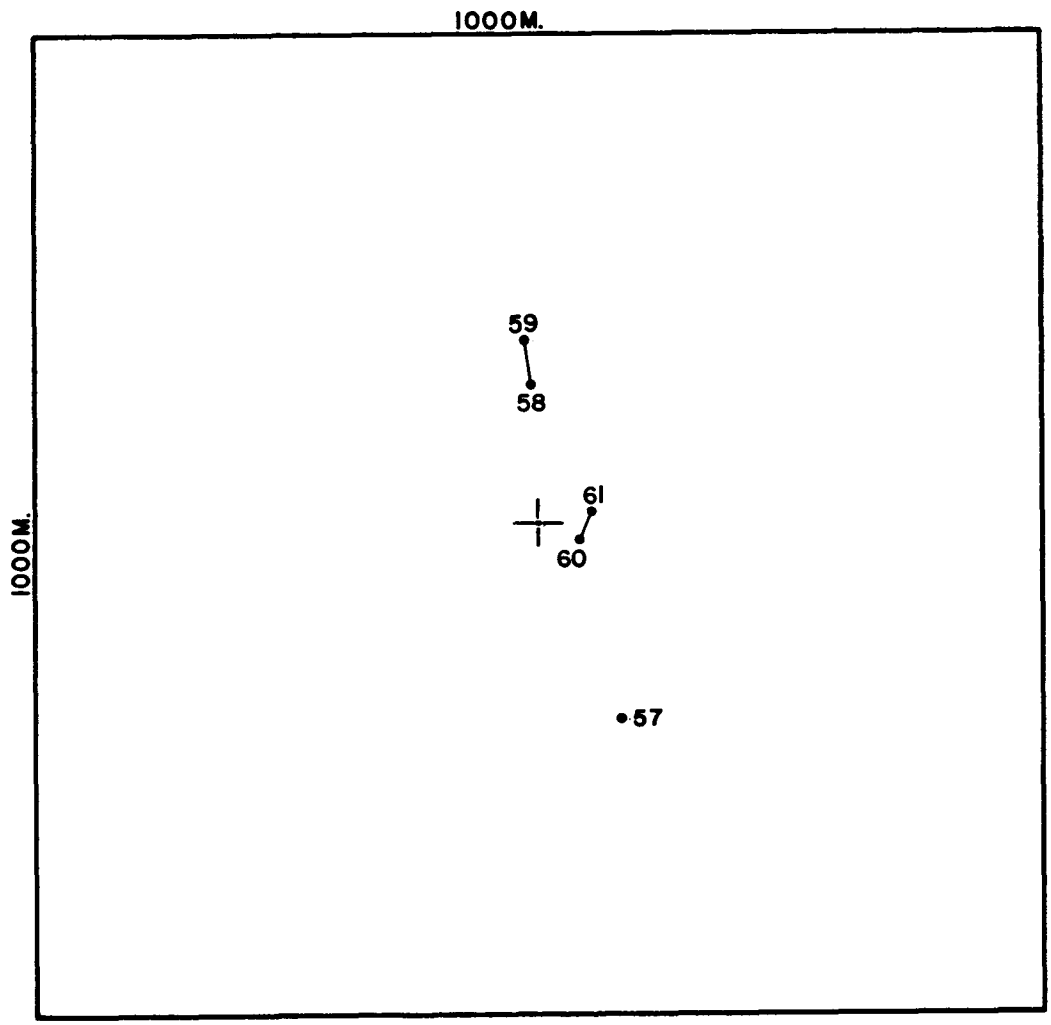


LEGEND

FIXMARK	EVENT
55	HYDROCAST
56	BEGIN HYDROLAB PROFILE
57	END HYDROLAB PROFILE
58	BEGIN TRANSMISSOMETER PROFILE
59	END TRANSMISSOMETER PROFILE

= LAT. 25°17.34'
LONG. 82°09.73'

STATION 20- WATER COLUMN DATA AND SAMPLE LOCATIONS — CRUISE IV

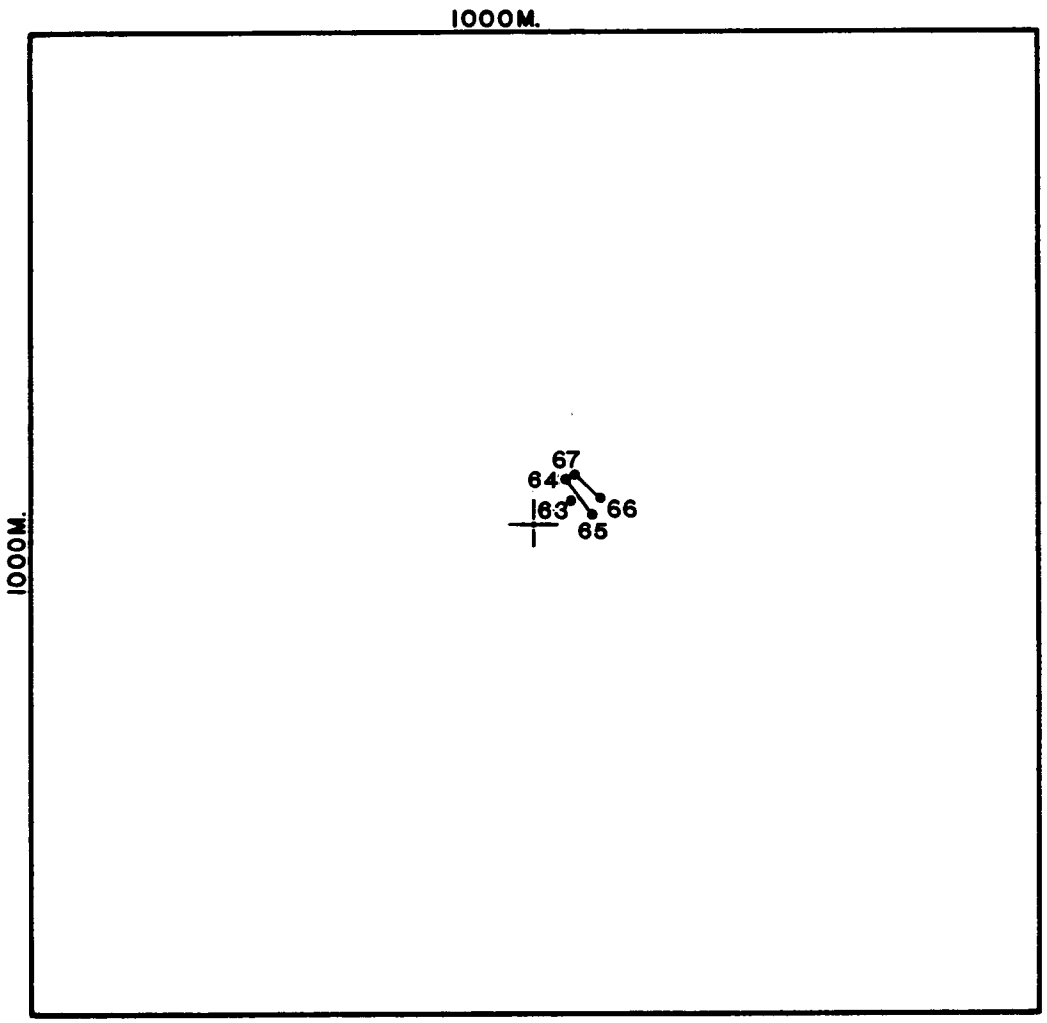


LEGEND

FIXMARK	EVENT
57	HYDROCAST
58	BEGIN HYDROLAB PROFILE
59	END HYDROLAB PROFILE
60	BEGIN TRANSMISSOMETER PROFILE
61	END TRANSMISSOMETER PROFILE

= LAT. 25°17.26'
LONG. 82°52.16'

STATION 21- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

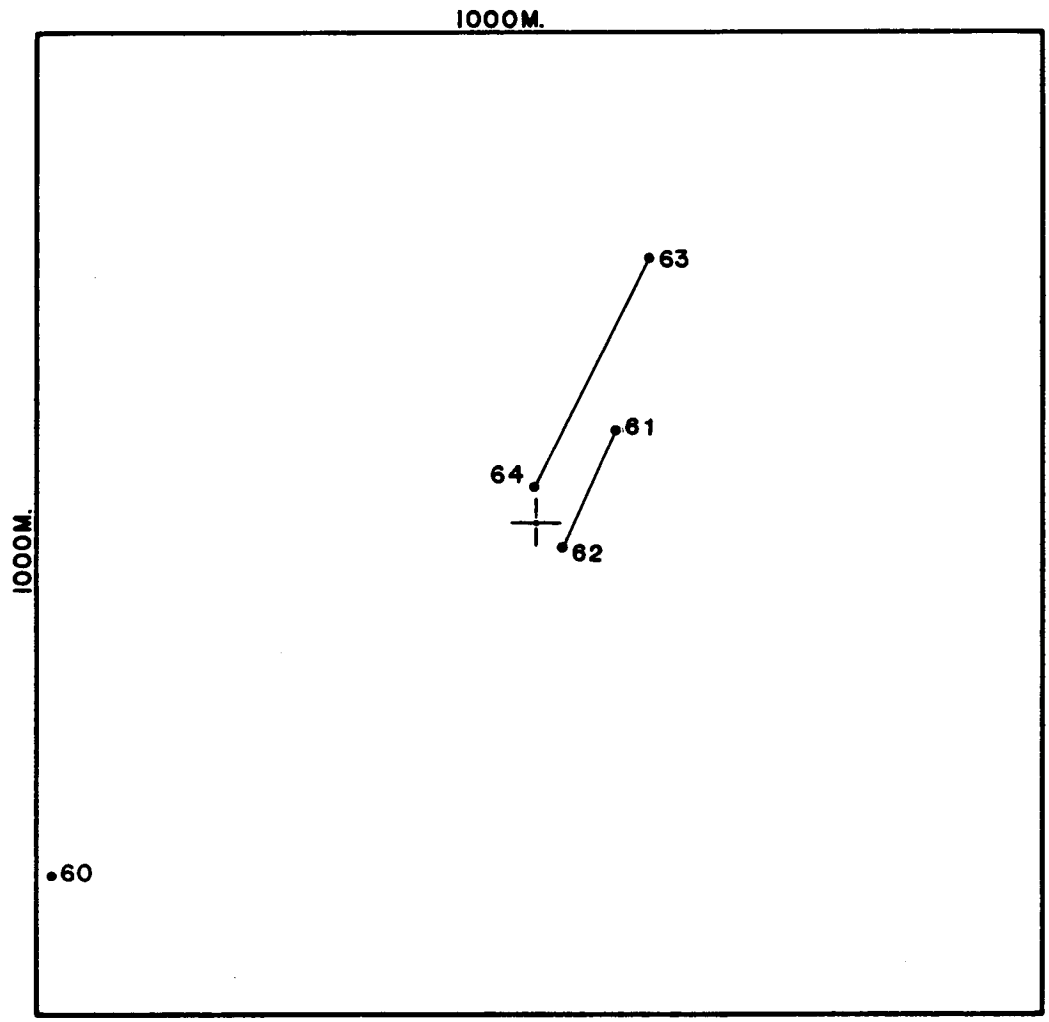


LEGEND

FIXMARK	EVENT
63	HYDROCAST
64	BEGIN HYDROLAB PROFILE
65	END HYDROLAB PROFILE
66	BEGIN TRANSMISSOMETER PROFILE
67	END TRANSMISSOMETER PROFILE

= LAT. 25°17.18'
LONG. 83°02.07'

STATION 23 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

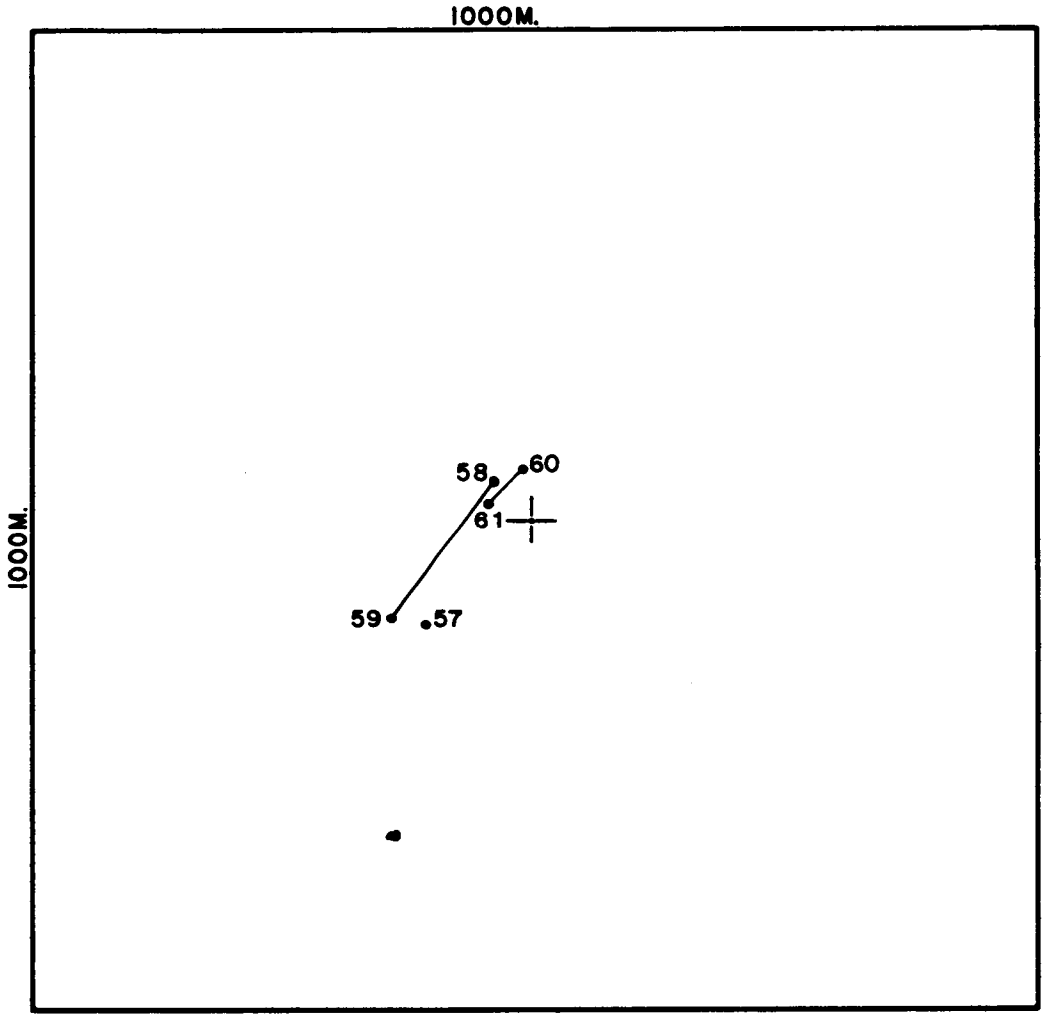


LEGEND

FIXMARK	EVENT
60	HYDROCAST
61	BEGIN HYDROLAB PROFILE
62	END HYDROLAB PROFILE
63	BEGIN TRANSMISSOMETER PROFILE
64	END TRANSMISSOMETER PROFILE

= LAT. 25°16.89'
LONG. 83°37.79'

STATION 28- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

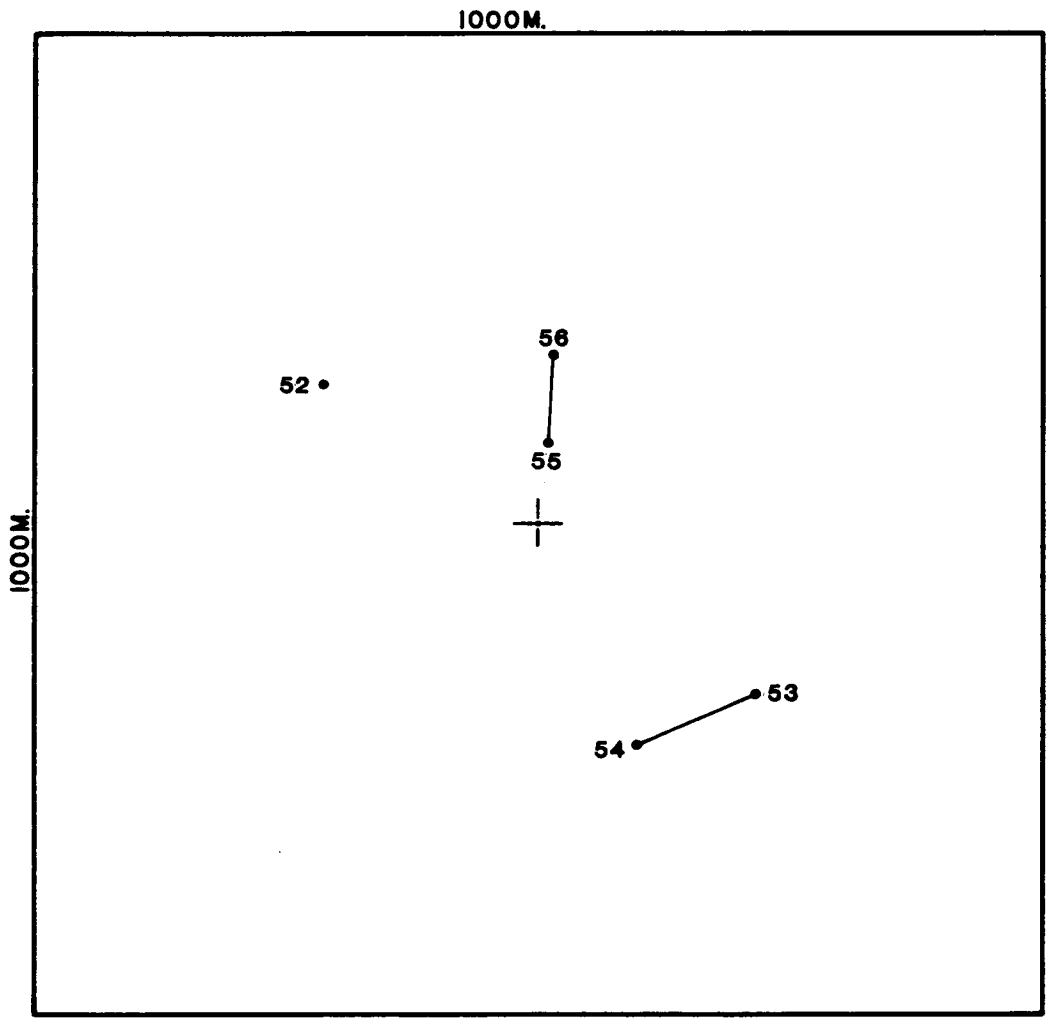


LEGEND

FIXMARK	EVENT
57	HYDROCAST
58	BEGIN HYDROLAB PROFILE
59	END HYDROLAB PROFILE
60	BEGIN TRANSMISSOMETER PROFILE
61	END TRANSMISSOMETER PROFILE

= LAT. 25°16.90'
LONG. 83°43.18'

STATION 2 WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

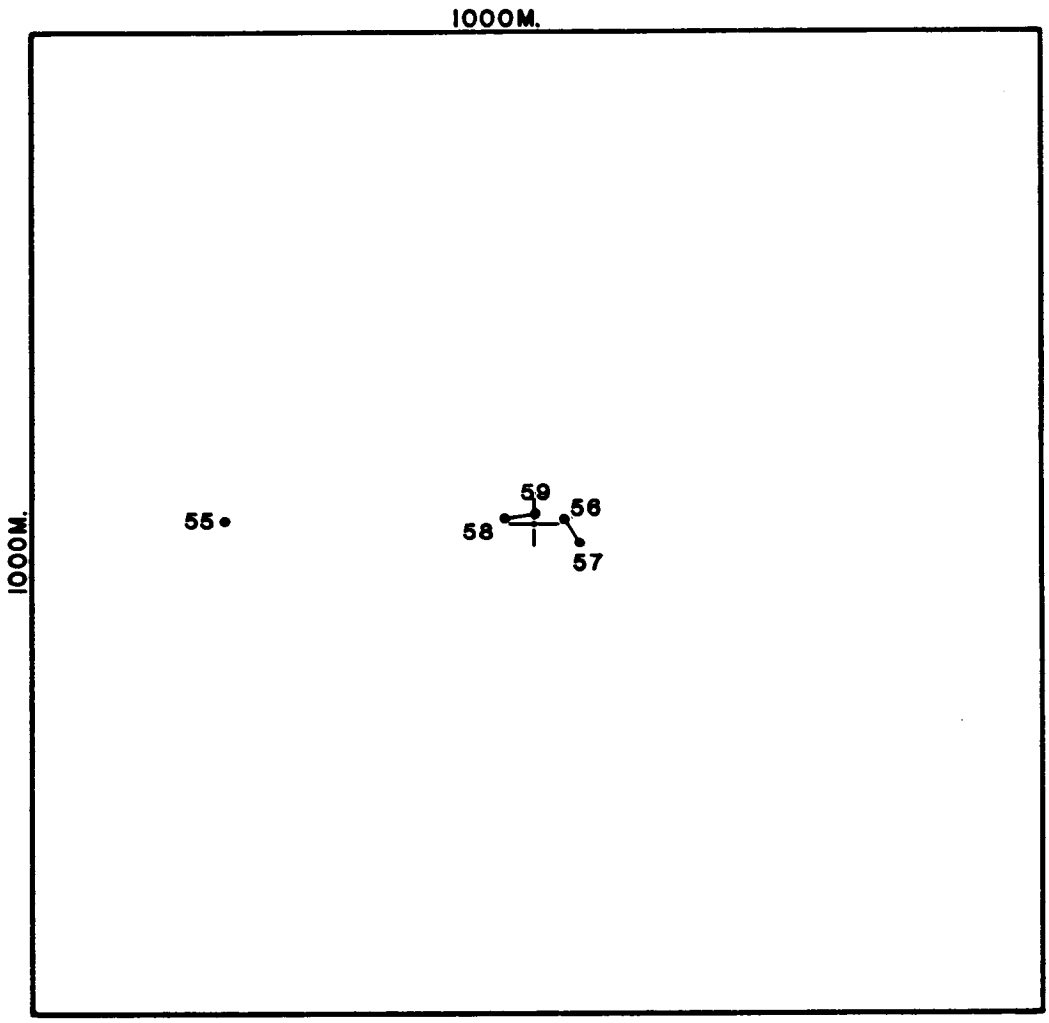


LEGEND

FIXMARK	EVENT
52	HYDROCAST
53	BEGIN HYDROLAB PROFILE
54	END HYDROLAB PROFILE
55	BEGIN TRANSMISSOMETER PROFILE
56	END TRANSMISSOMETER PROFILE

= LAT. 24°47.95'
LONG. 82°13.26'

STATION 25- WATER COLUMN DATA AND SAMPLE LOCATIONS — CRUISE IV

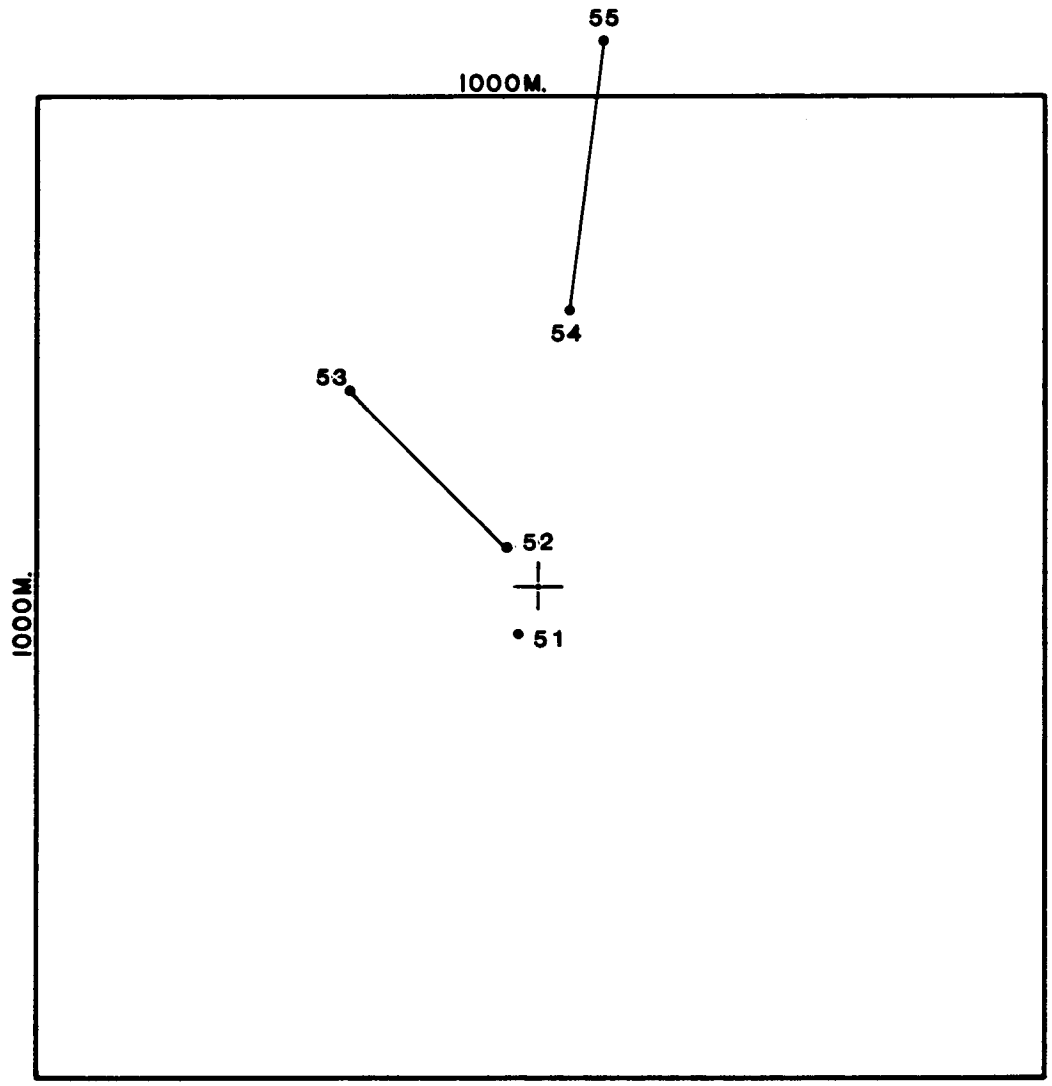


LEGEND

FIXMARK	EVENT
55	HYDROCAST
56	BEGIN HYDROLAB PROFILE
57	END HYDROLAB PROFILE
58	BEGIN TRANSMISSOMETER PROFILE
59	END TRANSMISSOMETER PROFILE

= LAT. 24°47.82'
LONG. 82°52.07'

STATION 20 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

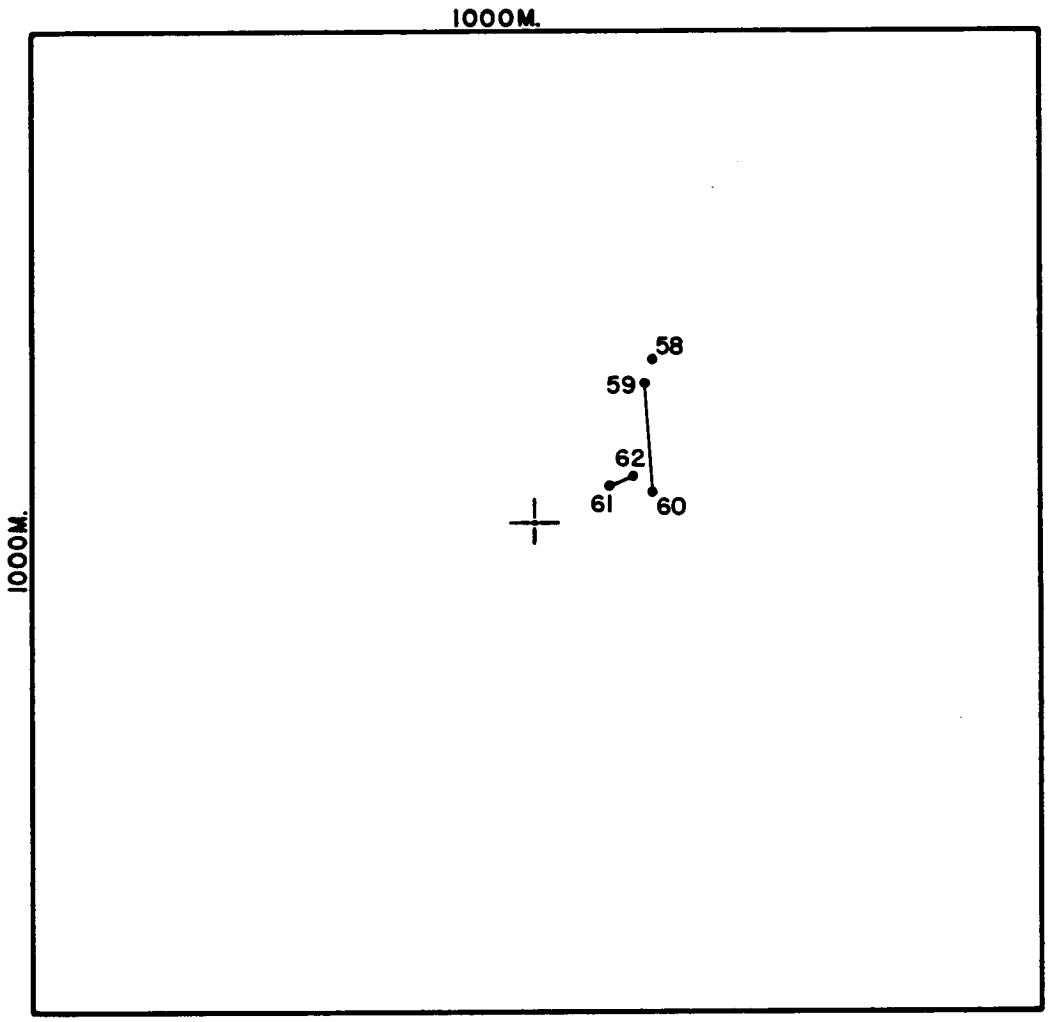


LEGEND

FIXMARK	EVENT
51	HYDROCAST
52	BEGIN HYDROLAB PROFILE
53	END HYDROLAB PROFILE
54	BEGIN TRANSMISSOMETER PROFILE
55	END TRANSMISSOMETER PROFILE

= LAT. 24°47.76'
LONG. 83°08.01'

STATION 27- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

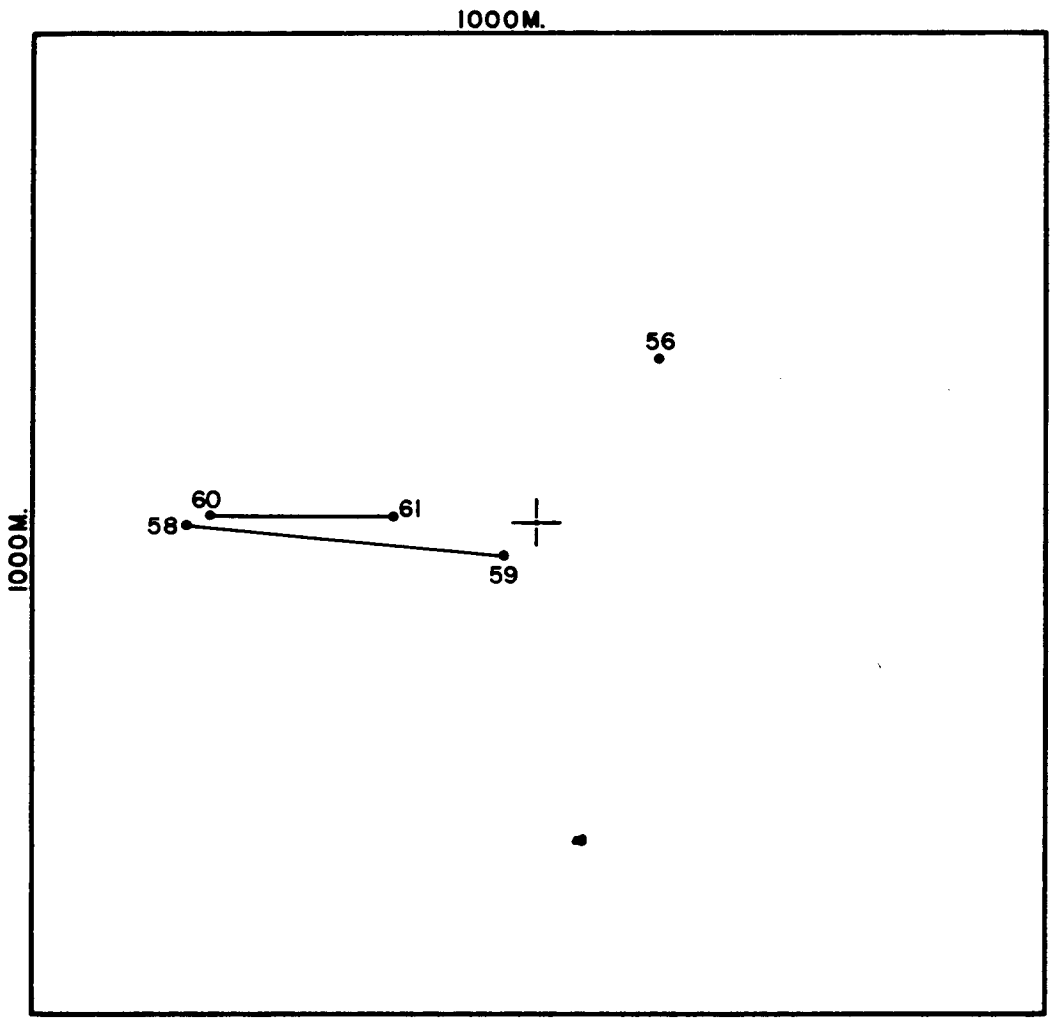


LEGEND

FIXMARK	EVENT
58	HYDROCAST
59	BEGIN HYDROLAB PROFILE
60	END HYDROLAB PROFILE
61	BEGIN TRANSMISSOMETER PROFILE
62	END TRANSMISSOMETER PROFILE

= LAT. 24°47.11'
LONG. 83°13.08'

STATION 28 – WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

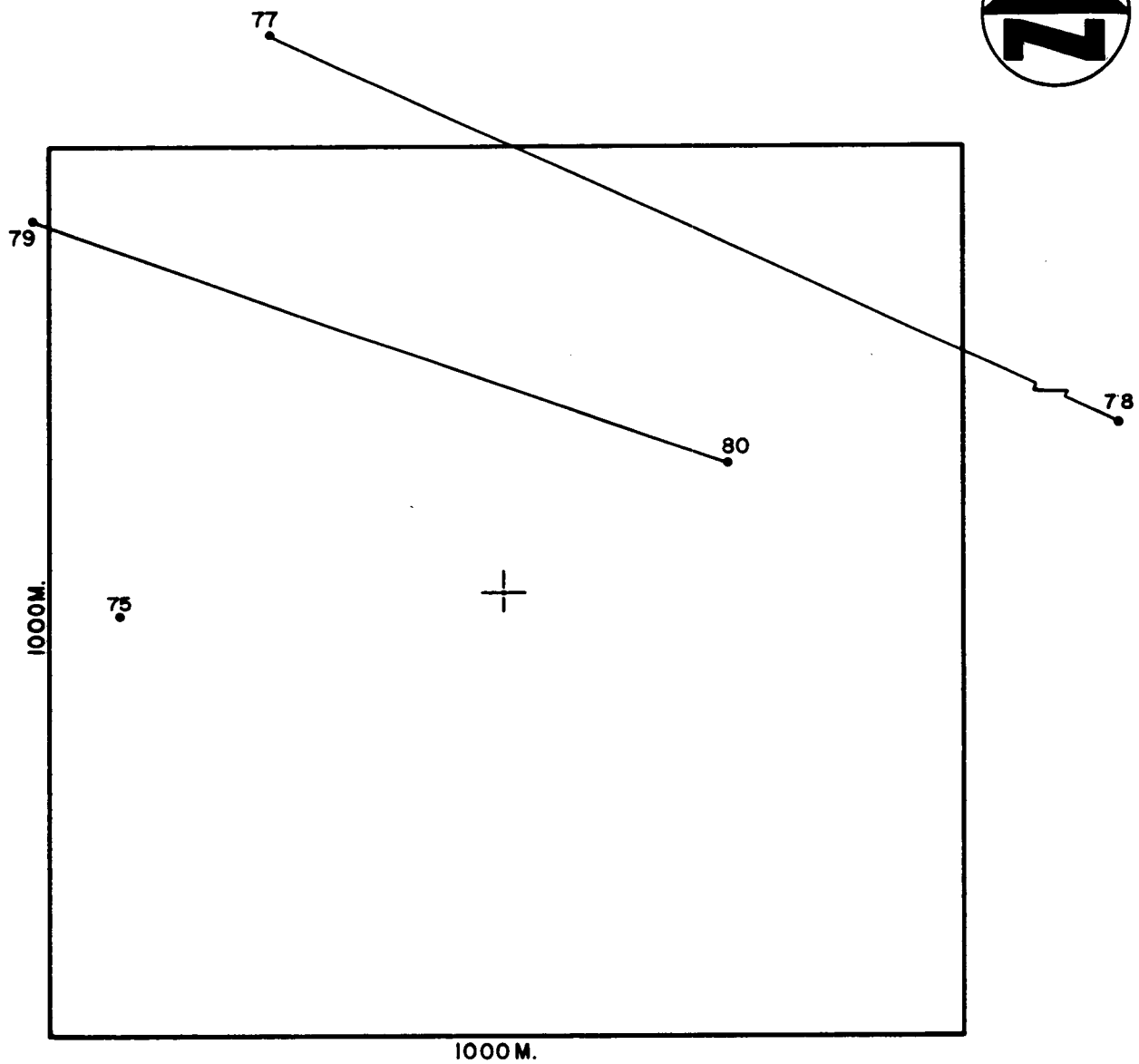


LEGEND

FIXMARK	EVENT
56	HYDROCAST
58	BEGIN HYDROLAB PROFILE
59	END HYDROLAB PROFILE
60	BEGIN TRANSMISSOMETER PROFILE
61	END TRANSMISSOMETER PROFILE

= LAT. 24°47.51'
LONG. 83°41.19'

STATION 2● WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV

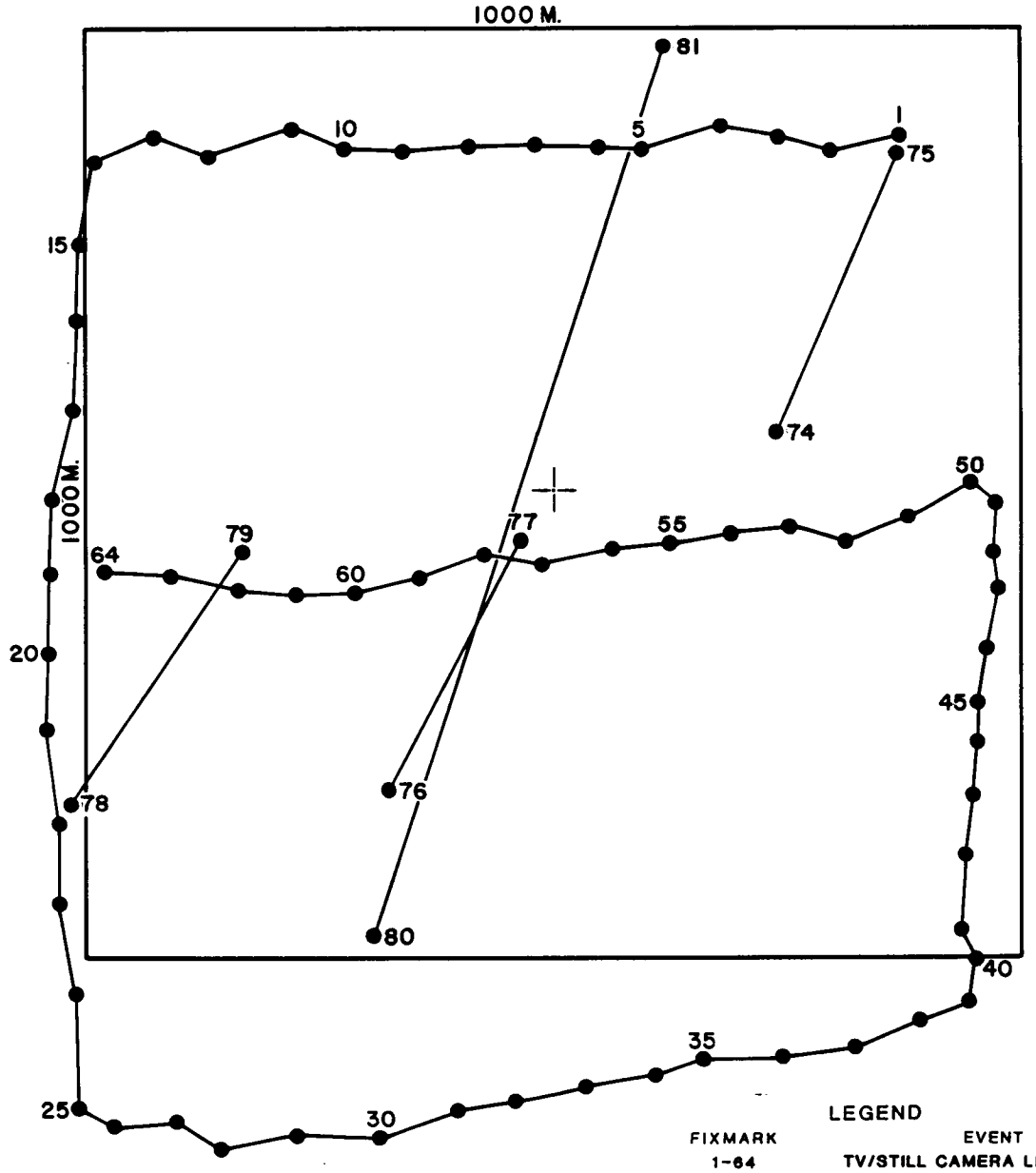


LEGEND

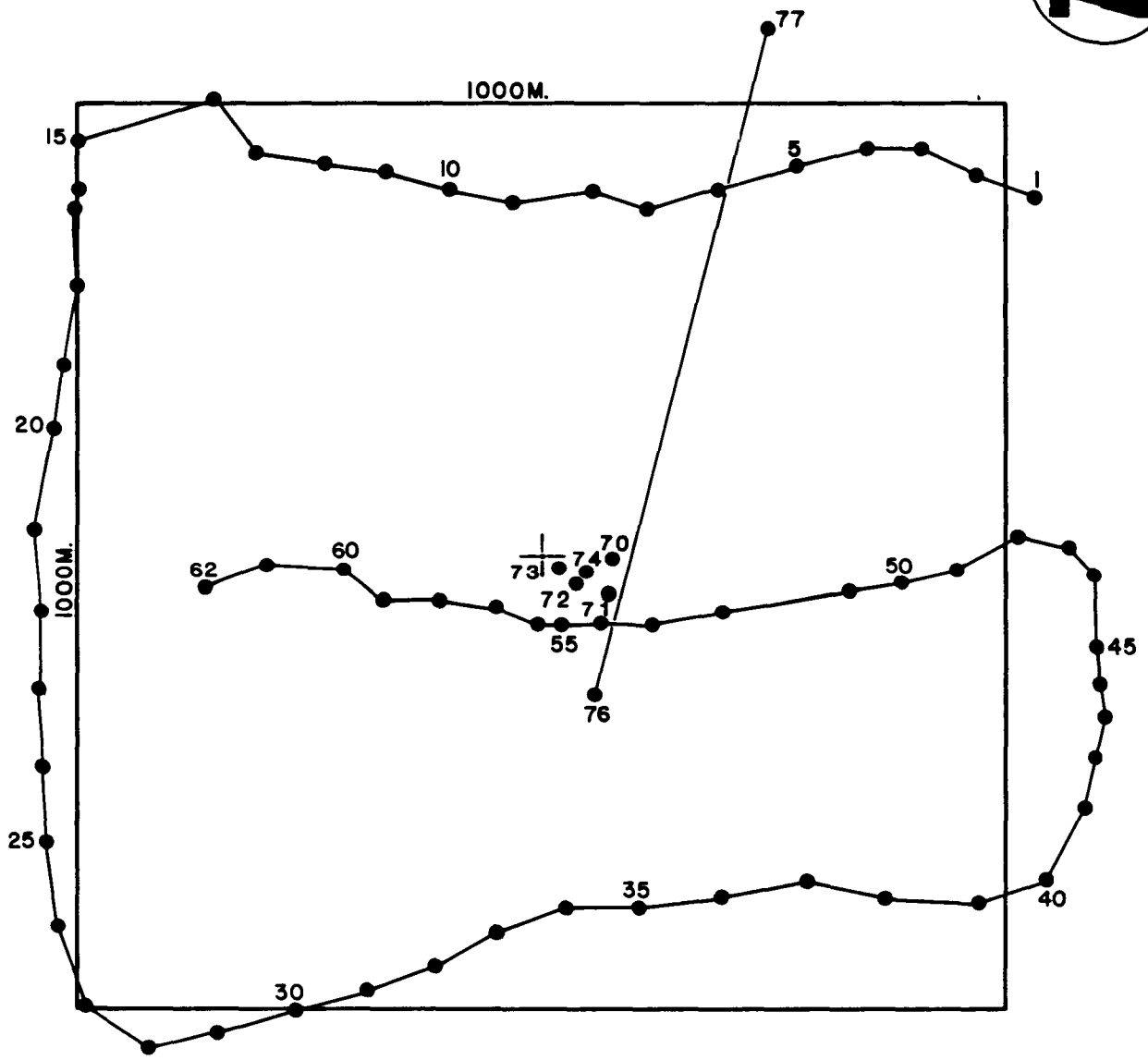
FIXMARK	EVENT	FIXMARK	EVENT
75	HYDROCAST A	78	END HYDROLAB PROFILE
76	HYDROCAST B	79	BEGIN TRANSMISSOMETER PROFILE
77	BEGIN HYDROLAB PROFILE	80	END TRANSMISSOMETER PROFILE

= LAT. 24°47.41'
LONG. 83°51.15'

STATION 30- WATER COLUMN DATA AND SAMPLE LOCATIONS – CRUISE IV



STATION 1- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

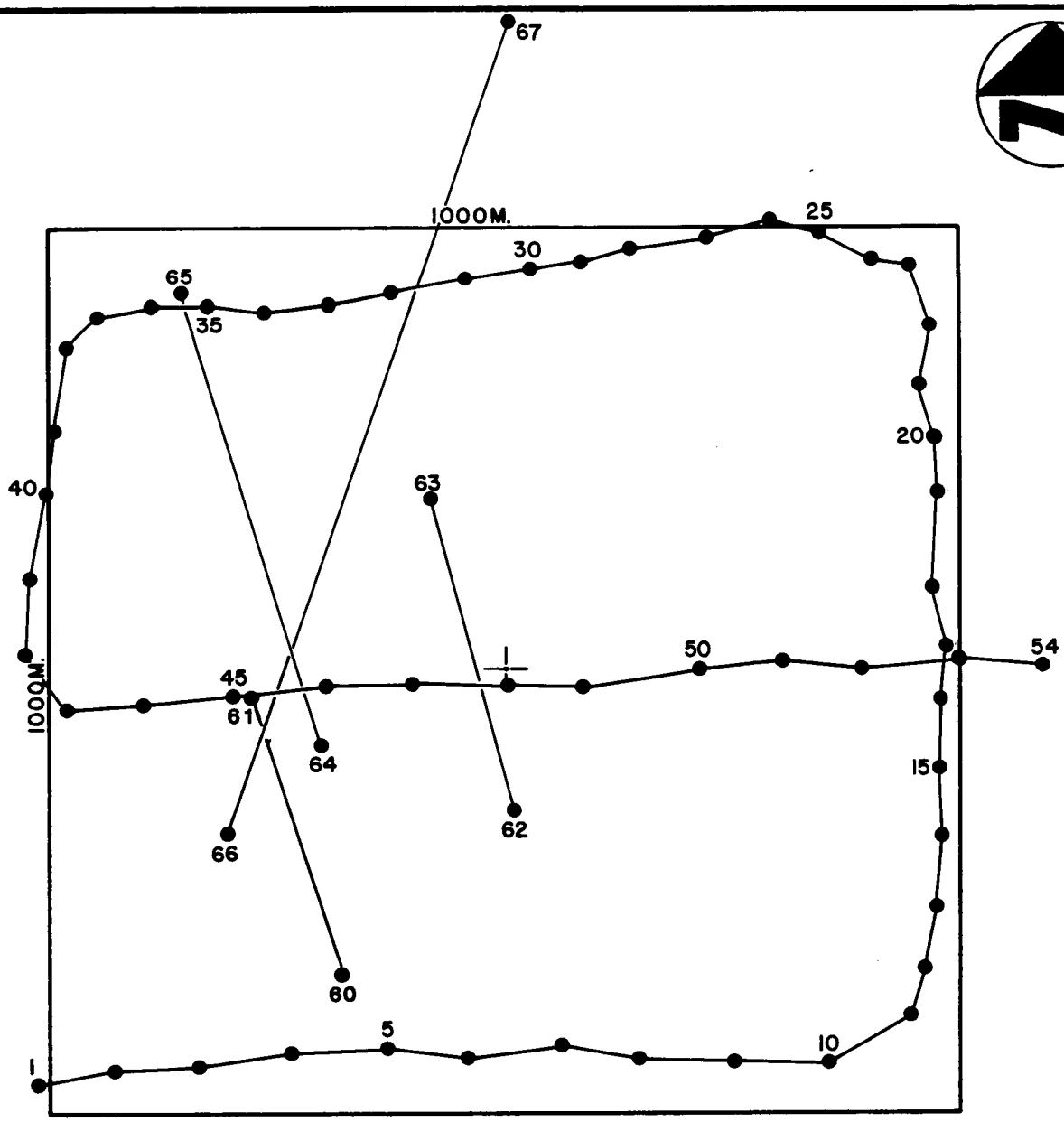


LEGEND

FIXMARK	EVENT
1-62	TV/STILL CAMERA LINE
70	BOX CORE SAMPLE A
71	BOX CORE SAMPLE B
72	BOX CORE SAMPLE C
73	BOX CORE SAMPLE D
74	BOX CORE SAMPLE E
76/77	TRAWL

= LAT. 26°45.84'
LONG. 82°45.18'

STATION 2- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

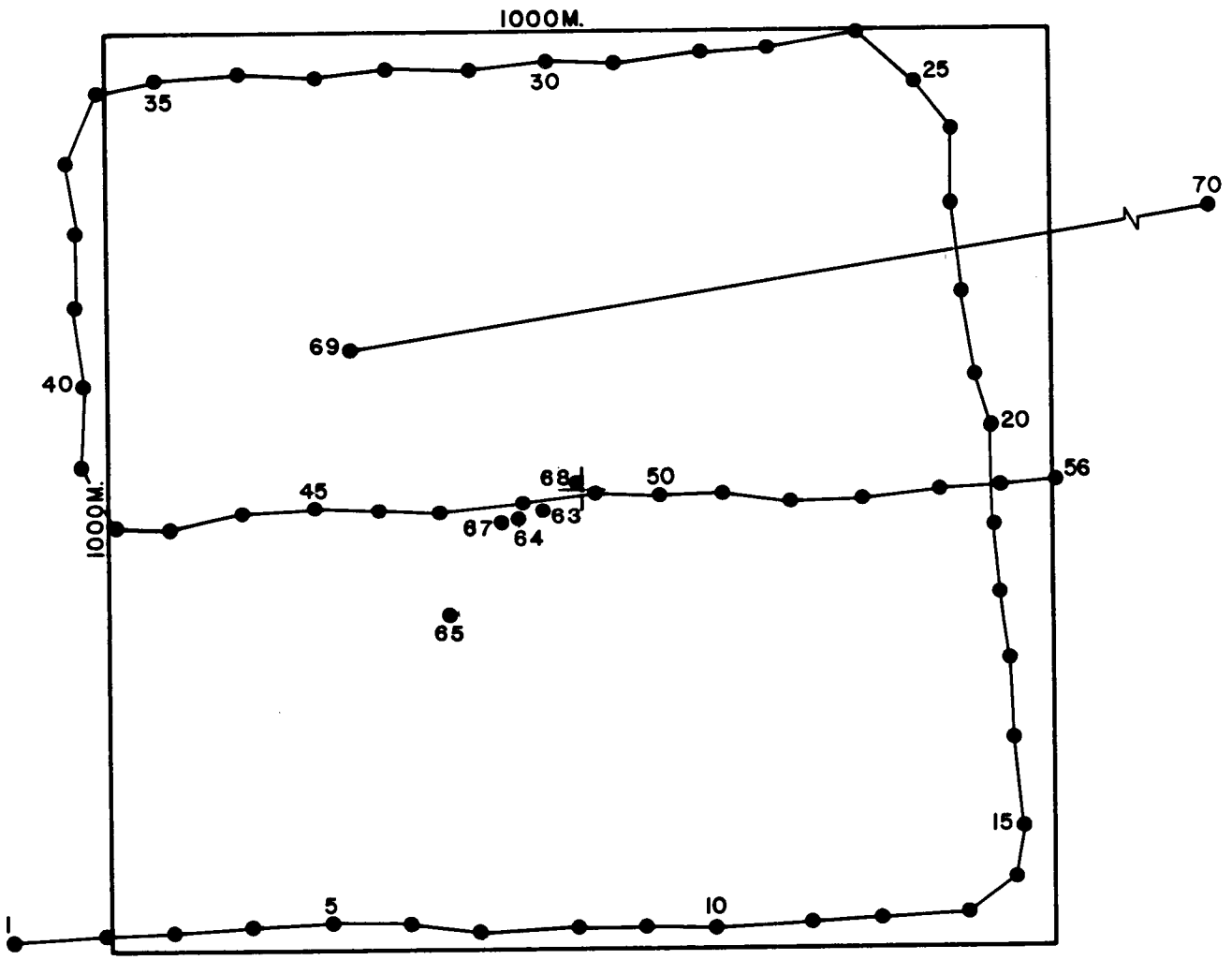


LEGEND

FIXMARK	EVENT
1-54	TV/STILL CAMERA LINE
60/61	DREDGE A
62/63	DREDGE B
64/65	DREDGE C
66/67	TRAWL

= LAT. 26°45.86′
LONG. 83°21.44′

STATION 3- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

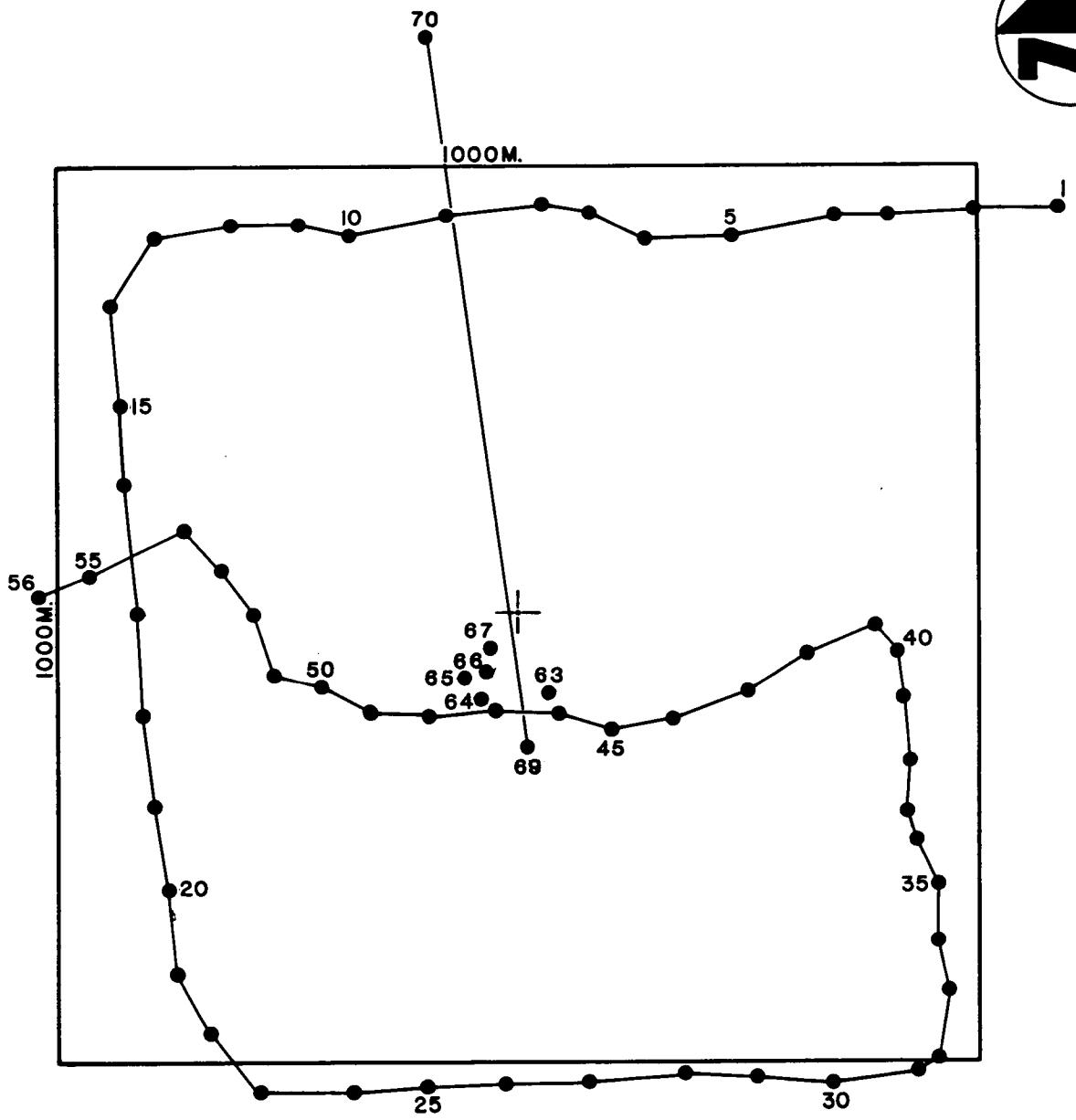


LEGEND

FIXMARK	EVENT
1-56	TV/STILL CAMERA LINE
63	BOX CORE SAMPLE A
64	BOX CORE SAMPLE B
65	BOX CORE SAMPLE C
67	BOX CORE SAMPLE D
68	BOX CORE SAMPLE E
69/70	TRAWL

= LAT. 26°45.81′
LONG. 83°32.12′

STATION 4- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

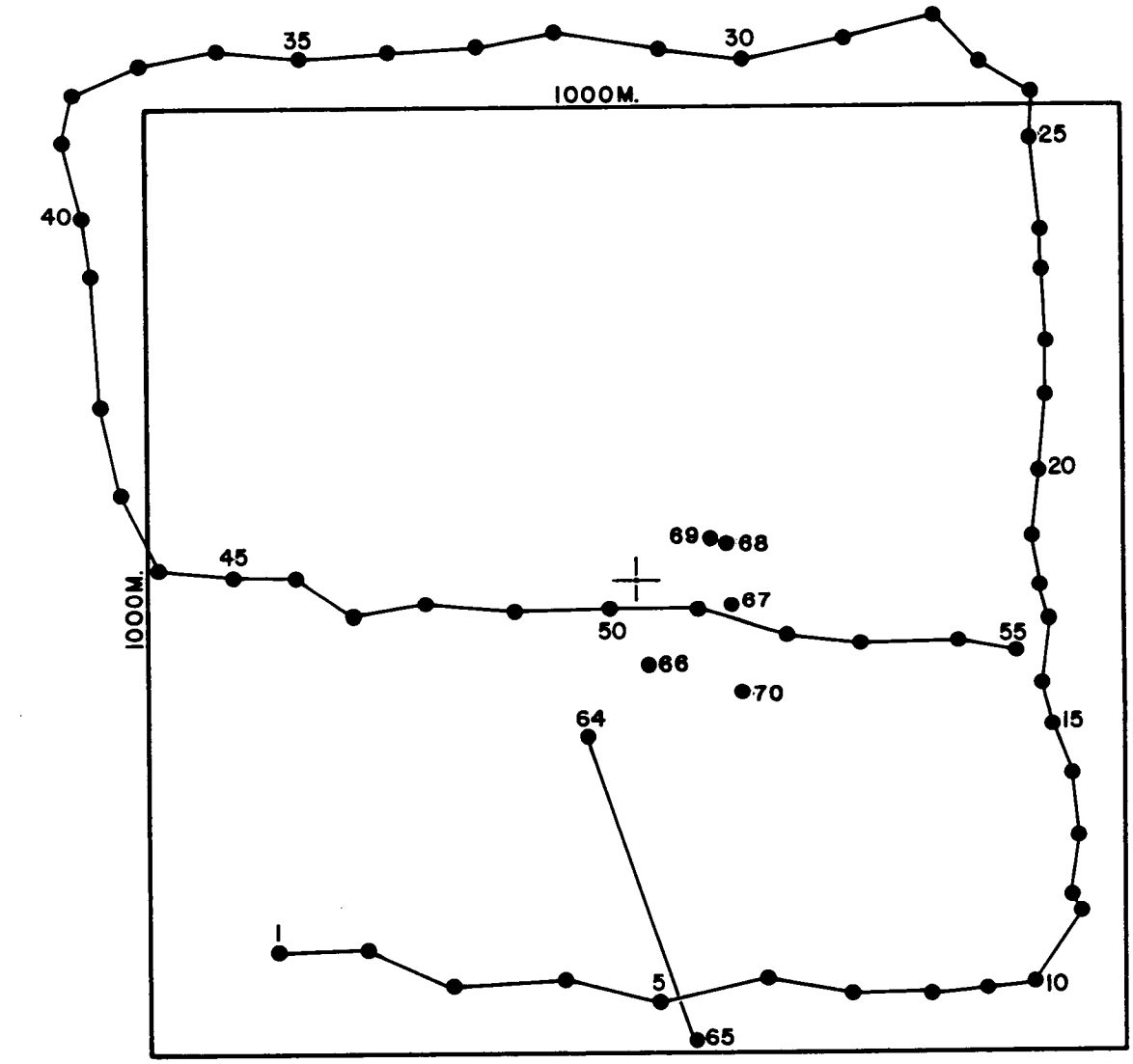


LEGEND

FIXMARK	EVENT
1-56	TV/STILL CAMERA LINE
63	BOX CORE SAMPLE A
64	BOX CORE SAMPLE B
65	BOX CORE SAMPLE C
66	BOX CORE SAMPLE D
67	BOX CORE SAMPLE E
69/70	TRAWL

= LAT. 26°45.70'
LONG. 84°00.13'

STATION 5- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

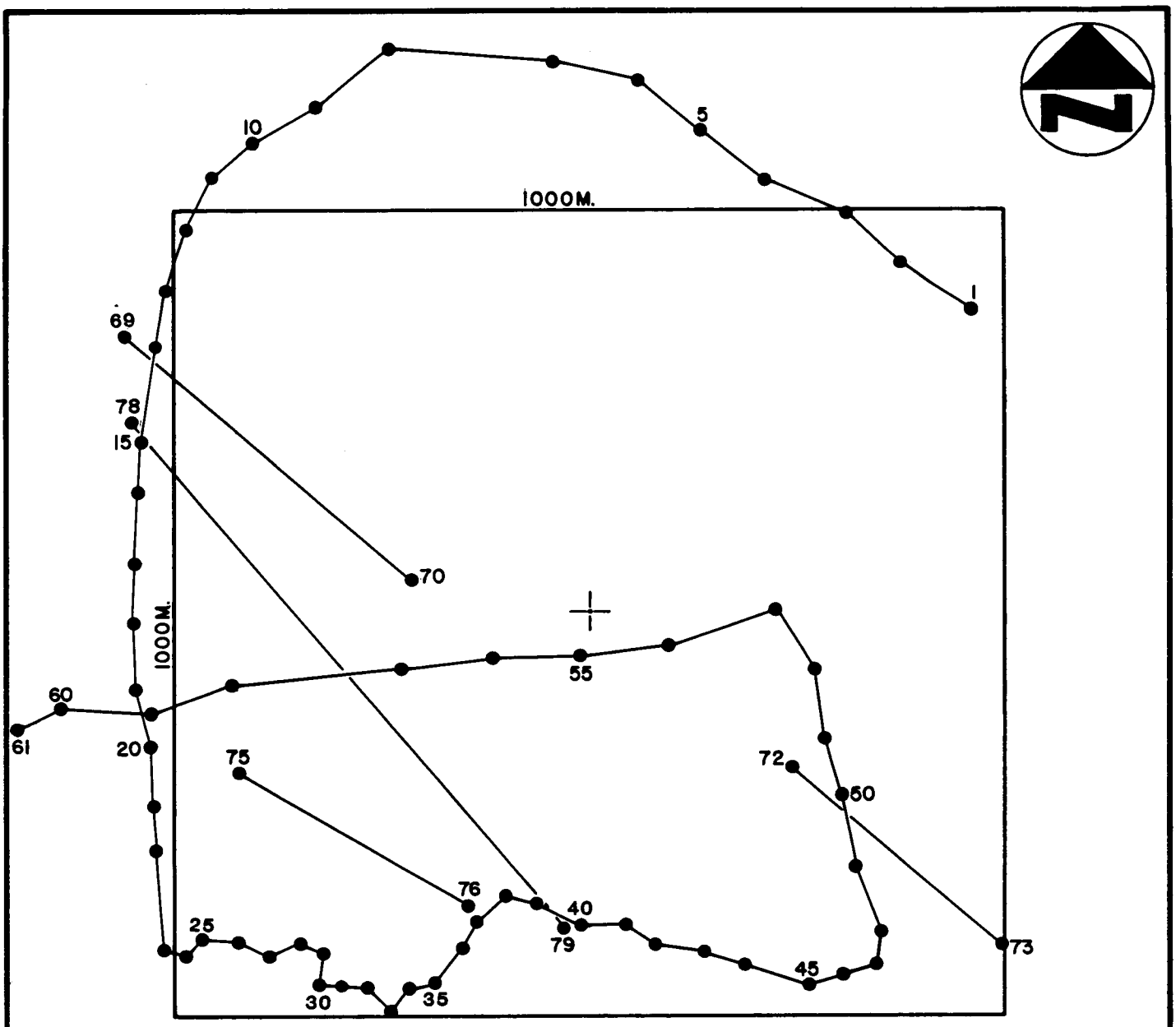


LEGEND

FIXMARK	EVENT
1-55	TV/STILL CAMERA LINE
64/65	TRAWL
66	BOX CORE SAMPLE A
67	BOX CORE SAMPLE B
68	BOX CORE SAMPLE C
69	BOX CORE SAMPLE D
70	BOX CORE SAMPLE E

= LAT. 26°16.79'
LONG. 82°38.35'

STATION 6- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

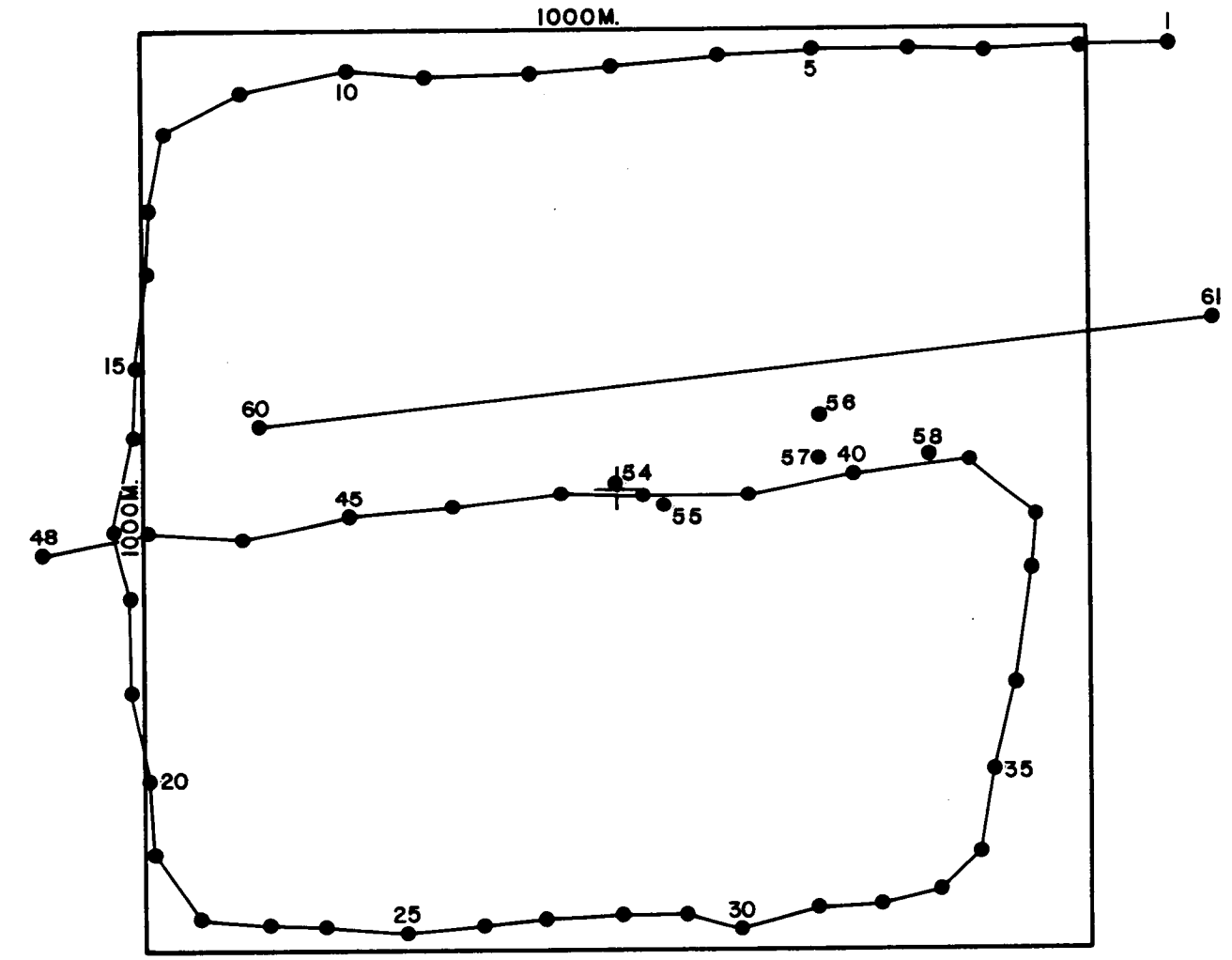


LEGEND

FIXMARK	EVENT
1-61	TV/STILL CAMERA LINE
69/70	DREDGE A
72/73	DREDGE B
75/76	DREDGE C
78/79	TRAWL

= LAT. 26°16.82'
LONG. 82°44.02'

STATION 7- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

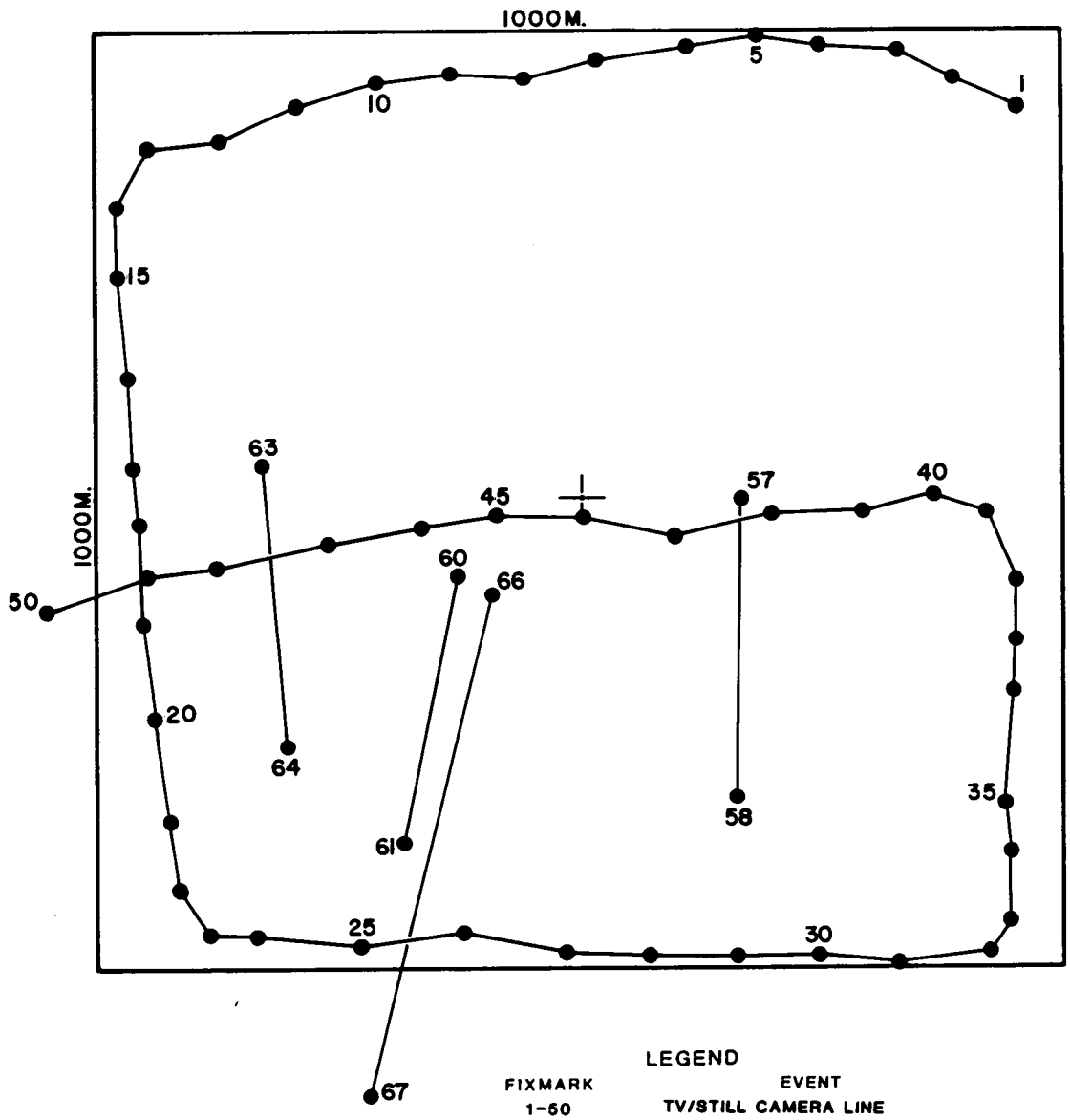


LEGEND

FIXMARK	EVENT
1-48	TV/STILL CAMERA LINE
54	BOX CORE SAMPLE A
55	BOX CORE SAMPLE B
56	BOX CORE SAMPLE C
57	BOX CORE SAMPLE D
58	BOX CORE SAMPLE E
60/61	TRAWL

= LAT. 26°16.72'
LONG. 83°12.81'

STATION 8- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS - CRUISE IV

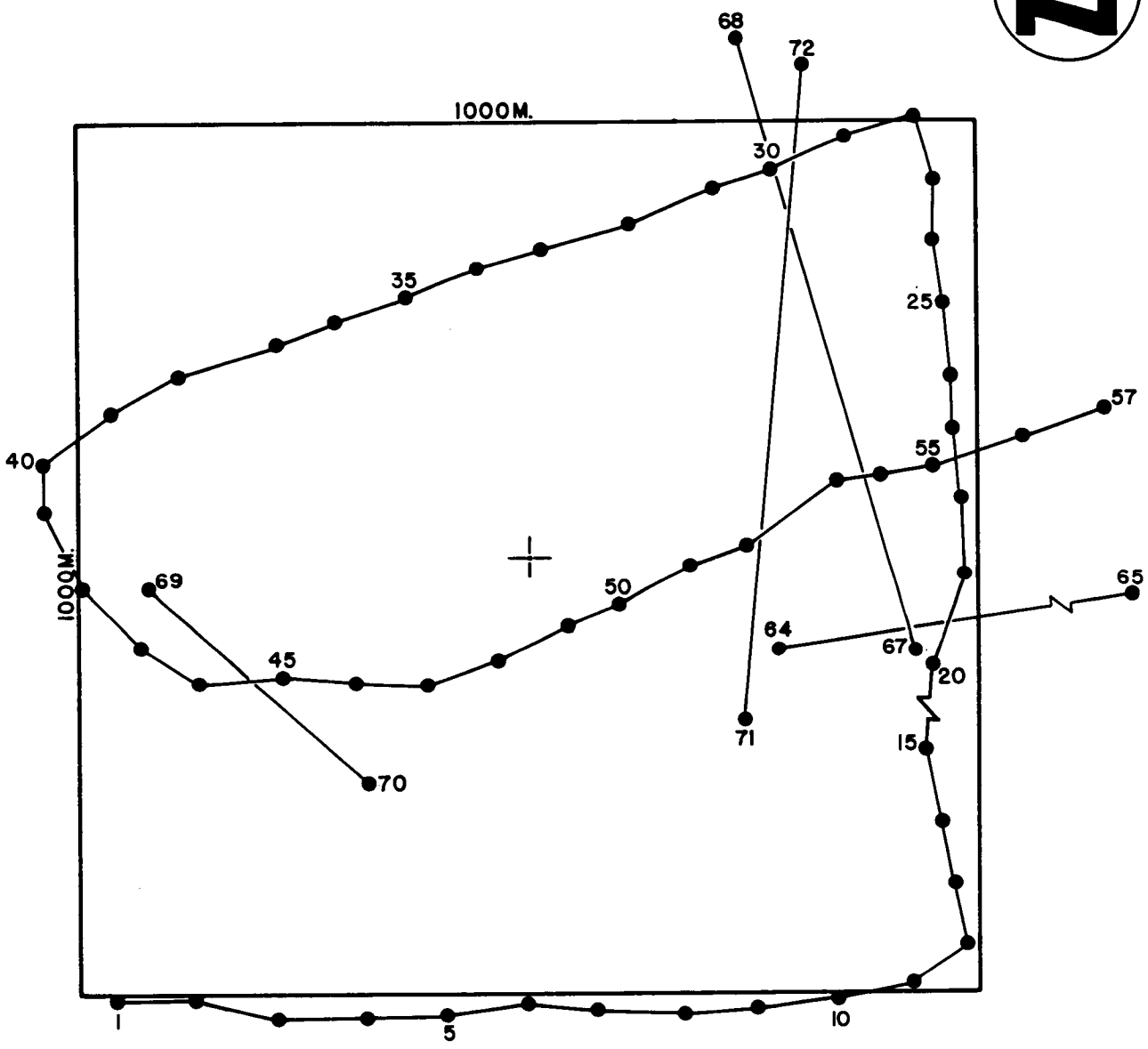


LEGEND

FIXMARK	EVENT
1-50	TV/STILL CAMERA LINE
57/58	DREDGE A
60/61	DREDGE B
63/64	DREDGE C
66/67	TRAWL

= LAT. 26°16.83'
LONG. 83°23.81'

STATION 9- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

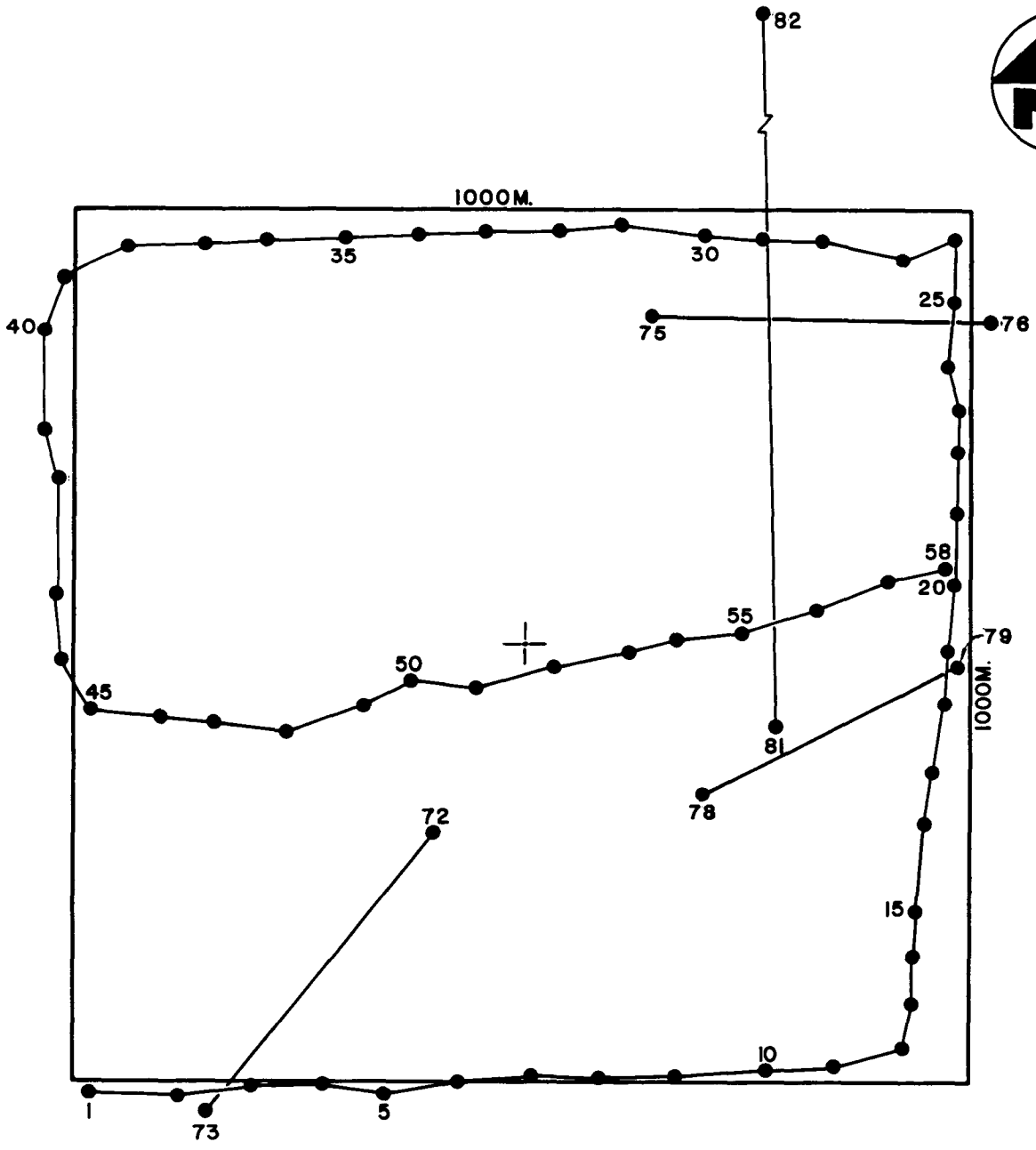


LEGEND

FIXMARK	EVENT
1-57	TV/STILL CAMERA LINE
64/65	DREDGE A
67/66	DREDGE B
69/70	DREDGE C
71/72	TRAWL

= LAT. 26°16.73'
LONG. 83°42.81'

STATION 10- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

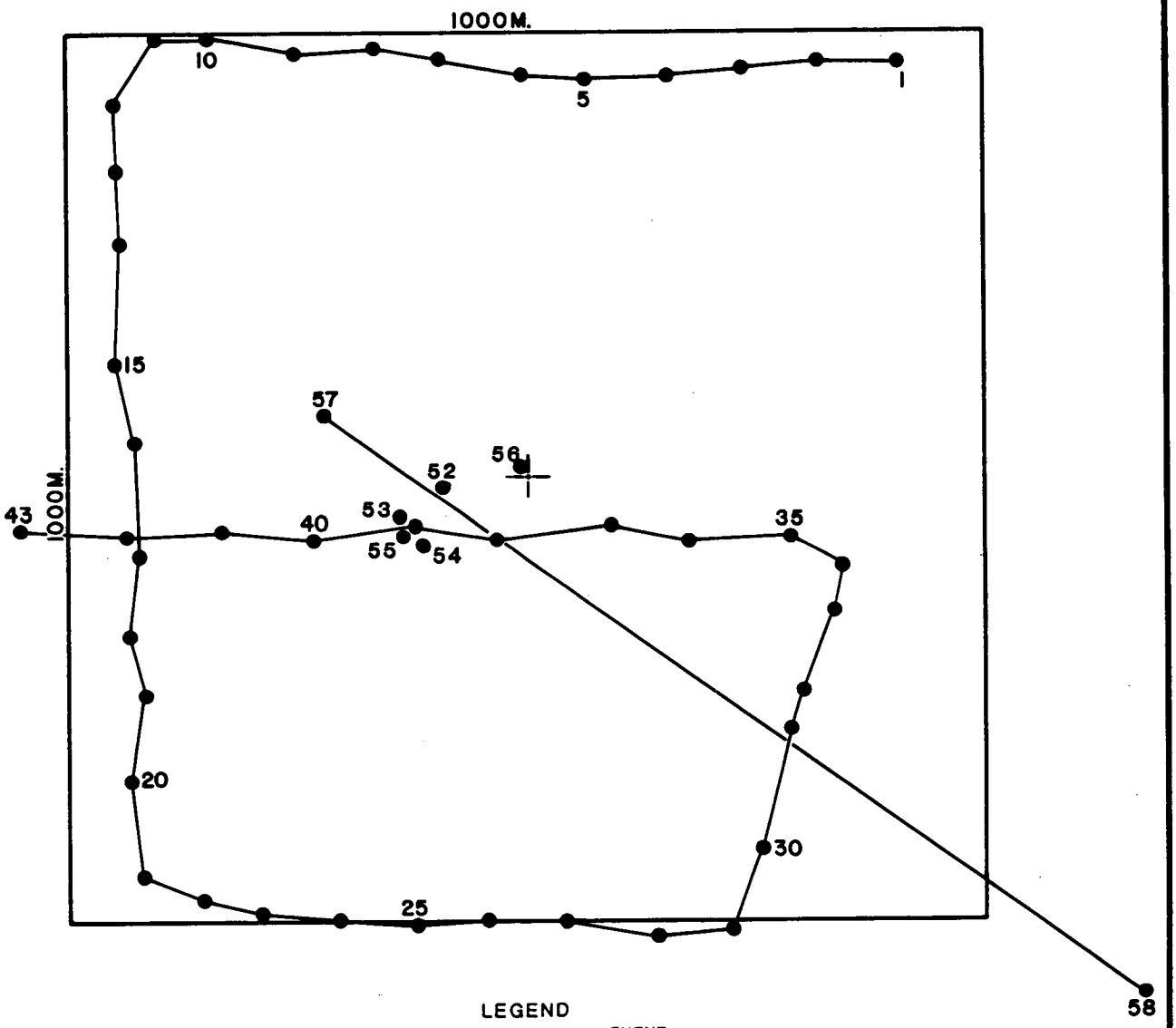


LEGEND

FIXMARK	EVENT
1-68	TV/STILL CAMERA LINE
72/73	DREDGE A
75/76	DREDGE B
78/79	DREDGE C
81/82	TRAWL

= LAT. 26°16.72'
LONG. 83°46.82'

STATION 11- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

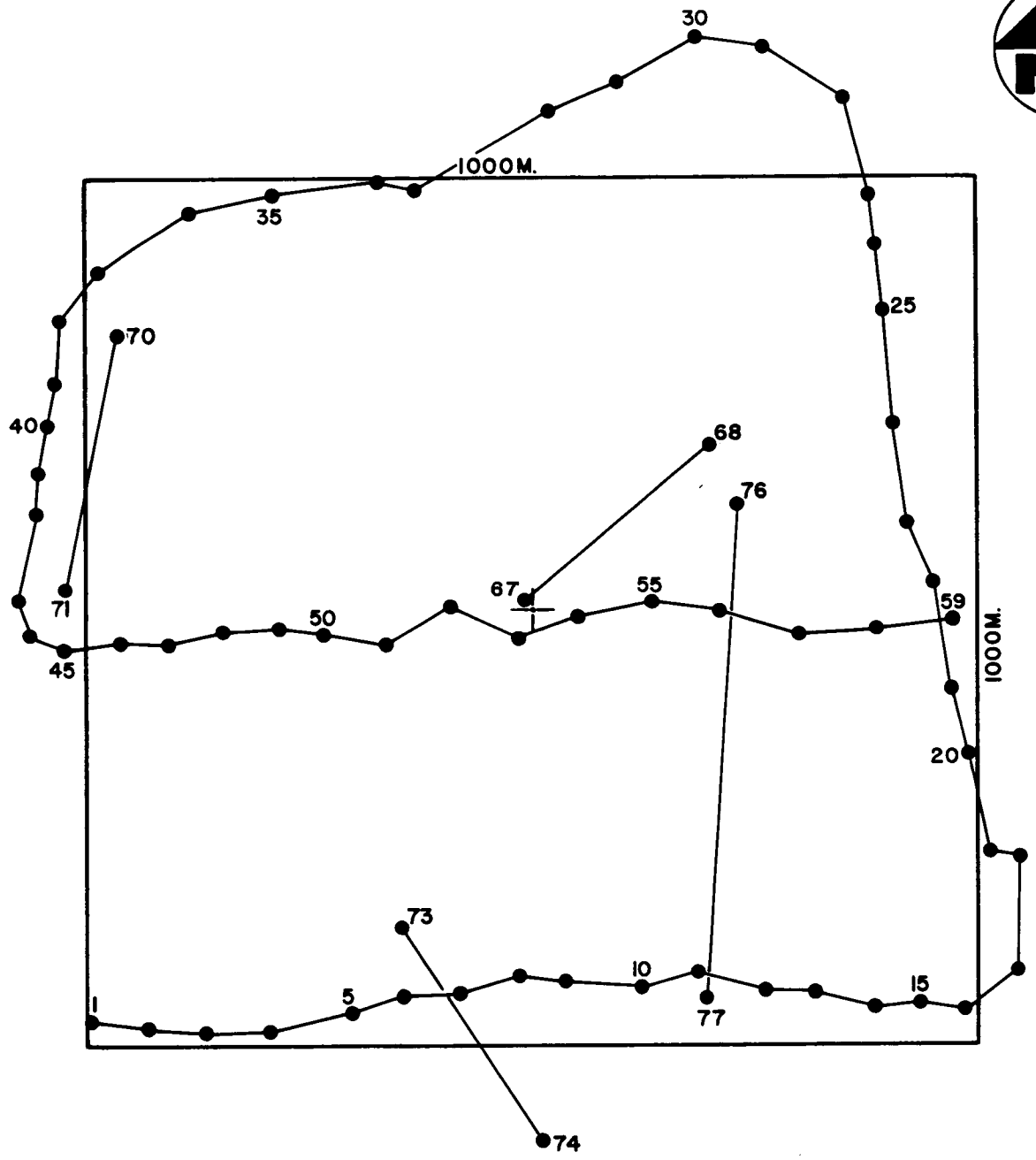


LEGEND

FIXMARK	EVENT
1-43	TV/STILL CAMERA LINE
52	BOX CORE SAMPLE A
53	BOX CORE SAMPLE B
54	BOX CORE SAMPLE C
55	BOX CORE SAMPLE D
56	BOX CORE SAMPLE E
57/58	TRAWL

= LAT. 26°16.72′
LONG. 83°47.67′

STATION 12 – TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

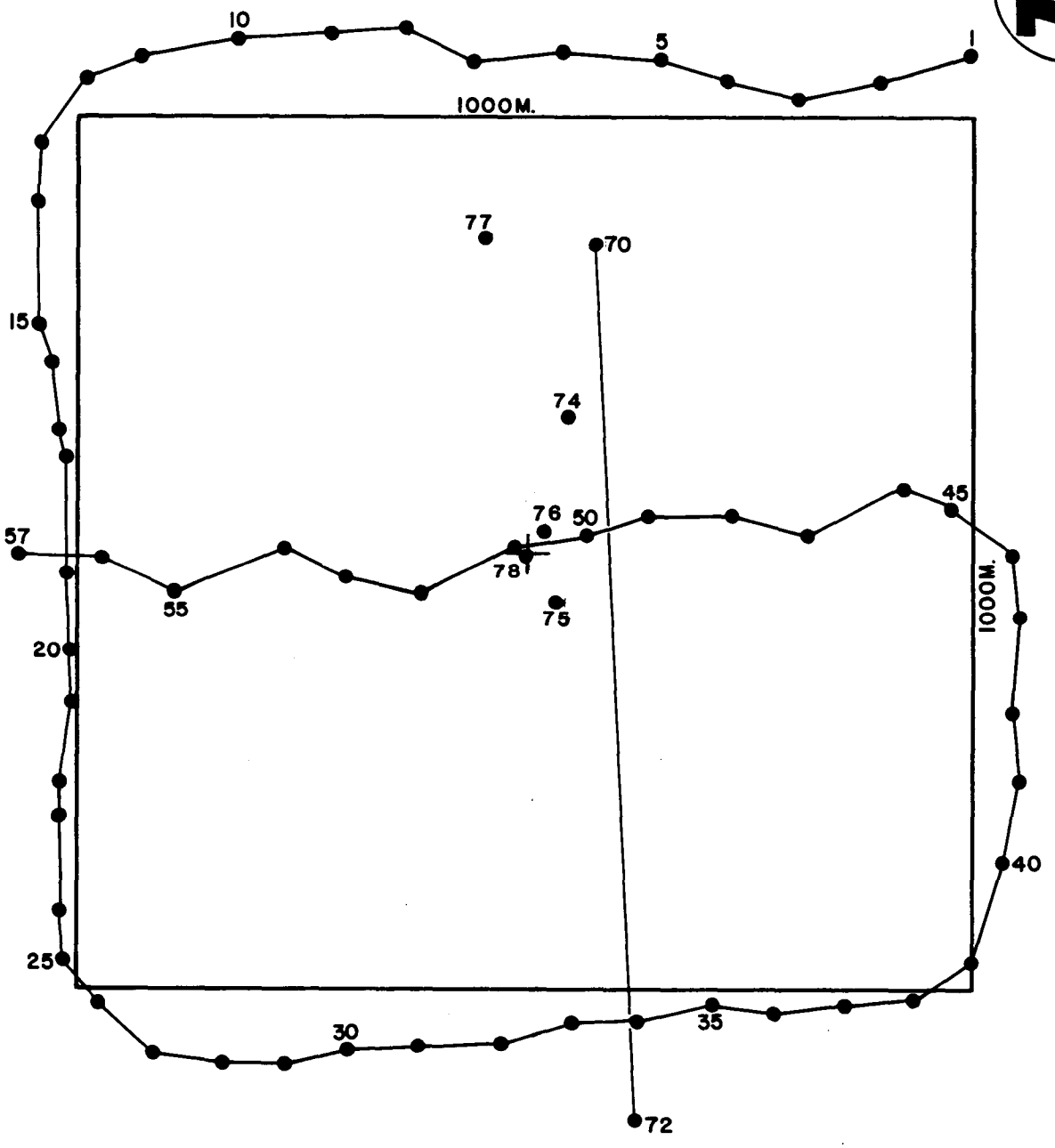


LEGEND

FIXMARK	EVENT
1-59	TV/STILL CAMERA LINE
67/68	DREDGE A
70/71	DREDGE B
73/74	DREDGE C
76/77	TRAWL

= LAT. 25°45.93'
LONG. 82°09.35'

STATION 13— TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

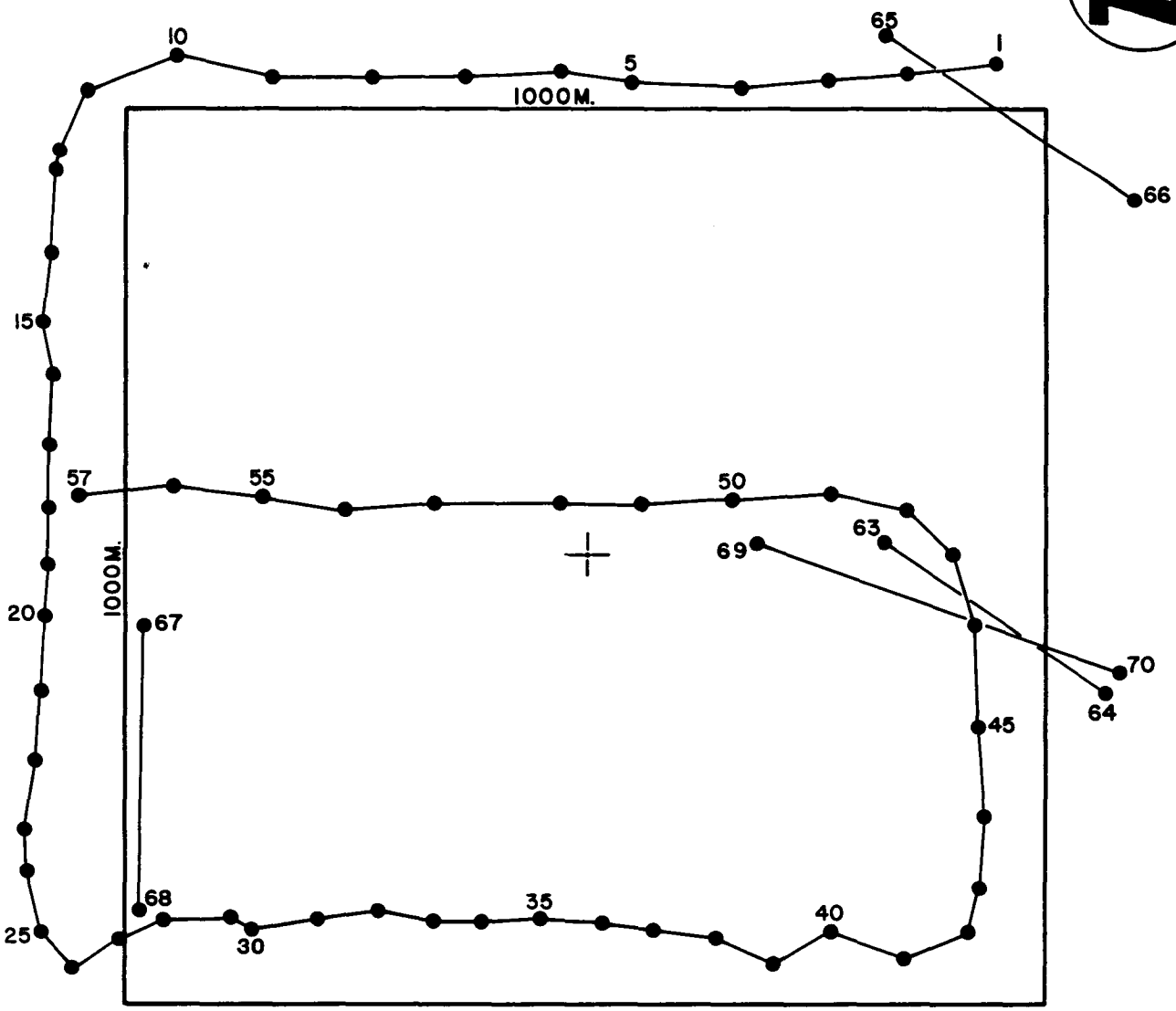


LEGEND

FIXMARK	EVENT
1-57	TV/STILL CAMERA LINE
70/72	TRAWL #2
74	BOX CORE SAMPLE A
75	BOX CORE SAMPLE B
76	BOX CORE SAMPLE C
77	BOX CORE SAMPLE D
78	BOX CORE SAMPLE E

= LAT. 25°46.01'
LONG. 82°23.82'

STATION 14 TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

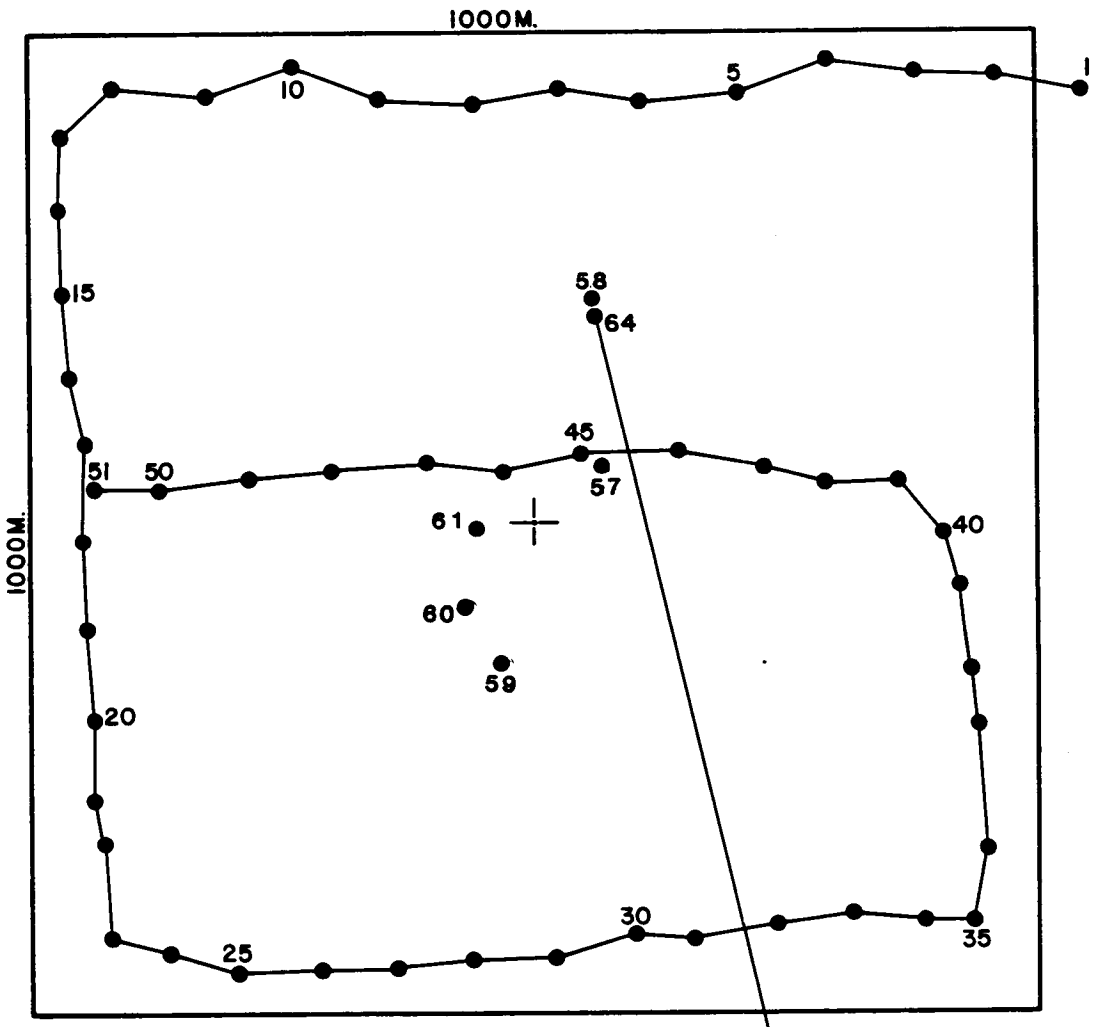


LEGEND

FIXMARK	EVENT
1-57	TV/STILL CAMERA LINE
63/64	DREDGE A
65/66	DREDGE B
67/68	DREDGE C
69/70	TRAWL

= LAT. 25°45.89'
LONG. 82°31.62'

STATION 18 — TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

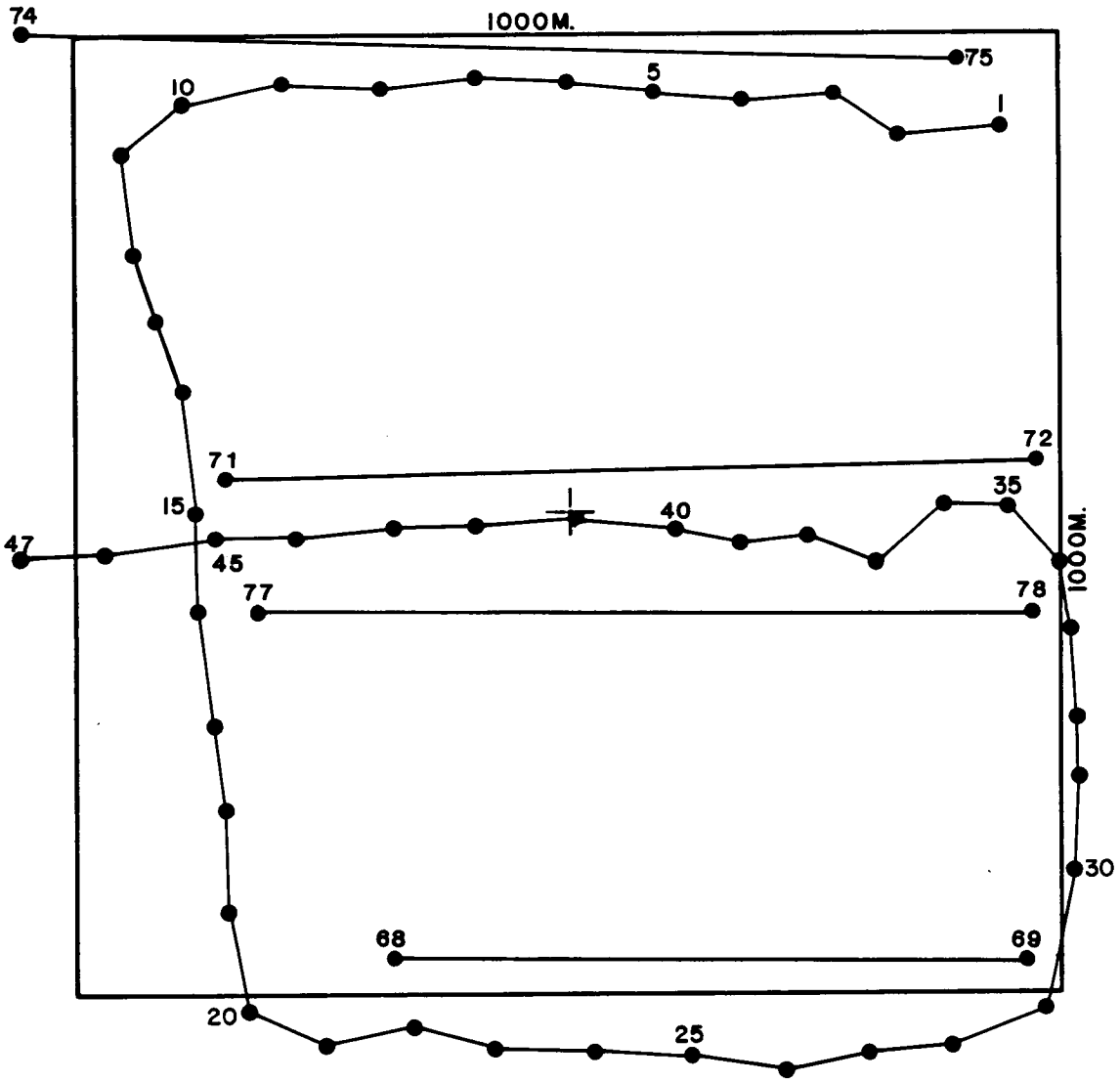


LEGEND

FIXMARK	EVENT
1-51	TV/STILL CAMERA LINE
57	BOX CORE SAMPLE A
58	BOX CORE SAMPLE B
59	BOX CORE SAMPLE C
60	BOX CORE SAMPLE D
61	BOX CORE SAMPLE E
64/65	TRAWL

= LAT. 25°45.70'
LONG. 83°11.07'

STATION 16- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

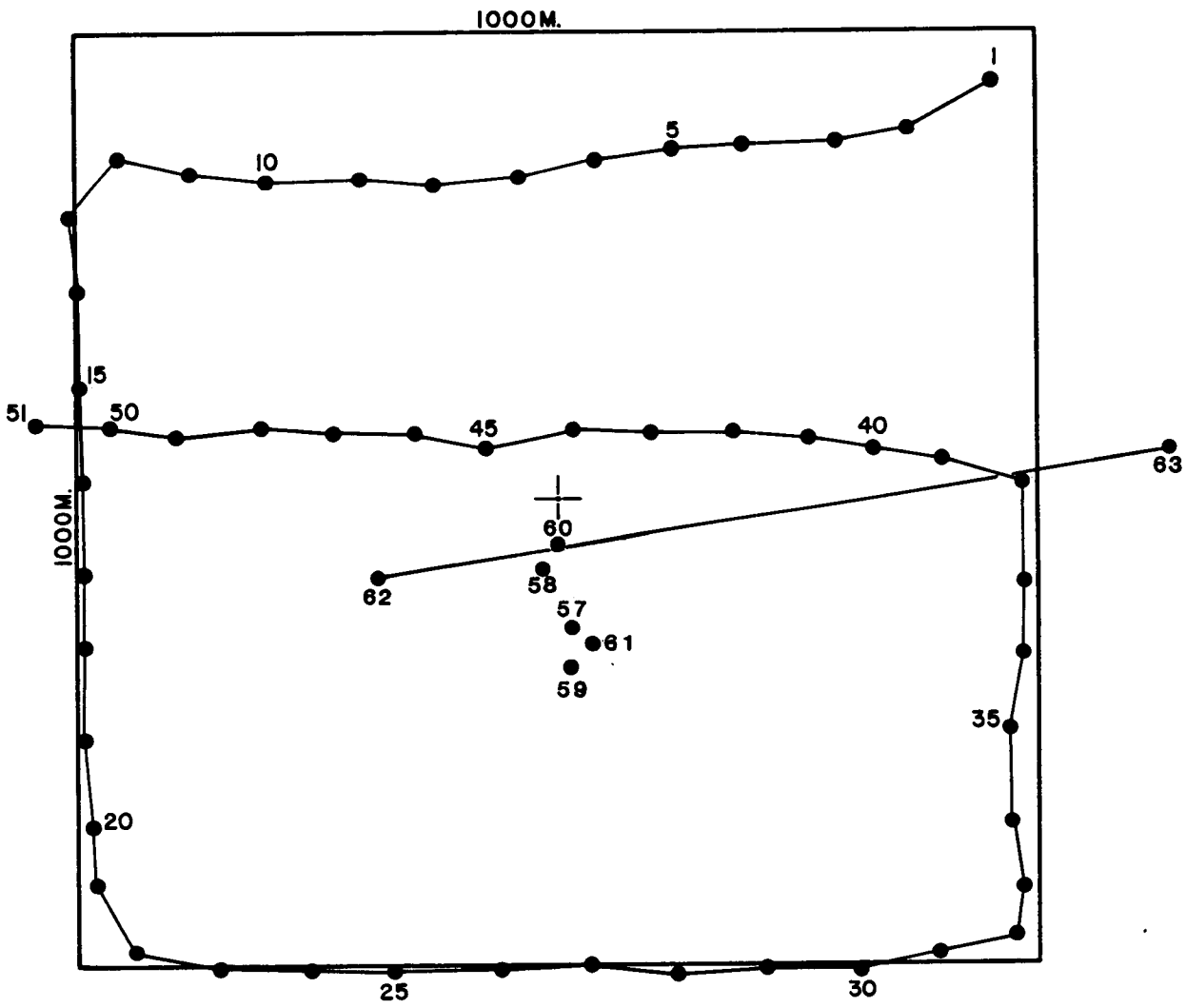


LEGEND

FIXMARK	EVENT
1-47	TV/STILL CAMERA LINE
68/69	DREDGE A
71/72	DREDGE B
74/75	DREDGE C
77/78	TRAWL

= LAT. 25°45.58'
LONG. 83°20.24'

STATION 17 — TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

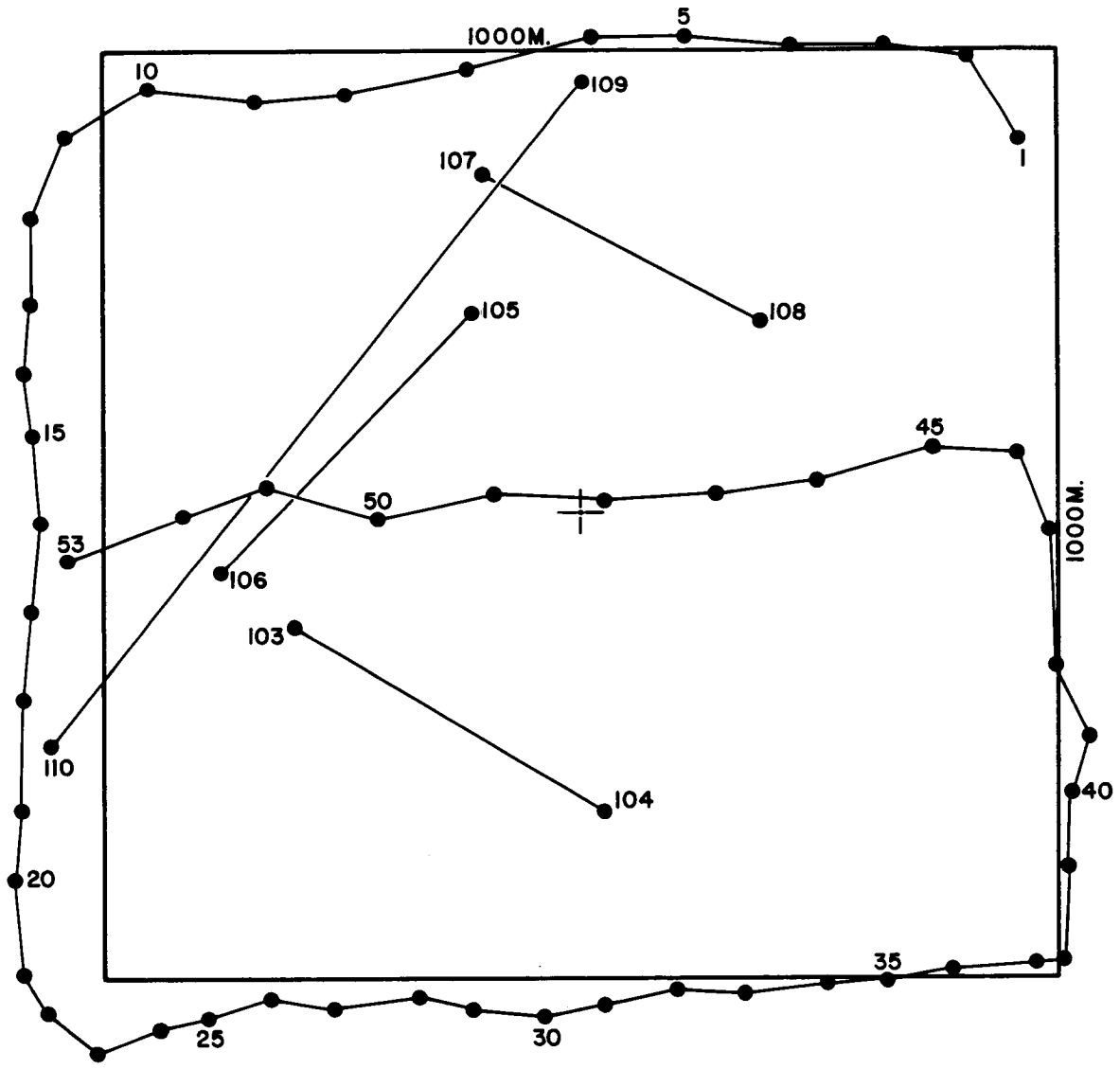


LEGEND

FIXMARK	EVENT
1-51	TV/STILL CAMERA LINE
57	BOX CORE SAMPLE A
58	BOX CORE SAMPLE B
59	BOX CORE SAMPLE C
60	BOX CORE SAMPLE D
61	BOX CORE SAMPLE E
62/63	TRAWL

= LAT. 25°45.37′
LONG. 83°42.22′

STATION 18 — TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

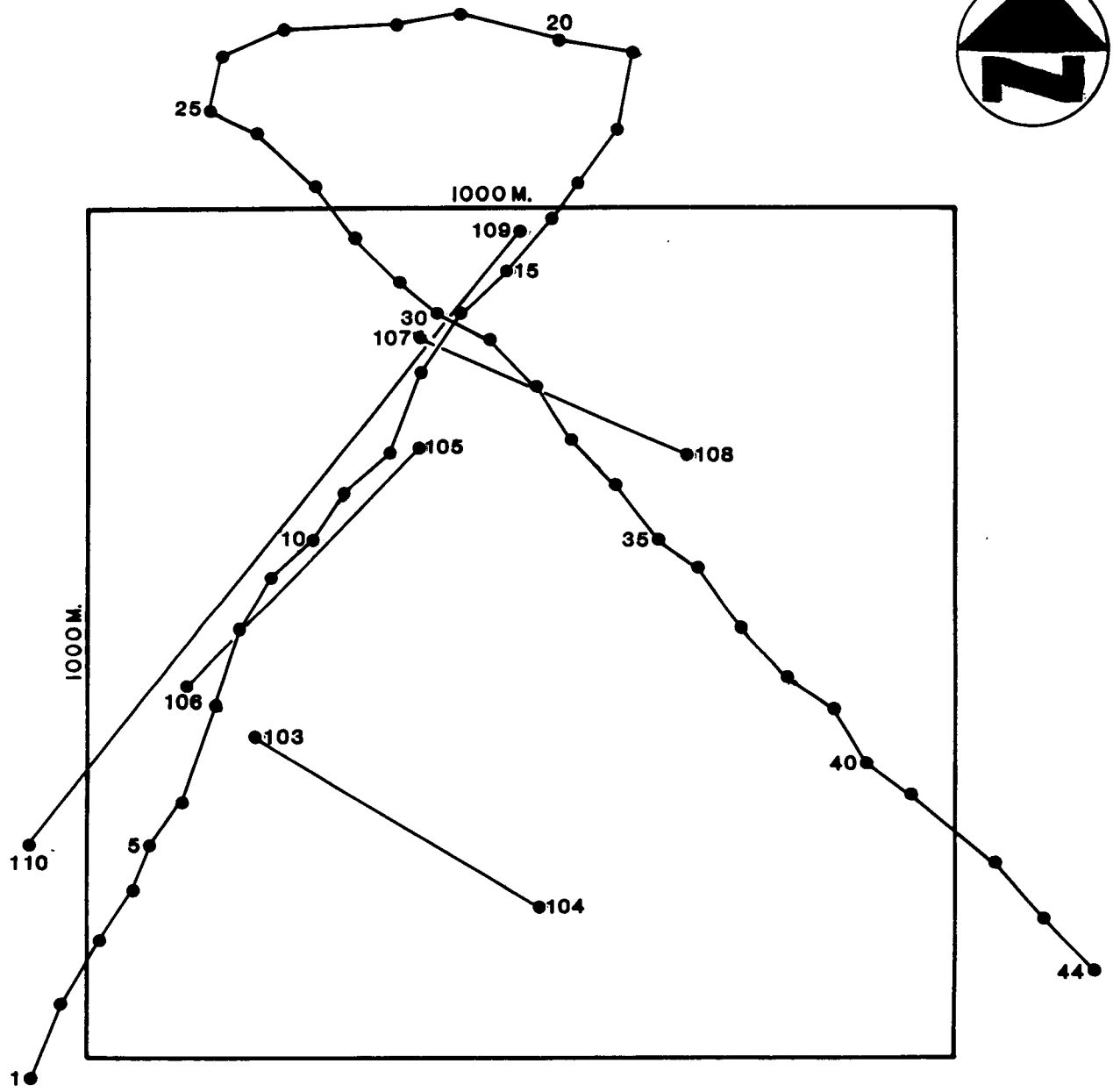


LEGEND

FIXMARK	EVENT
1-53	TV/STILL CAMERA LINE #1
103/104	DREDGE A
105/106	DREDGE B
107/108	DREDGE C
109/110	TRAWL

= LAT. 25°17.36'
LONG. 82°09.00'

STATION 1 — TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

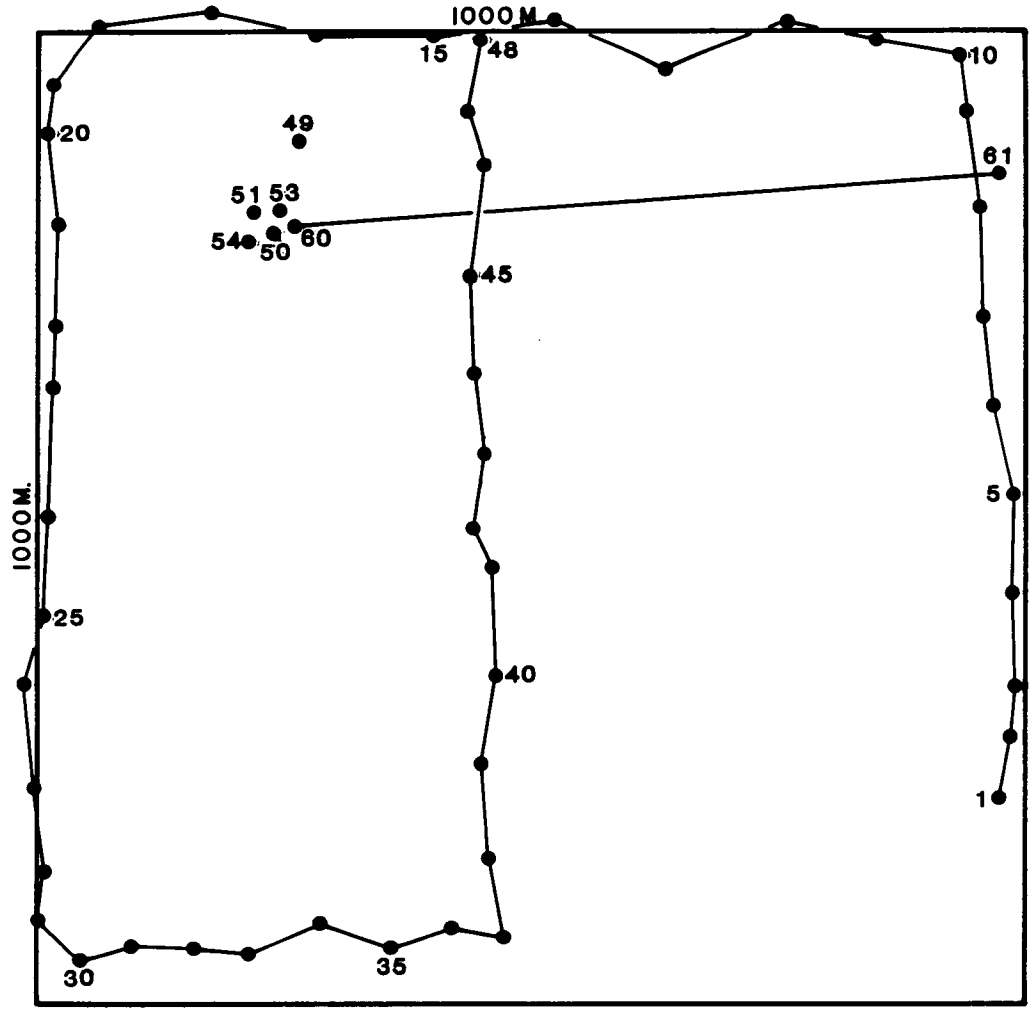


LEGEND

FIXMARK	EVENT
1-44	TV/STILL CAMERA LINE #2
103/104	DREDGE A
105/106	DREDGE B
107/108	DREDGE C
109/110	TRAWL

= LAT. 25°17.36'
LONG. 82°09.00'

STATION 19- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS

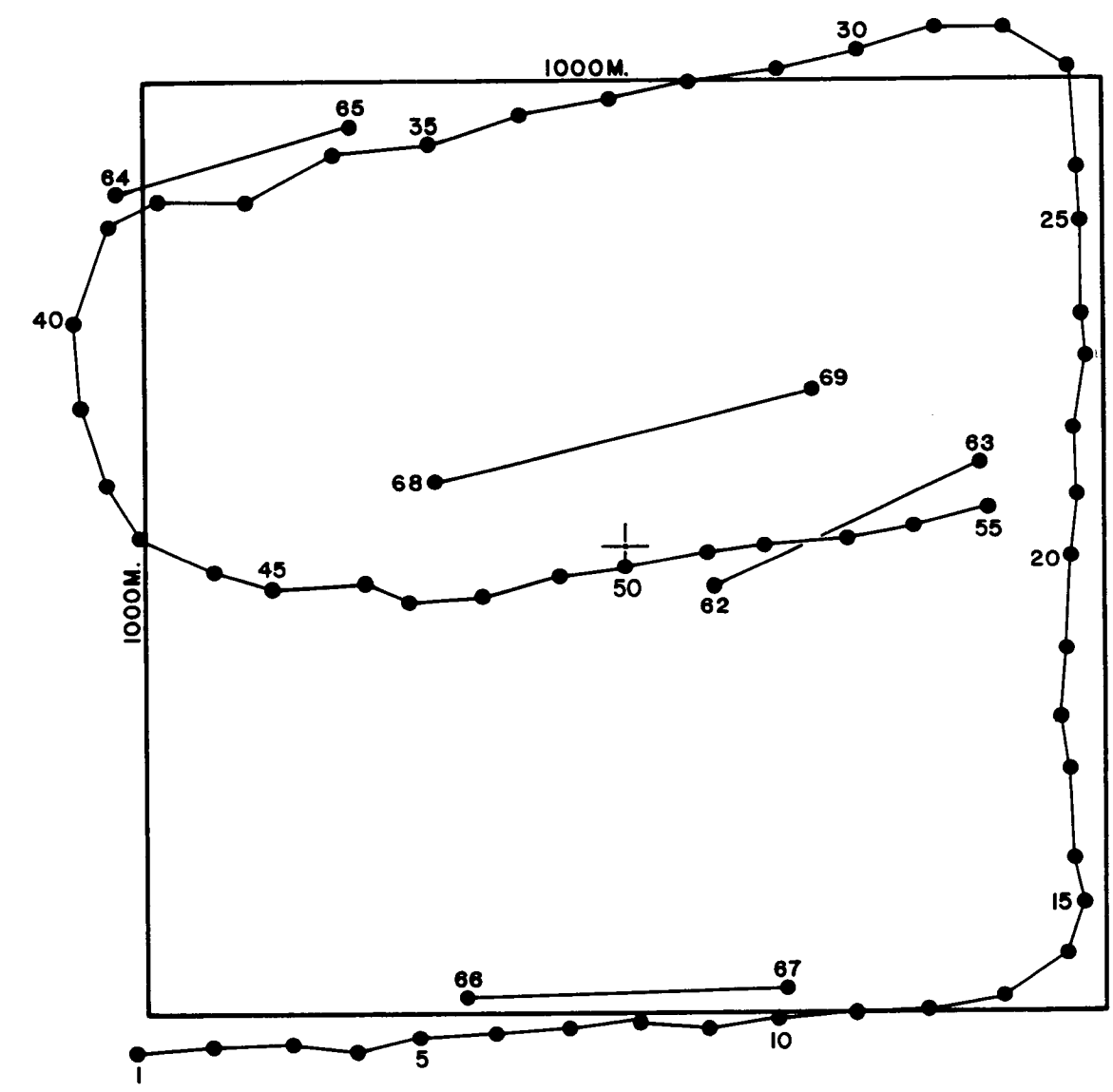


LEGEND

FIXMARK	EVENT
1-48	TV/STILL CAMERA LINE
49	BOX CORE SAMPLE A
50	BOX CORE SAMPLE B
51	BOX CORE SAMPLE C
53	BOX CORE SAMPLE D
54	BOX CORE SAMPLE E
60/61	TRAWL

= LAT. 25°17.34'
LONG. 82°09.73'

STATION 20- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

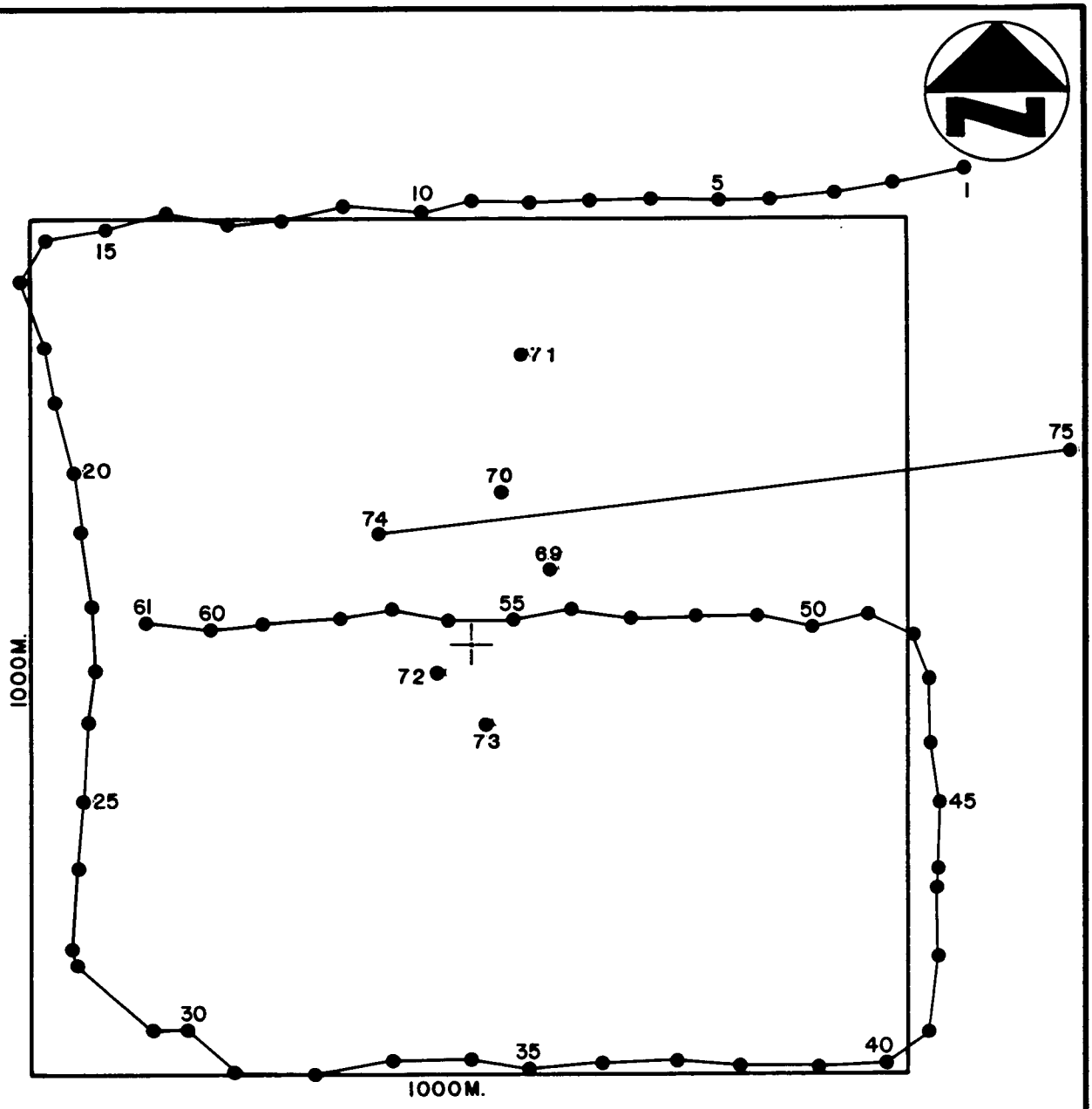


LEGEND

FIXMARK	EVENT
1-55	TV/STILL CAMERA LINE
62/63	DREDGE A
64/65	DREDGE B
66/67	DREDGE C
68/69	TRAWL

= LAT. 25°17.26'
LONG. 82°52.16'

STATION 21- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

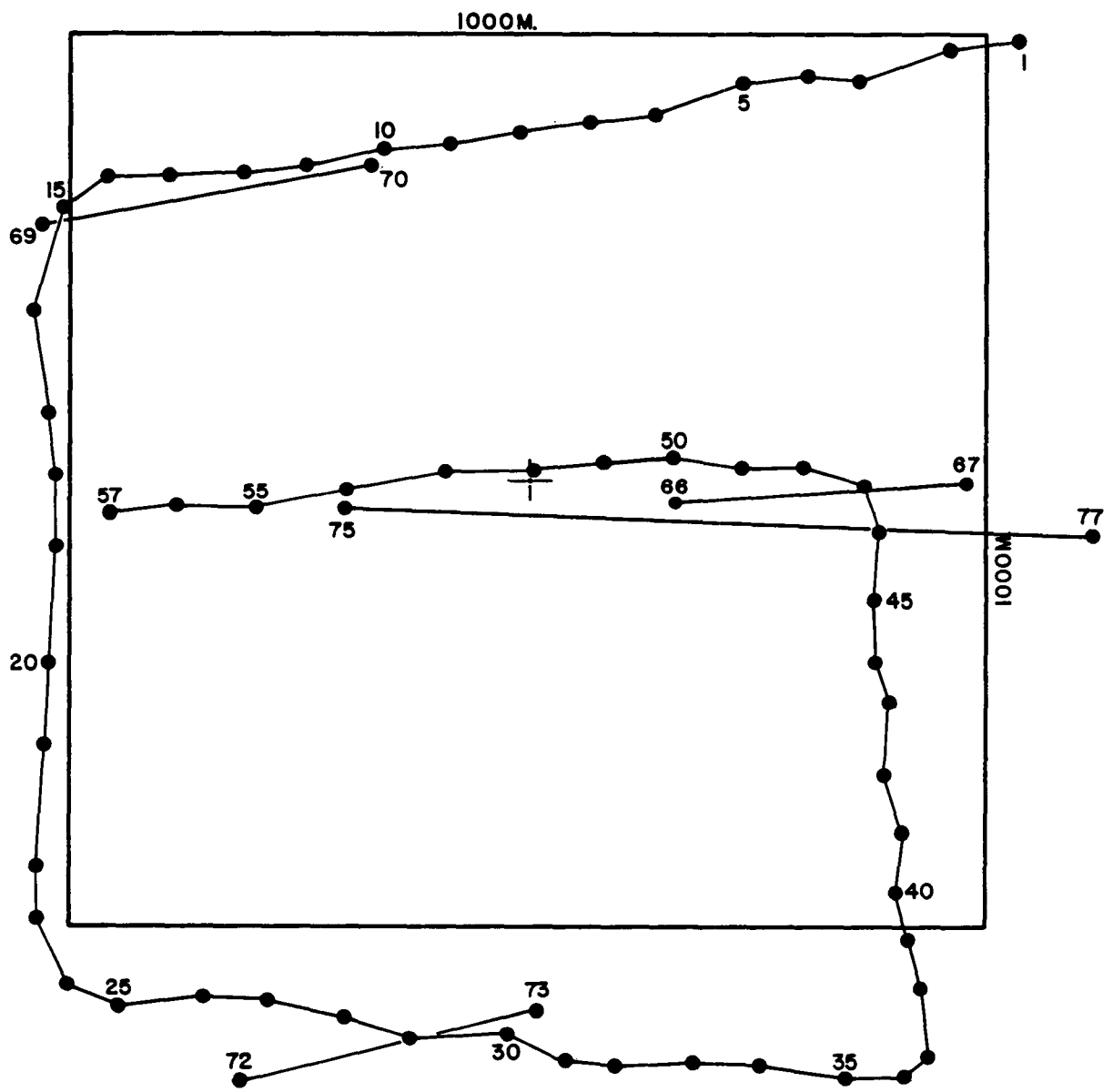


LEGEND

FIXMARK	EVENT
1-61	TV/STILL CAMERA LINE
69	BOX CORE SAMPLE A
70	BOX CORE SAMPLE B
71	BOX CORE SAMPLE C
72	BOX CORE SAMPLE D
73	BOX CORE SAMPLE E
74/75	TRAWL

= LAT. 25°17.18'
LONG. 83°02.07'

STATION 22 – TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

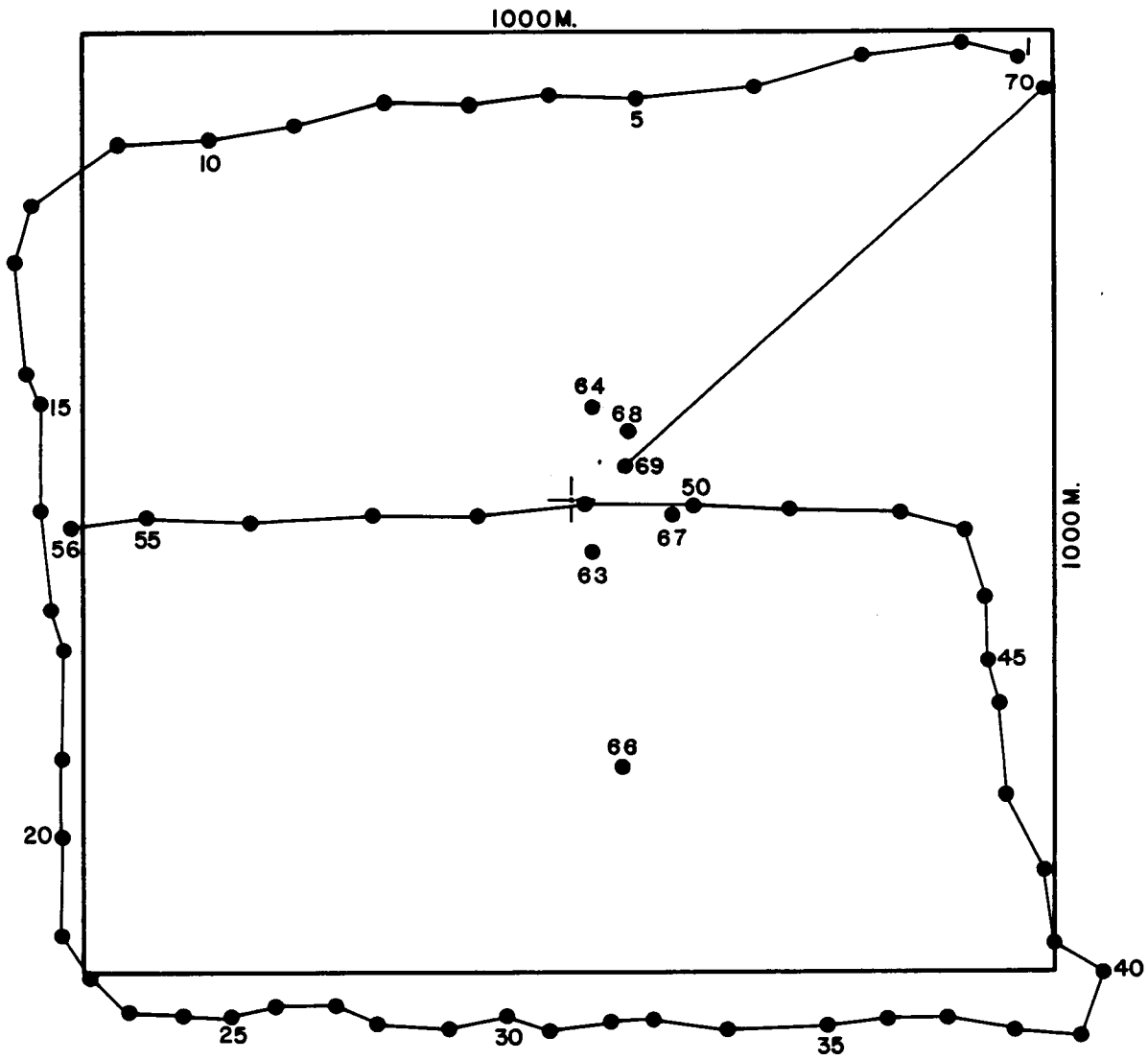


LEGEND

FIXMARK	EVENT
1-37	TV/STILL CAMERA LINE
66/67	DREDGE A
69/70	DREDGE B
72/73	DREDGE C
75/77	TRAWL

= LAT. 25°16.89'
LONG. 83°37.79'

STATION 23- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS - CRUISE IV

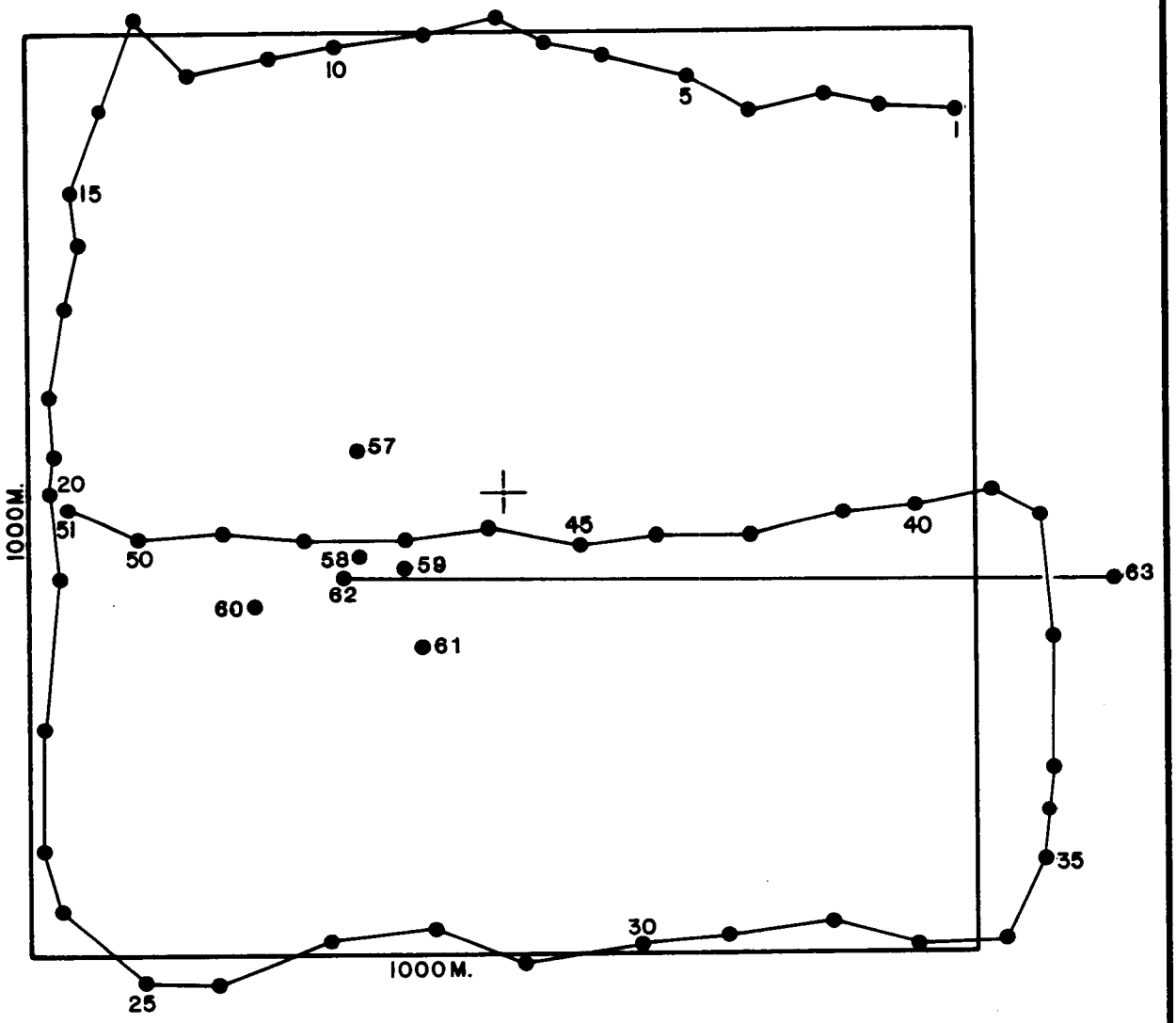


LEGEND

FIXMARK	EVENT
1-56	TV/STILL CAMERA LINE
63	BOX CORE SAMPLE A
64	BOX CORE SAMPLE B
66	BOX CORE SAMPLE C
67	BOX CORE SAMPLE D
68	BOX CORE SAMPLE E
69/70	TRAWL

= LAT. 25°16.90'
LONG. 83°43.18'

STATION 24- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

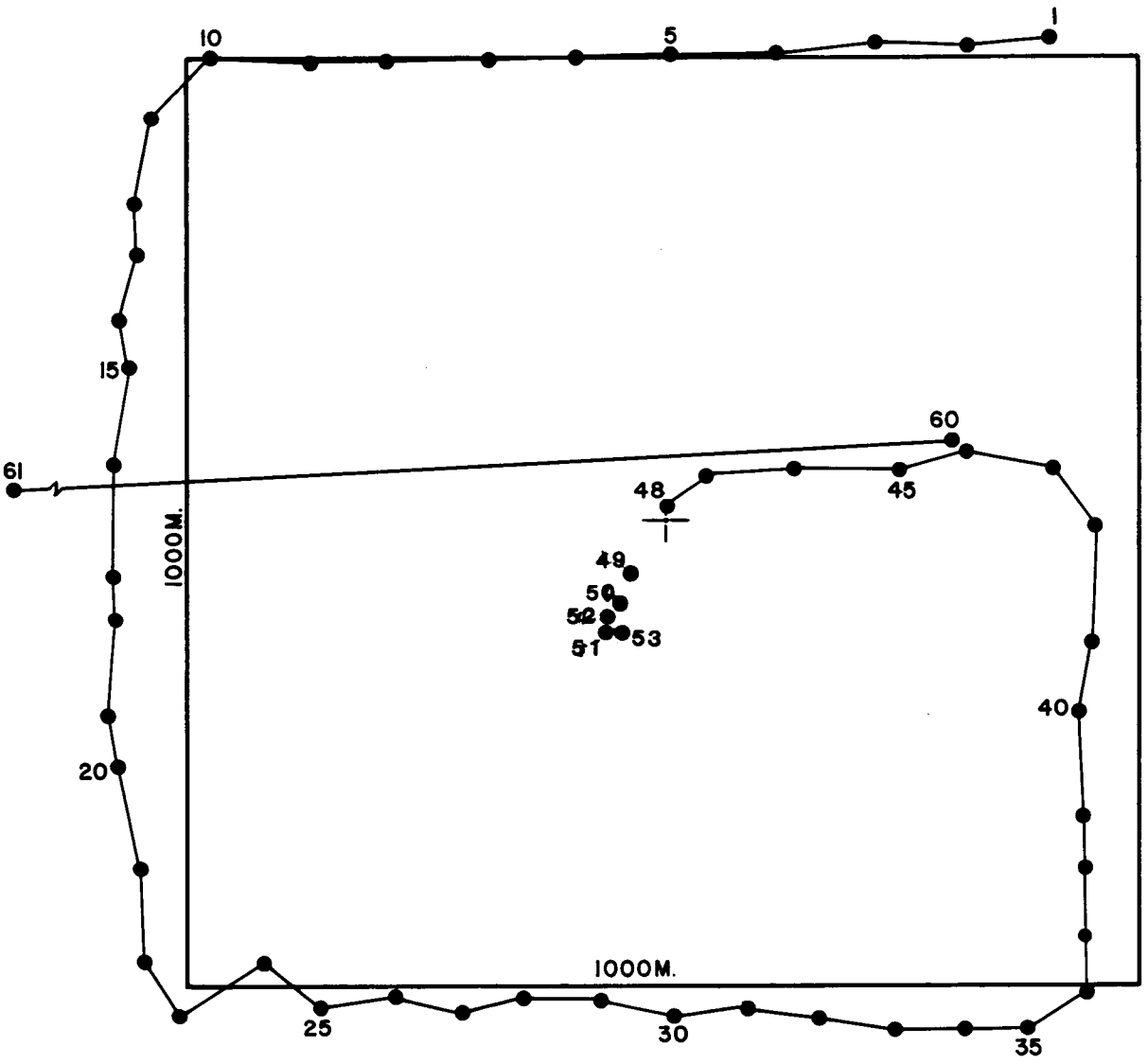


LEGEND

FIXMARK	EVENT
1-51	TV/STILL CAMERA LINE
57	BOX CORE SAMPLE A
58	BOX CORE SAMPLE B
59	BOX CORE SAMPLE C
60	BOX CORE SAMPLE D
61	BOX CORE SAMPLE E
62/63	TRAWL

= LAT. 24°47.95'
LONG. 82°13.26'

STATION 29- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

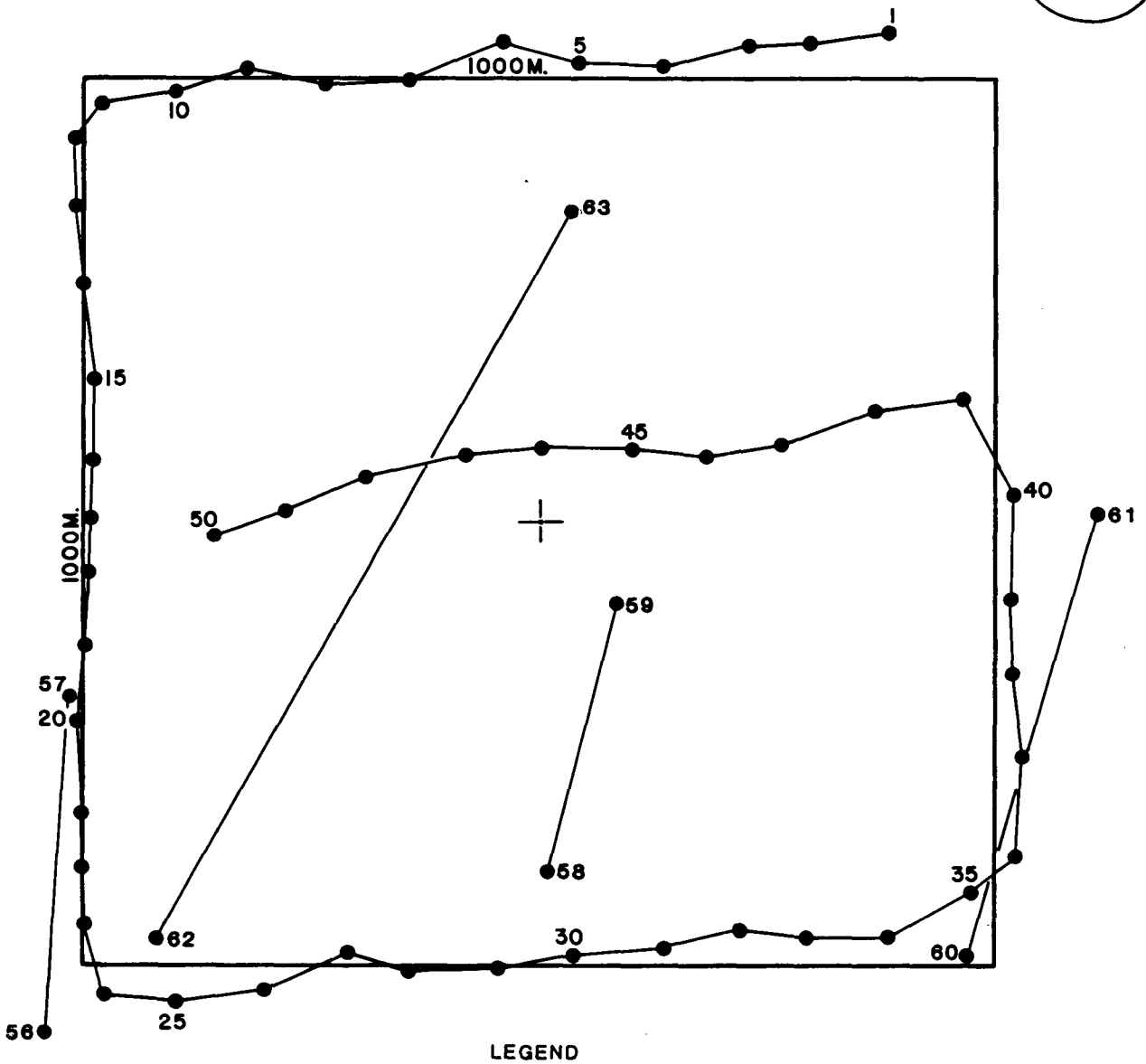


LEGEND

FIXMARK	EVENT
1-62	TV/STILL CAMERA LINE
49	BOX CORE SAMPLE A
50	BOX CORE SAMPLE B
51	BOX CORE SAMPLE C
52	BOX CORE SAMPLE D
53	BOX CORE SAMPLE E
60/61	TRAWL

= LAT. 24°47.82'
LONG. 82°52.07'

STATION 2● TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV

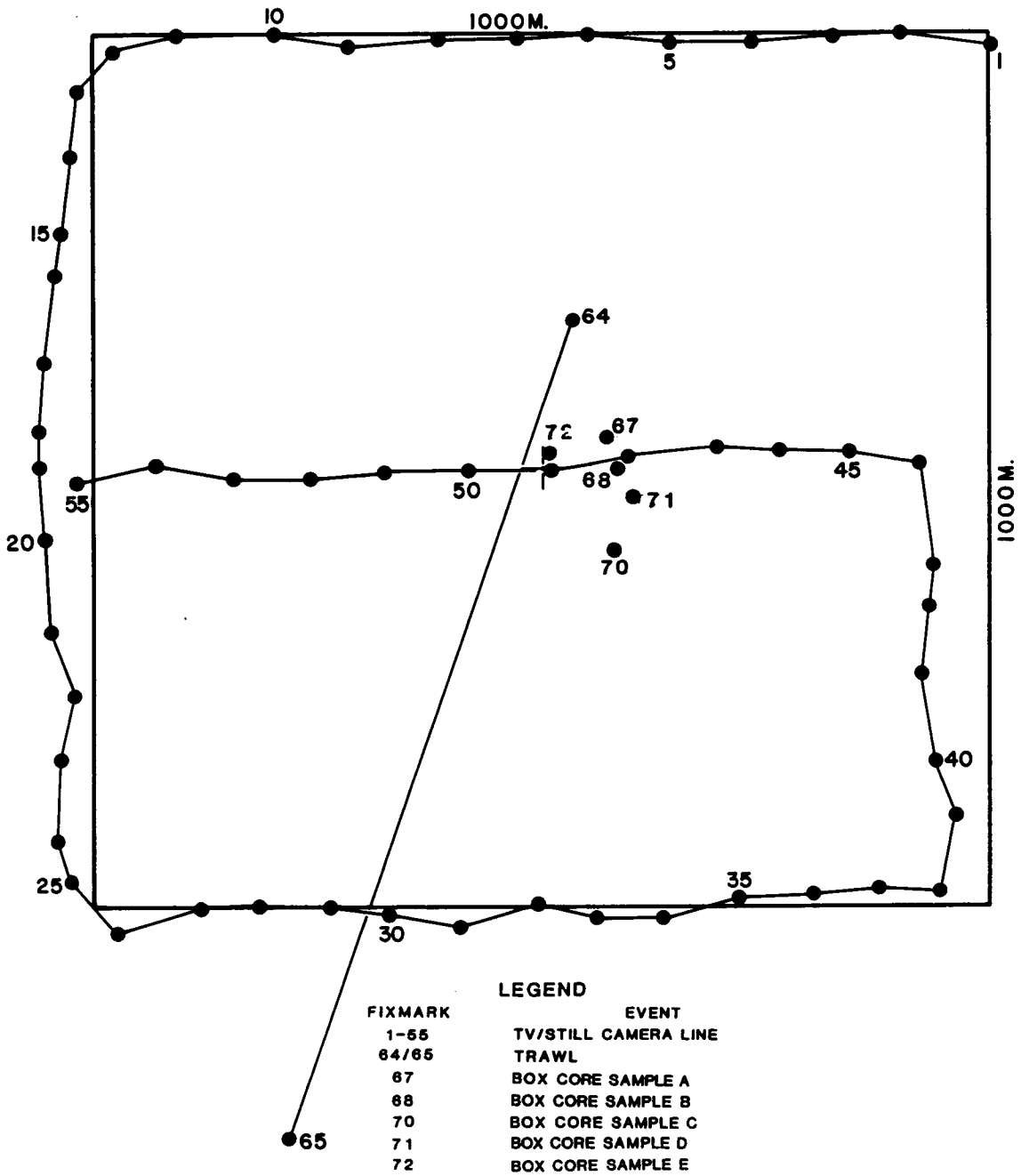


LEGEND

FIXMARK	EVENT
1-50	TV/STILL CAMERA LINE
56/57	DREDGE A
58/59	DREDGE B
60/61	DREDGE C
62/63	TRAWL

= LAT. 24°47.76'
LONG. 83°08.01'

STATION 27- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

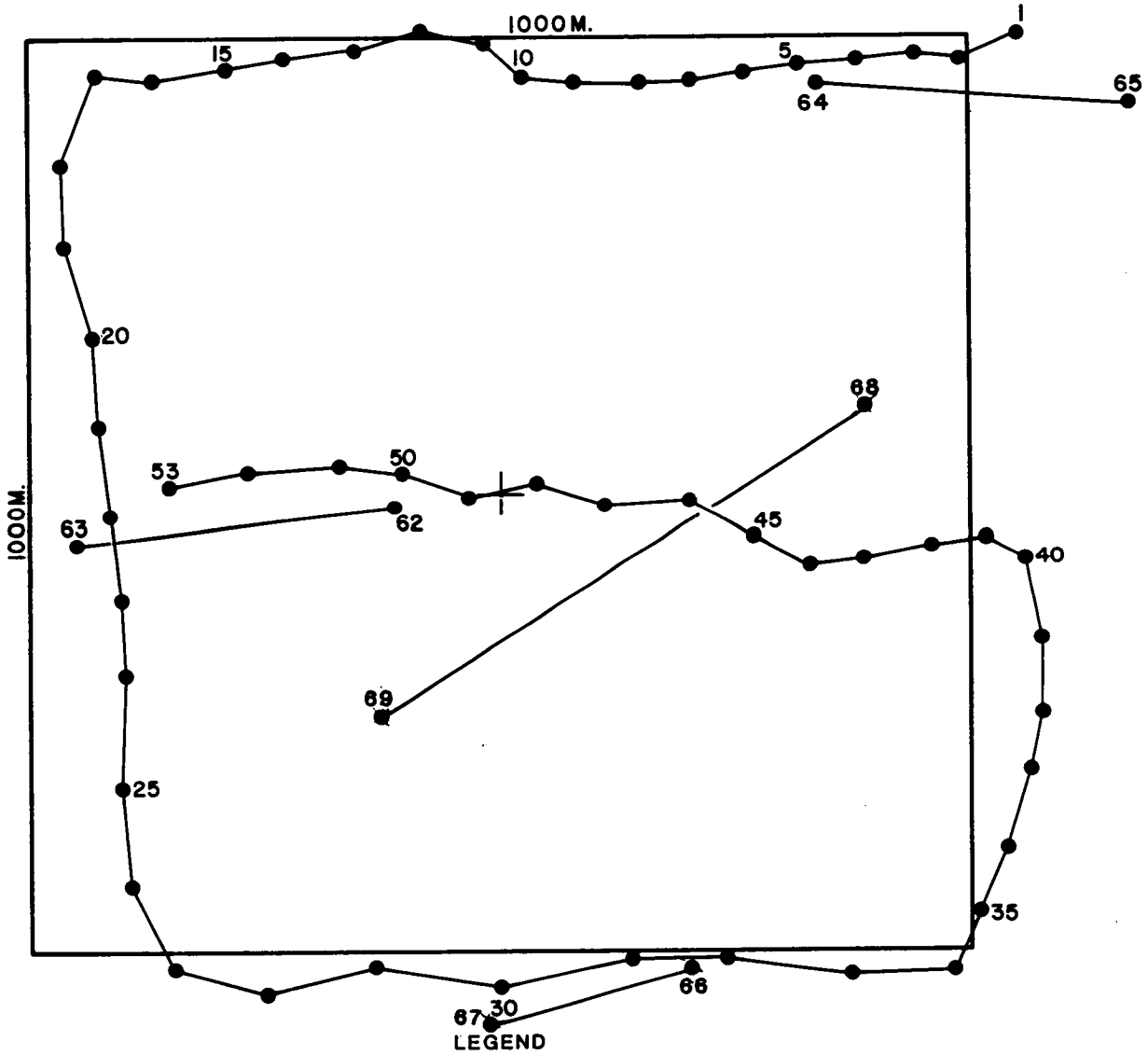


LEGEND

FIXMARK	EVENT
1-55	TV/STILL CAMERA LINE
64/65	TRAWL
67	BOX CORE SAMPLE A
68	BOX CORE SAMPLE B
70	BOX CORE SAMPLE C
71	BOX CORE SAMPLE D
72	BOX CORE SAMPLE E

= LAT. 24°47.11'
LONG. 83°13.08'

STATION 28- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS-CRUISE IV

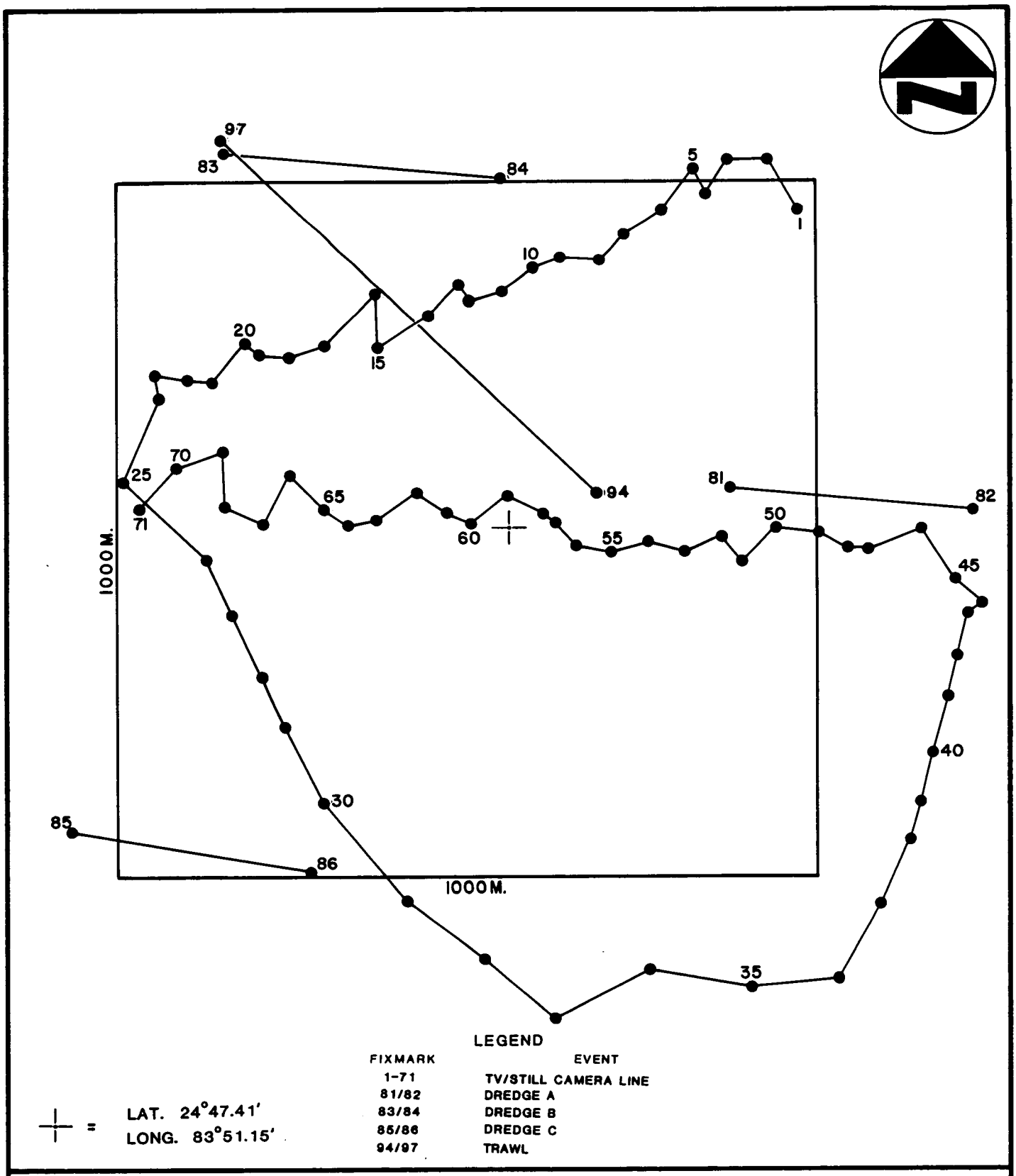


LEGEND

FIXMARK	EVENT
1-53	TV/STILL CAMERA LINE
62/63	DREDGE A
64/65	DREDGE B
66/67	DREDGE C
68/69	TRAWL

= LAT. 24°47.51'
LONG. 83°41.19'

STATION 29- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS — CRUISE IV



STATION 30- TELEVISION/STILL CAMERA DATA AND BENTHIC SAMPLE LOCATIONS – CRUISE IV

APPENDIX A-2 STATISTICAL MEASURES OF GRAIN SIZE

The statistics used on the grain size distribution were performed using the following formulae:

Where: phi (ϕ) = $-\log_2 x$; x = particle size in millimetres

(i) Median = phi value at 50 percent level

(ii) Mean grain size (Mz) - overall size measure (Folk, 1974).

$$Mz = \frac{\phi 16 + \phi 50 + \phi 84}{3}$$

Class	phi (ϕ)	mm
Gravel	<-1	2.0
Very coarse sand	<0	1.0
Coarse sand	<1	0.5
Medium sand	<2	0.25
Fine sand	<3	0.125
Very fine sand	<4	0.0625
Silt-clay	>4	<0.0625

(iii) Inclusive graphic standard deviation (sorting coefficient) (ϕ) measure of uniformity or sorting (Folk, 1974).

$$\sigma = \frac{\phi 84 - \phi 16}{4} + \frac{\phi 95 - \phi 5}{6.6}$$

Values	Degree of Sorting
<0.35 ϕ	Very well sorted
0.35 ϕ - 0.50 ϕ	Well sorted
0.50 ϕ - 0.71 ϕ	Moderately well sorted
0.71 ϕ - 1.00 ϕ	Moderately sorted
1.00 ϕ - 2.00 ϕ	Poorly sorted
2.00 ϕ - 4.00 ϕ	Very poorly sorted

(iv) Inclusive graphic skewness (Sk) - the degree of asymmetry between the central part of the grain size composition curve and the "tail" portions of the curve (Folk, 1974).

$$Sk = \frac{\phi 16 + \phi 84 - 2\phi 50}{2\,(\phi 84 - \phi 16)} + \frac{\phi 5 + \phi 95 - 2\phi 50}{2\,(\phi 95 - \phi 5)}$$

Sk Values	Degree of Sorting
+1.00 - +0.30	Strongly fine-skewed
+0.30 - +0.10	Fine-skewed
+0.10 - -0.10	Near symmetrical
-0.10 - -0.30	Coarse skewed
-0.30 - -1.00	Strongly coarse-skewed

(v) Graphic kurtosis (Kg) - ratio between the sorting in the "tails" of the granulometric curve and the sorting of the new central portion of the curve (Folk, 1974).

$$Kg = \frac{\phi 95 - \phi 5}{2.44\,(\phi 75 - \phi 25)}$$

Kg Values	Degree of Sorting
<0.67	Very platykurtic
0.67 - 0.90	Platykurtic
0.90 - 1.11	Mesokurtic
1.11 - 1.50	Leptokurtic
1.50 - 3.00	Very leptokurtic
>3.00	Extremely leptokurtic

Literature Cited

Folk, R.L. 1974. Petrology of sedimentary rocks. Hemphill Publishing Co., Austin, Tx. 182 pp.

APPENDIX A-3 SHIPBOARD PROCEDURES FOR COLLECTION OF SURFICIAL SEDIMENT SAMPLES FOR HYDROCARBON ANALYSIS

Sampling Procedure:

1. Cleaning sampler prior to sediment sample collection:

   a. A stainless steel corer (9 cm I.D. x 5 cm deep-collects 500 cm^3 of sediment) and scoop were rinsed with 100 ml of acetone, followed by a distilled water rinse. This was done prior to each box core sampling. No rinsing was done between subsamples taken from the same box core.

   b. Corer and scoop were not touched to any surface, except for the sediment, glass jars, or metal storage container.

2. Subsampling from the box core:

   a. The stainless steel corer was pushed into the sediment until the flange rested on the sediment surface (5 cm penetration).

   b. The sediment contained in the corer was removed by a stainless steel scoop and transferred to a glass jar (the entire volume of sediment was transferred.)

c. The corer was pulled from the sediment, moved 5 cm laterally, and pushed back into the sediment for a duplicate sample. This duplicate sample was transferred to the same glass jar as the first sample.

d. Two core subsamples were taken from each box core; the storage jars were approximately three-quarters full.

e. Storage jars were labeled, placed in a storage box, and stored in the freezer.

3. Cleaning of the sampler after collection of sediment sample:

a. All sediment was rinsed with distilled water from the sampling corer and scoop.

b. These were then dried with paper towels.

c. The sampling corer and scoop were each rinsed with 100 ml of acetone.

d. The corer was handled only by the outer edges of the flange, and the scoop only by the handle.

e. The cleaned scoop and corer were then placed in a covered, clean container.

Blanks:

1. Three jars were used, marked Blanks-1, -2, and -3, for each box core.

2. One of the blank jars was opened near the box core following the collection of the third, eighth, and thirteenth samples.

3. The blank jars were left open for 30 seconds, then sealed and stored with the sediment jars in the freezer.

Shipboard Contaminants:

Three possible ship contaminants were sampled and marked. The sample jars were then washed with soap and water and sealed in plastic bags for storage. The possible contaminants sampled were the ship's fuel oil, lube oil, and oily bilge water.

APPENDIX A-4 LABORATORY METHODOLOGY FOR SURFICIAL SEDIMENT HYDROCARBON ANALYSIS

1. Standard Mix and Internal (Spiked) Standards

A standard reference mixture containing known concentrations of specific aliphatic, aromatic and olefinic compounds was prepared. This mixture is outlined in Table 1. On several occasions, methylstearate was added to a clay control (bentonite clay precombusted at 550°C to remove all organic matter) and to select sediment samples. These samples were then taken through the entire freeze-drying, extraction, saponification, clean-up and analysis procedure. This was done to establish the percent recovery and to verify sensitivity, resolution, and reproducibility of the methods.

Each sample was "spiked" with a known concentration of eicosene and phenanthrene, these being used as internal standards for the Sigma-10 data system to reference for providing qualitative analysis. These compounds also provided a check on the efficiency of the separation into aliphatic and aromatic-olefinic fractions.

2. Sample Drying

Frozen sediment samples were thawed, homogenized, and 100 to 200-g subsamples were placed in clean aluminum pans for freeze-drying. At this point, the internal standards and reference standard mix were added. Freeze-drying was accomplished using a Labconco Model 5 Lyophilizer, equipped with a molecular

Table 1. Proposed composition of hydrocarbon reference mixture.

HYDROCARBON	CONCENTRATION in hexane (g/l)
$n\text{-}C_{15}$	1.0
$n\text{-}C_{16}$	0.1
$n\text{-}C_{17}$	0.5
pristane	10
$n\text{-}C_{18}$	0.1
phytane	0.1
$n\text{-}C_{19}$	0.1
$n\text{-}C_{20}$	0.1
$n\text{-}C_{18:1}$ (octadecene)	0.1
$n\text{-}C_{20:1}$ (eicosene)	0.1
$n\text{-}C_{21}$	0.5
$n\text{-}C_{22}$	0.1
$n\text{-}C_{26}$	0.1
$n\text{-}C_{28}$	0.1
$n\text{-}C_{30}$	0.1
$n\text{-}C_{32}$	1.5
Cholestane (5α)	0.5
androstane (5α)	0.5
naphthalene	0.1
1-methyl naphthalene (98%)	1.0
1,3-dimethylnaphthalene	1.0
phenanthrene	0.1
3,6-dimethylphenanthrene	0.1
phyrene	0.1
9,10-dihydrophenanthrene	0.1
acenaphthene	0.1
fluorene	0.1
biphenyl	0.1
nonadecylbenzene	0.1

sieve trap in the vacuum line to eliminate possible contamination from pump oil vapors.

3. Sediment Extraction

The freeze-dried samples were extracted through 300 cycles on a Soxhlet extraction apparatus using a methylene chloride: methanol (14:1) azeotrope. Following extraction, the azeotropic solution was concentrated to approximately 10 ml volume, using a vacuum rotary evaporation apparatus.

4. Sulfur Removal

The concentrated extract solution was passed through a glass column of activated copper granules 50 mm x 5 mm to remove sulfur contamination. The column was then washed with 5 ml of CH_2Cl_2: MeOH azeotrope and the washings were added to the de-sulfured sediment extract.

5. Saponification

Equal volumes of water and 0.5 N potassium hydroxide in methanol were combined with the extract and refluxed for four hours. Saturated NaCl solution was then added and the mixture extracted three times with hexane to recover the non-saponifiable hydrocarbon compounds. The hexane extracts were combined, washed with water (pre-extracted with hexane), dried over anhydrous Na_2SO_4, and then reduced to approximately 5 ml volume with a vacuum rotary evaporator. The hexane solution for some samples was then transferred to a tared glass vial, taken to dryness under a stream of dry N_2 gas, and weighed to the nearest 0.1

mg. Since this resulted in a loss of the more volatile components and since all samples contained $\leq$0.1 mg hydrocarbons, the evaporation step was eliminated.

6. Column Chromatography

The concentrated hexane solution of nonsaponifiable hydrocarbons was added to a glass column containing 5:1 (volume:volume) silica gel over microneutral alumina. The column tube was 10 mm in diameter and was packed to a height of approximately 10 cm of activated silica gel/alumina.

The aliphatic hydrocarbon (hexane) fraction was eluted from the column with three column volumes of hexane. The aromatic/olefinic (toluene/hexane) fraction was then eluted with three column volumes of a 2:3 (volume:volume) toluene/hexane solution. Each fraction was collected in a separate vial. Evaporation under dry nitrogen to obtain the mass of each fraction was found to cause excessive loss of each fraction, so this practice was discontinued. The mass of each fraction and of each component was determined by gas chromatography, relative to the mass of the known internal standard spike.

7. Gas Chromatography

Gas chromatographic analysis of the above fractions was carried out using a Perkin-Elmer Sigma-3 Gas Chromatograph coupled with a Sigma-10 chromatography data system. The instrument was equipped with dual hydrogen flame ionization detectors (FID) and linear temperature programmers. Glass capillary columns were used (30 m x 0.25 mm I.D.) coated with SE-30 methylsilicone liquid phase.

The carrier gas was nitrogen at a flow of 1 ml min^{-1}. Injection was made through a sample splitter and the chromatopgraph was temperature programmed from 100°C to 180°C at 6° min^{-1}, with a 5 min hold at 180°C to recover n-alkanes in the n-C_{12} to n-C_{33} range.

8. Gas Chromatographic Mass Spectrometric Analysis

Six samples of both aliphatic and aromatic/olefinic fractions were selected for characterization by glass capillary gas chromatographic mass spectrometric analysis (GC/MS). This was done after studying the GC-FID chromatographic fingerprints. Analysis was performed using a Hewlett-Packard Model 5710-A Gas Chromatograph equipped with 30 m glass capillary SE-30 columns. These were the same as those used for GC-FID. The gas chromatograph was interfaced with a Hewlett-Packard Model 5980-A Quadrapole Mass Spectograph, supported by a Hewlett-Packard 5933-A Computer Data System. Samples of the standard mix and reagent blanks were analyzed along with samples for calibration and mass spectra comparison.

9. Interlaboratory Calibration

Interlaboratory calibration samples included the standard reference hydrocarbon mix, two sediment samples analyzed in duplicate, one sediment sample spiked with the standard reference mix analyzed in triplicate, and one clay control sample. Each sample was analyzed by the independent laboratory using identical methods to establish extraction efficiency and reproducibility of the methods. The results were supportive of the findings of the original analyses.

APPENDIX A-5 SHIPBOARD PROCEDURES FOR COLLECTION OF SURFICIAL SEDIMENT SAMPLES FOR TRACE METAL ANALYSIS

1. Wearing plastic gloves, one of the four 20-dram polystyrene vials was removed from its Ziploc bag.

2. Subsampling from the box core: The cap was removed and the vial placed, open-side down, on the surface of the sediment.

3. The vial was gently pushed down into the sediment until the bottom of the vial was at the sediment surface and the vial was full of sediment. This provided an approximately 5-cm deep subsample.

4. The vial was removed (with gloves on), by pushing one hand down into the sediment beside the vial and extending one's fingers across the open end of the vial.

5. Next, the entire vial was pulled out of the sediment and the cap replaced.

6. Excess sediment and water were wiped/washed from the outside of the closed vial with clean water and/or a paper towel.

7. Two rounds of plastic tape were wrapped around the vial to join the cap with the body of the vial.

8. The vials were labeled, replaced in the Ziploc bag, and frozen.

9. Two vials provided the equivalent of <u>one</u> sample.

APPENDIX A-6 LABORATORY METHODOLOGY FOR SURFICIAL SEDIMENT TRACE METAL ANALYSIS

1.0 Sample Preparation

The outer portions of the polystyrene vials were rinsed with distilled-deionized water. The covers were replaced with Parafilm in which small holes were made with an acid-washed glass rod. The still frozen samples were then placed in a freeze-drier and left for about 48 h. Next, the plastic covers (pre-washed with 2 N HNO_3) were replaced and the vial with dried sediment was shaken manually. For the generally coarse-grained sediments, this procedure produced a virtually unaltered sample which was unconsolidated (loose) and as homogeneous as possible. To further assure homogeneity and inspect for >3 mm particles, the sample was visually inspected and stirred with a teflon policeman. The sample vials were stored in sealed plastic bags. A test of the efficiency of the freeze-drying technique was previously made by drying freeze-dried sediments at 105°C (Trefry et al., 1978). The results showed that the freeze-drying method dried 99.78 ± 0.08% of what would be dried at 105°C.

2.0 Sediment Digestion

All 30 sediment samples (2 replicates per station) were analyzed for trace metals after "partial digestion" with 1N HNO_3. Eight of the samples were also analyzed after total dissolution with hydrofluoric, nitric, and perchloric acids ($HF-HNO_3-HClO_4$). Weighing of dried aliquots of sediment for digestion was carried out in a Plexiglass hood using a two-place O'Haus electronic balance. Each sample was remixed prior to weighing and every effort was made to take a representative sample of these often inhomogeneously appearing

sediments. Two-gram portions were used for partial digestion and approximately two-gram aliquots were taken for total dissolution. The partial digestion scheme is given in Table 1. The methodology for total sediment dissolutions for trace metal analysis is outlined in Table 2.

3.0 Atomic Absorption Analysis

Flame atomic absorption spectrophotometric (AAS) analysis of the sediment digests for Cr, Fe, and Zn was carried out using a Perkin-Elmer 460 instrument equipped with a deuterium-arc background corrector. Flameless AAS was used for detecting low levels of Cd, Cu, Ni, and Pb present. An HGA 400 with AS-40 was coupled with the Perkin-Elmer 460 for flameless analyses. Instrument settings generally followed the manufacturer's specifications except where optimization techniques could be used to increase sensitivity and stability. The parameters for AAS analyses are given in Tables 4 and 5.

Iron analyses were made on 10 to 50-fold dilutions, respectively, whereas Cr and Zn analyses were made on the original solution. Cadmium, Cu, Ni, and Pb analyses by flameless AAS were made on 10 to 50-fold dilutions of the original solution. Dilutions were made with a 1000-µl Eppendorf pipette (with acid-washed tips) and a dispensing repipette. All dilutions were made in acid-washed polystyrene vials.

Because metal concentrations were particularly low in these sediments, AAS analyses were carried out at an expanded scale or by flameless techniques. All standards used were in a comparable acid matrix of 0.1 or 1.0 $\underline{N}$ HNO_3 and background correction was applied for all analyses. Method-of-additions

Table 1. Sediment partial digestion methodology.

---

1. Approximately 2 g of freeze-dried, unpowdered, >3 mm particle-size sediment were weighed into a tared 50-ml polyethylene centrifuge tube (tube was pre-cleaned in warm 1:1 HNO_3:H_2O solution for several hours and rinsed twice with distilled-deionized water).

2. The tube was covered with a screw-type polypropylene cap which had a small hole in it.

3. 1N HNO_3 (redistilled) was added to the sample in 1-ml aliquots using an Eppendorf pipette with an acid-washed plastic tip.

4. The centrifuge tube was swirled gently after each addition of 1 ml of 1N HNO_3.

5. Steps 3 and 4 were repeated until no reaction (of HNO_3 with $CaCO_3$) was observed or until 10 ml of 1N HNO_3 had been used.

6. If additional $CaCO_3$ remained unreacted, 1-ml aliquots of 2.5 N HNO_3 were added using an Eppendorf pipette. These additions were continued until the reaction was complete. (If the 2-g samples were 100% $CaCO_3$, 10 ml of 1N HNO_3 plus 12 ml of 2.5 N HNO_3 would be required.)

7. Appropriate volumes of 2.5 N and/or 1N HNO_3 were added to adjust the final volume and normality of the solution (see the following Table 3, for determining volumes to be added).

8. The centrifuge tube was tightly fitted with a polypropylene screw cap and was shaken for two hours on a wrist-action shaker.

9. The leachate was separated from the sediment residue by centrifugation and the clear solution was stored in an acid-washed polystyrene vial.

Table 2. Sediment total dissolution methodology.

---

1. Approximately 1 g of sediment was weighed into a tared 50-ml polyethylene centrifuge tube (tube was pre-cleaned in warm 1:1 HNO_3 solution for several hours and rinsed twice with distilled-deionized water).

2. The sample was then treated in the same manner used in the partial digestion procedure. This involved addition of 1-ml aliquots of 1N and 2.5 N HNO_3 until the $CaCO_3$ dissolution was completed. However, no normality adjustment was made in this treatment. Instead, the sediment/acid mixture was centrifuged and the resultant Ca-rich solution was decanted into an acid-washed polystyrene vial.

3. The residual sediment was washed into a teflon beaker with ultrapure water and heated until dry.

4. Then, 2 ml of concentrated HNO_3 and 2 ml of concentrated HF were added to the teflon beaker, a teflon watch cover put in place, and the mixture was heated gently for three to four hours.

5. Next, 0.5 ml of concentrated $HClO_4$ were added and the mixture was heated more intensely for two hours.

6. The watch cover was then removed and the solution allowed to come to near-dryness (i.e., when the $HClO_4$ reaction was completed).

Table 2. (Continued)

7. Steps 4, 5, and 6 were repeated.
8. To dissolve the residual moist paste, 1 ml of concentrated HNO_3 was added and followed by small additions of ultrapure water.
9. The dissolving paste was heated very strongly as additional water was added.
10. As dissolution occurred, the Ca-rich leachate was added to the teflon beaker and heated.
11. The solution was transferred to a 25-ml volumetric mixing cylinder and diluted to volume with distilled-deionized water.

Table 3. HNO_3 additions scheme for partial digestion of bottom sediments for trace metal analysis.

ml. of 1 N HNO_3 used to titrate $CaCO_3$	ml of 2.5 N HNO_3 used to titrate $CaCO_3$	ml of 2.5 N HNO_3 added to adjust normality	ml of 1 N HNO_3 added to adjust vol. and N	Total Vol. (ml)	Approx. Final N of HNO_3
1	0	0	30	31	0.97
2	0	1	30	33	0.98
3	0	2	30	35	1.00
4	0	2	30	36	0.97
5	0	3	30	38	0.99
6	0	4	20	30	1.00
7	0	4	20	31	0.97
8	0	5	20	33	0.98
9	0	6	20	35	1.00
10	0	6	20	36	0.97
10	1	7	20	38	0.99
10	2	8	20	40	1.00
10	3	8	10	31	0.97
10	4	9	10	33	0.98
10	5	10	10	35	1.00
10	6	10	10	36	0.97
10	7	11	10	38	0.99
10	8	12	0	30	1.00
10	9	12	0	31	0.97
10	10	13	0	33	0.98
10	11	14	0	35	1.00
10	12	14	0	36	0.97

Table 4. Instrument parameters for flame atomic absorption spectrophotometry.

	Element		
	Cr	Fe	Zn
Analytical Wavelength (nm)	357.9	248.3	213.9
Slitwidth (nm)	0.7	0.2	2.0
Lamp Energy (mA)	12	25	10
Fuel (C_2H_2)[a]	40	30	30
Oxidant-Air[b]	60	60	60
Integration period (s)	3	2	2
Scale Expansion[c]	3x	---	---
Sensitivity[d]	0.7	3	0.2

[a]Flowmeter divisions at 11 psig.

[b]Flowmeter divisions at 50 psig.

[c]Applicable only to leachate analysis. No scale expansion used during total dissolution analysis.

[d]Concentration in $\mu g\ ml^{-1}$ in solution which will give reading of about 0.2 absorbance units.

Table 5. Instrument parameters for flameless atomic absorption spectrophotometry.

	Element			
	Cd	Cu	Pb	Ni
Analytical Wavelength (nm)	228.8	324.7	283.3	232.0
Slit width (nm)	0.7	0.7	0.7	0.7
Lamp Energy (mA)	4	12	12	25
Argon Flow Rate	Stop Flow	Stop Flow	Stop Flow	Stop Flow
Dry Temperature (°C)	120°	120°	120°	120°
Time (s)	20	20	20	20
Char Temperature (°C)	250°	900°	700°	1000°
Time (s)	20	20	20	20
Atomize Temperature (°C)	2300°	2300°	2300°	2300°
Time (s)	5	5	5	5
Sensitivity[a]	2	0.3	25	0.6

[a]Concentration in ng ml^{-1} in solution which will give reading of about 0.2 absorbance units.

(standard additions) analyses were also carried out for each element using a variety of sample types. These checks help evaluate matrix problems due to chemical interference with resultant signal suppression. Additions analyses were carried out by taking three or four 2-ml aliquots of sample and adding 0.1-ml portions of deionized water to one aliquot and appropriate spikes of the element of interest to the remaining sample portions. Care was taken to insure that the resultant absorbance was still on the linear portion of the working curve. Our work shows good comparisons between additions analyses for Cu, Fe, and Zn as well as for some Ni analyses, yet unacceptable deviations (>10%) for Cr, Cd, Pb, and some Ni values. These results were not unexpected due to the Ca-rich matrix which characterized most of our samples. However, it did mean that our Cr, Cd, Pb and Ni values had to be determined by the more lengthly additions method.

4.0 Instrument Neutron Activation Analysis

4.1 Barium-139 Technique

The neutron activation analysis procedure was based on the 83.3-min Ba-139 activity. An aliquot of the sample being assayed was weighed into an acid-cleaned, two-dram polystyrene vial and heat sealed. The volume of the subsample was exactly 2.0 ml. Subsamples, plus two Ba standards were irradiated for 75 min in the rotary rack of the reactor. Immediately after irradiation, 1.0 ml of the subsample was transferred to a 50-ml polypropylene beaker containing 100 mg each of NaCl and KCl and 20 mg Ba^{++} ion in 0.5 $\underline{N}$ HNO_3. This solution was then heated on a boiling water bath for 3 to 5 min, and then 2 ml of 1.0 $\underline{N}$ H_2SO_4 was added slowly with swirling to induce precipitation of

$BaSO_4$. The precipitate was allowed to digest on the water bath for an additional 5 min, then filtered on a 25-mm, 0.4 μm Millipore filter and washed with 3 ml NaCl/KCl solution, and 3 ml $1\underline{N}$ H_2SO_4.

The 20 mg of Ba added acted as a "carrier" of the activated Ba and insured an adequate $BaSO_4$ precipitate. Conversely, the NaCl and KCl added during this post-irradiation procedure acted as "hold-back carriers" in reducing the amount of Na-24, Cl-38, and K-42 that was retained in the precipitate and filter. Presoaking the Millipore filter in NaCl-KCl-HNO_3 also inhibited the retention of Na-24, Cl-38, and K-42.

The filter (and precipitate) was mounted on a 1 mm x 25 mm x 75 mm microscope slide with one-inch "3M" tape, sealed in a plastic bag, and counted for 6 min with a high resolution Ge(Li) spectrometer. All subsamples and standards were processed in the identical manner.

All 4096 channels of the gamma ray data were recorded on computer-compatible magnetic tape for subsequent analysis. The intensity of the 166 keV gamma ray, associated with the Ba-139 activity, was measured for each subsample and compared to the corresponding line in the co-irradiated Ba standards. Thus, a measure of the Ba mass was determined for each subsample. The minimum detectable Ba mass with this procedure was of the order of 15 to 40 ng, depending on the degree of interferences (chiefly strontium).

4.2 Vanadium-52 Direct Irradiation (INAA) Technique

The liquid subsample for V determination was quantitatively pipetted (2.4 ml) into an acid-cleaned polystyrene vial and then irradiated for three minutes using a pneumatic transport system. The thermal neutron flux at the terminus of the pneumatic tube was 2.5×10^{12} $n(cm^2\text{-}s)^{-1}$. The subsample was allowed to decay for three minutes to diminish the very short-lived interfering and background activities. During the decay period, 2.0 ml of the subsample were quantitatively pipetted into a Beckman "Poly-Q" counting vial. At the end of the decay period, the V-52 activity was measured by counting the sample for three minutes on a 30-cc Ge(Li) spectrometer. The entire 4096 channel spectrum was recorded on computer-compatible magnetic tape for subsequent analysis. The transfer of the sample to a counting vial eliminated interfering activity induced in the irradiation vial, as well as the Ar-41 activity induced in the irradiated air above the sample.

5.0 Literature Cited

Trefry, J.H,, A.D. Fredericks, S.R. Fay, and M.L. Byington. 1978. Heavy metal analysis of bottom sediment, p. 346-374. In: The Mississippi, Alabama, Florida outer continental shelf baseline environmental survey, 1977/1978. Vol. II-A. A final report to the U.S. Department of Interior, Bureau of Land Management, New Orleans OCS Office, Contract No. AA550-CT7-34.

APPENDIX A-7 EQUIPMENT SPECIFICATIONS

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R/V "VENTURE"

GENERAL SPECIFICATIONS

LENGTH: 125 Feet
BREDTH: 27 Feet
DRAFT: 7 Feet

CAPACITIES:
FUEL: 6450 Gallons
POTABLE WATER: 7100 Gallons

POWER: AC 60 KW Ships & Auxiliary 440-220 & 110 V
Separate 60 KW Avail Forward for Seismic Power Supply

ELECTRONICS: RADIO: 1 ea. SSB Raytheon 1275-B
1 ea. AM Raytheon 75A-3C
2 ea. VHF Raytheon
2 ea. C.B.

FATHOMETER: 1 ea. Ross 600 Foot
1 ea. EDO 6000 Fathom Survey Sounder

RADAR: 1 ea. Kelvin Hughes 20 Mile
1 ea. Raytheon 24 Mile

GYROCOMPASS: 1 ea. Sperry MK 18

SAFETY: 1 ea. 16' Whaler w/16 HP
1 ea. 12 Man CG App. Raft
1 ea. 25 Man Inflateable Canopy Covered Raft to SOLAS Spec.

FOOD: Refrigerator & Freezer Space for 30 Days or More

ACCOM: For 10 in Charter Party plus Ships Crew
1 ea. 4 Man Room and 3 ea. 2 Man Rooms each air cond., hotwater heated and having port lights for ventilation.
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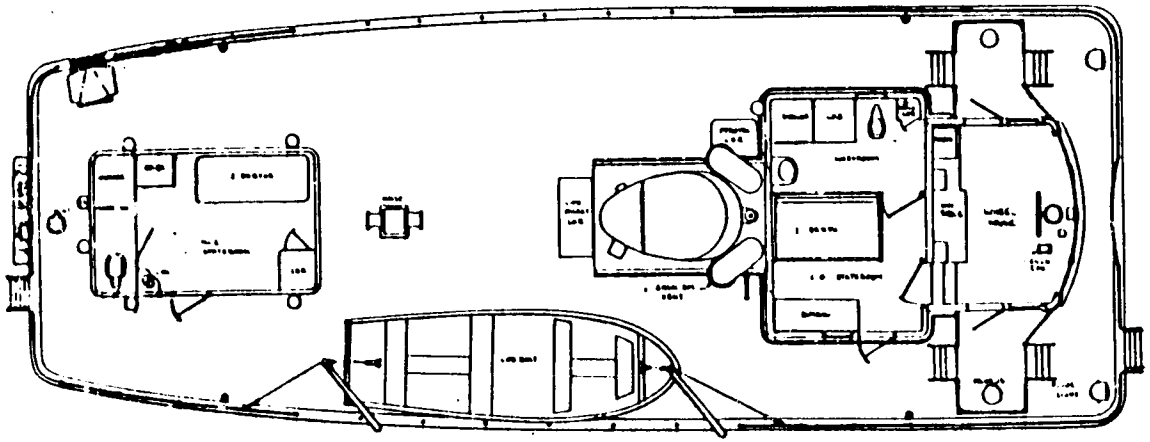

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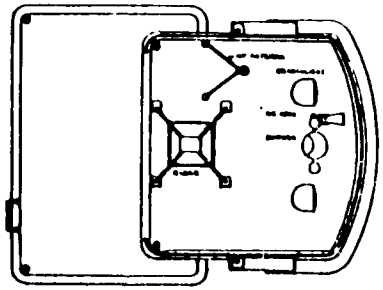

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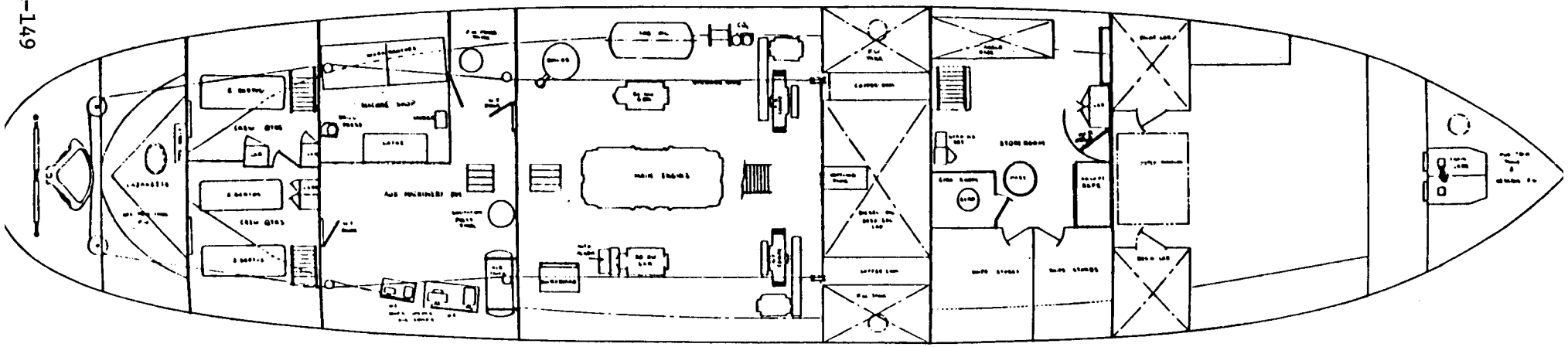

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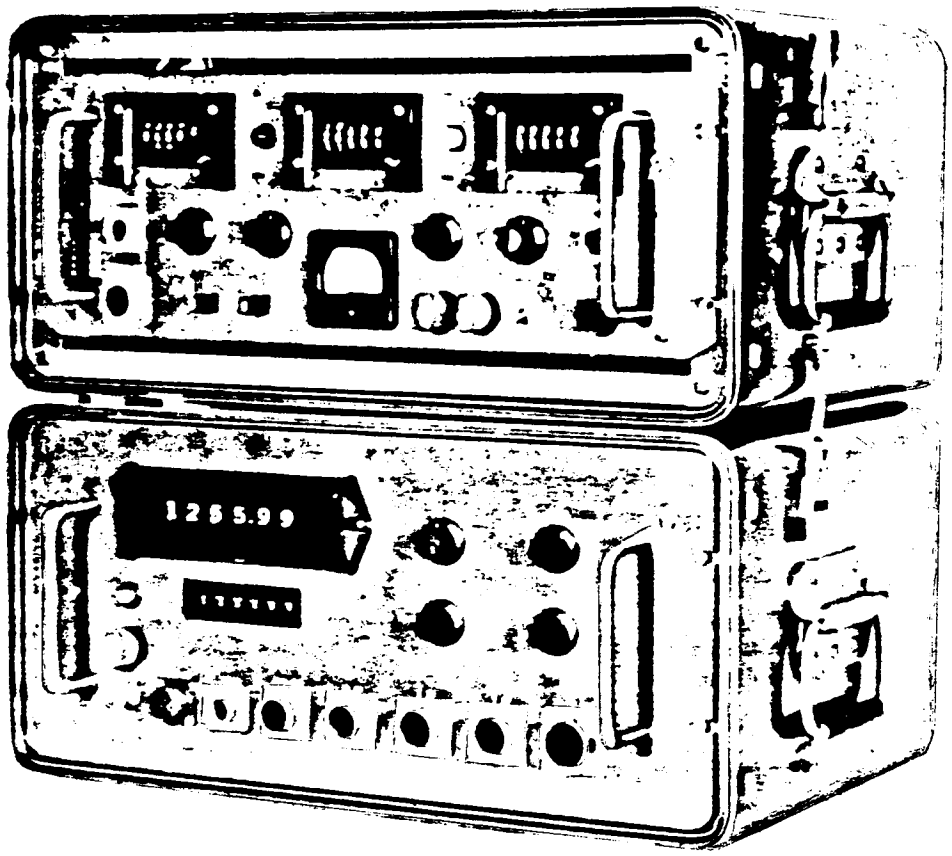

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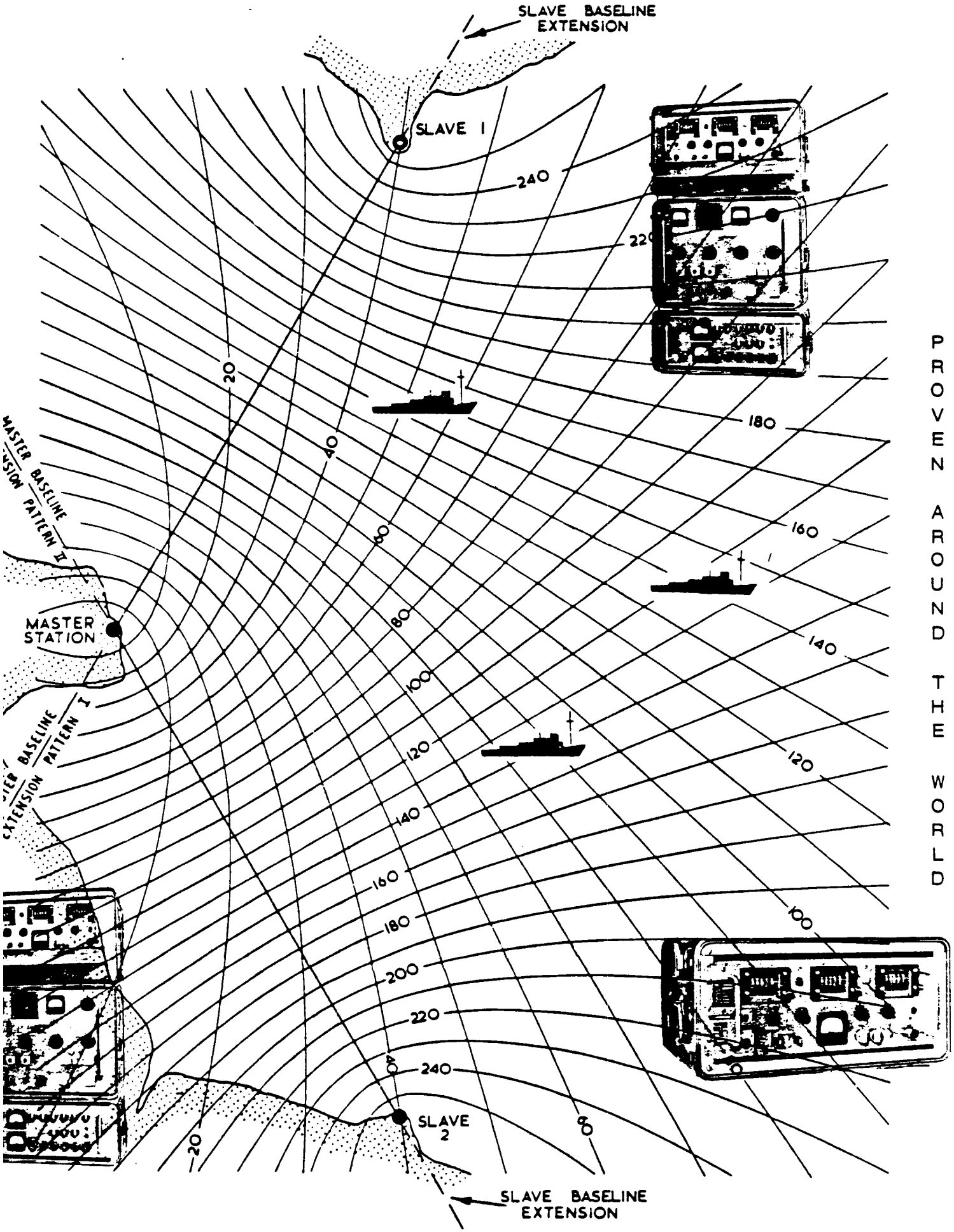
Working Range	50-100 Miles Temperate Lats. / 25- 50 Miles Tropical Lats. } 10 W Radiated Power
	100-200 Miles Temperate Lats. / 50-100 Miles Tropical Lats. } 40 W Radiated Power
ACCURACY:	
Hyperbolic Mode	.015 Lane
Range-Range Mode	.015 Lane
POWER:	
Hi-FIX Master or Slave	6a @ 24 V.D.C.
Shipboard Receiver	4a @ 24 V.D.C.


SLAVE BASELINE EXTENSION
SLAVE 1
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220
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Although a Pulse/8 Chain may be configured to operate as a Loran C Chain, on one of the established repetition rates, its main application is seen to be that of providing temporary coverage over selected exploration areas utilising the Decca S501 Receiver. The specification of this Receiver meets the requirements of offshore surveying, with the Oil Industry especially in mind, providing simultaneous tracking of three lines of position, high accuracy and optional computer interfacing amongst its many features.

This system uses 150ft masts in areas of low noise rising to 300ft as necessary, with baselines in the region of 150 to 250 miles. Designed for easy transportation the equipment for one transmitting station, excluding mast, weighs approximately 600lbs. with a volume of about 40 cu ft. Power output from each station is approximately 1kw RMS power at the peak of the pulse using a 300ft mast, and is capable of providing for an accuracy of 50 metres within a range of 300 miles from any pair of stations.

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A standard system employs in a given chain from three to a maximum of six stations depending upon the coverage required. The transmitters radiate in turn phase coded pulse groups in precise time registration with each other at a pulse group repetition rate specific to that chain. The receiver – Decca Survey Receiver Type S501 – will then determine from any two or three pairs of received signals position lines derived from the time difference between them.

TECHNICAL DATA SUMMARY

Max. Range:
300 to 500 miles over seawater; up to 200 miles over poor conductivity paths dependent on mast height and radiated power.

Antenna:
Above specifications based on 300 foot height. Use of 150 foot unit may be possible in interference free, low noise areas.

Accuracy:
Depends on the signal to atmospheric noise and synchronous interference levels at the receiver. Nominally ±50–100 metres standard deviation within the main coverage area.

Operating Frequency:
Carrier 100 kHz ±0.2%

Signal Characteristics:
Similar to Loran C

Pulse Spacing:
Similar to Loran C. 8 Pulses spaced 1,000 μs apart per group

Pulse Repetition Interval:
Groups repeat at Pulse repetition intervals selectable from 20,000 to 100,000 μs in 100 μs steps.

Timing Accuracy:
Controlled by Caesium Frequency standard to better than 1×10^{-12}

Pulse Shape:
65 μs to peak and 60 db down at 500 μs after peak

Spectrum Use:
99% of the radiated energy falls between 90 kHz and 110 kHz

Output Energy:
3.5 Joules/Pulse at Pulse repetition interval of 100,000 μs—linearly decreasing to 2.0 Joules/Pulse at Pulse repetition interval of 30,000 μs.

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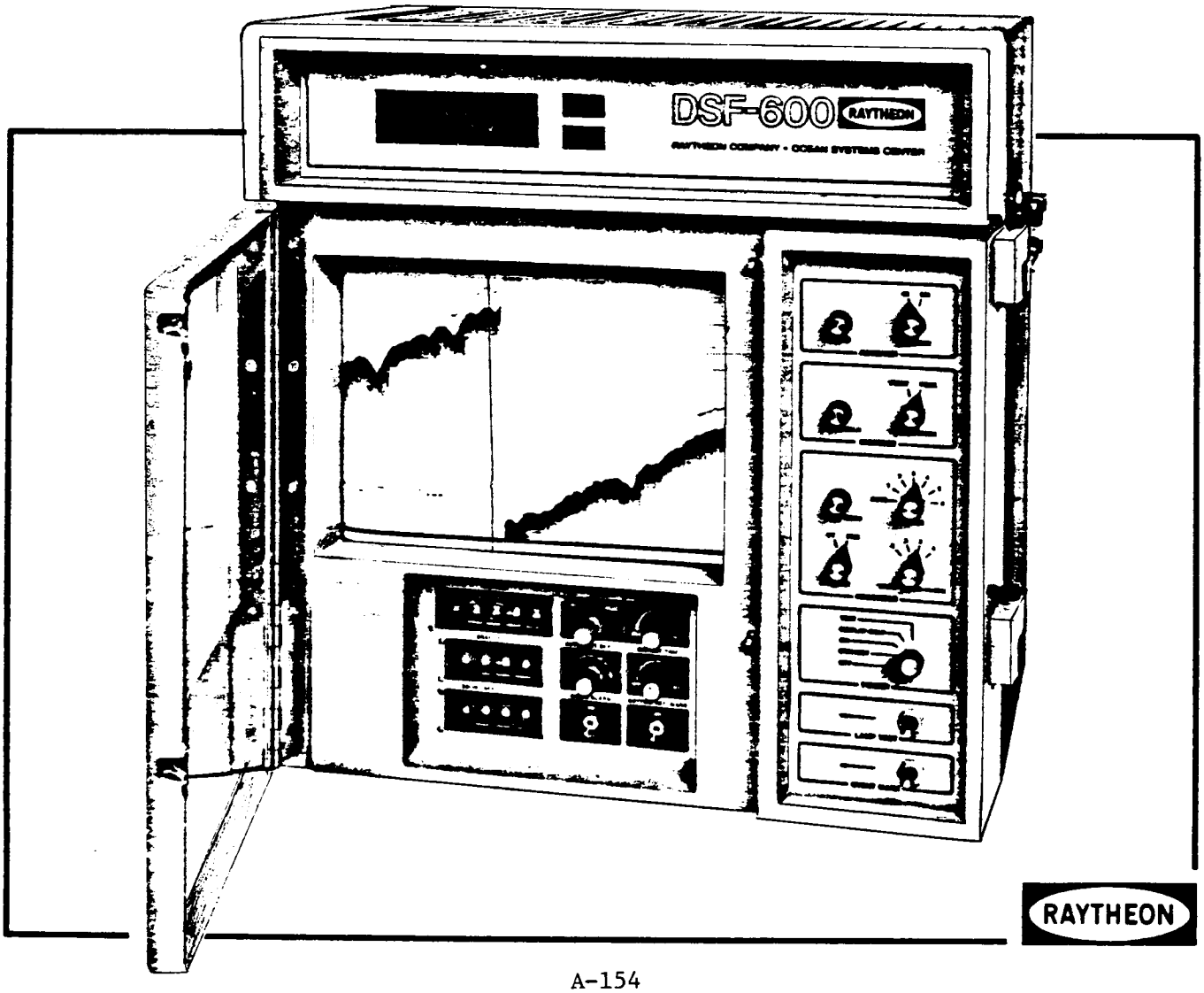

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Chart Paper Speeds (Switch Selectable): 1, 2, 3, 4 inches per minute; 2.5, 5, 7.5, 10 cm/min. for metric unit

Chart Window: Hinged to permit direct access to secondary controls; allows chart annotation.

Scale (specify one): Feet/fathoms or meters low/meters high calibration available. Scales controlled by front panel switch.

Depth Range Phases: 0 to 310 ft. or fms in six overlapping phases. 0 to 124 m or 0 to 620 m in six overlapping phases.

Note: 200 kHz operation limited to a maximum depth range of 100 fms or 200 m.

	Feet/Fathoms	Meters-Low	Meters-High
Phase 1	0-60	0-24	0-120
Phase 2	50-110	20-44	100-220
Phase 3	100-160	40-64	200-320
Phase 4	150-210	60-84	300-420
Phase 5	200-260	80-104	400-520
Phase 6	250-310	100-124	500-620

Note: With the 40 kHz system operating in "display only" mode (Phase 6), depth range can be expanded to 600 fms (1100 m).

Printing: Belt-driven stylus

Accuracy: ± 0.25 ft. (7.62 cm) from 1 to 100 ft., (0.3 to 30.48 m) and 0.25% of indicated depth above 100 ft. (30.48 m).

Controls

Speed of Sound: Thumbwheel switch adjustable from 4600 ft./s (1402 m/s) to 5050 ft./s (1539 m/s) with an absolute sound speed stability of ± 50 PPM.

Tide and Draft: Thumbwheel switch adjustable. Tide compensation range ± 9.9 ft. (2.99 m). Draft compensation range 0 to 19.9 ft. (5.99 m). Tide and draft values remain constant during scale switching.

Chart Zero: Initial set-up: Align chart paper with indicated depth on digital display and compensate for stylus wear.

Shallow Water Limit Control: Inhibits digitizing of any reading shallower than desired depth. Lockout depth extends to 100 ft. Does not affect graphic recording.

Alarm: When 3 successive pulses are missed, display reads zeros; ft./fms or meters indicator flashes; audio alarm sounds. (Audio controlled by on/off switch.)

Bottom Reference Mark: Prints leading edge of the tracker gate at a fixed distance above bottom; varies as a function of depth:

Depth Phase	Fixed Distance	Depth Phase	Fixed Distance
1, 2, 3, 4 ft.	5 ft.	1, 2, 3, 4 m low	1 m
5, 6 ft.	9 ft.	5, 6 m low	3 m
1, 2, 3, 4 fm	4 fm	1, 2, 3, 4 m high	8 m
5, 6 fm	6 fm	5, 6 m high	10 m

Digitizer: Bottom Acquisition Circuit

Automatic, generates a digital output signal indicating true bottom, which in turn is used to generate a gate that locks around and tracks this depth indication. The circuit operates in a "hands-off" mode and does not require operator assistance after initial equipment turn-on and receive sensitivity adjustment.

A bottom tracking verification is printed at the leading edge of the tracker gate above the bottom. A switch enables printing of the bottom verification marks

Digital Display

Includes depth display readout and feet, fathom, or meter scale indication.

Provides four digit reading to 0.1 ft./fms. For the metric unit, provides a reading to 0.01 m for phases 1 to 4 on meters-low range (0-84) and 0.1 m for all other ranges and phases.

The digital readout is a seven segment display capable of being read in direct sunlight. Character height is 0.6 in.

A secondary control varies the data update rate on the display to smooth the least significant display digits.

Computer Input/Output Circuits

1. Digital inputs accepted from the computer I/O or data logger are:
   a) Inhibit Gate (TTL positive logic)

      Holds last reading and inhibits output data from changing while gate is at a logical "0." Updates output data every digitizing cycle when at a logical "1."

   b) Data Strobe (TTL positive logic)

      Two-bit binary code which selects what information is presented at the output connector on the data bus line.

      $^{**}R_A$ $^{**}R_B$
      00 Draft — $^{**}R_A$ = Readout select A
      10 Tide
      01 Sound Speed — $^{**}R_B$ = Readout select B
      11 Depth

   c) Computer Controlled Event Mark

Computer Input/Output Circuits (Continued)

2. Digital outputs provided in parallel operation are:
   a) Depth—Four significant digits BCD (8421 code) non-scaled (multiplexed on data bus). Output will read all zeros when, 1) data has been lost; 2) in an alarm mode or; 3) until three successive valid data readings have been made after an alarm to confirm tracking.
   b) Digital depth display resolution:
      ft./fms—0.1ft./fms or better all phases
      meters—0.01 m phases 1 to 4 meters-low range. 0.1 m phases 5 and 6 meters-low range. 0.1 m all phases, meters-high range.
   c) Scale—0 feet or meters-low range. 1 fathom or meters-high range.
   d) Alarm—missing valid echo.
   e) Data Available—flags computer that data is not in transition state and is available for readout on data bus.
   f) Speed of sound (8421 BCD) non-scaled (multiplexed on data bus).
   g) ± Tide (8421 BCD) non-scaled (multiplexed on data bus).
   h) Draft (8421 BCD) non-scaled (multiplexed on data bus).
   i) Readout multiplier to scale values of a, f, g, h, above. Multiply value by the following:

      00 multiply by 10^0 01 multiply by 10^{-1}

      10 multiply by 10^{-2}

Transmitter

Capable of plug-in modulator modification to operate on either or both (not simultaneously) primary frequencies (40 kHz and 200 kHz). For dual frequency operation, a switch is provided to select either 40 kHz or 200 kHz.

Transmitted pulse width will be switched from 0.1 ms to 1.0 ms automatically with phase/scale selection.

Power Output: 500 W at 40 kHz 250 W at 200 kHz

Sounding Rate: 600 soundings (max.) per minute depending on phase/scale.

Optical Keying: Key pulse initiated by photo-sensitive transistor.

Standby Mode: Key pulse to transmitter is disabled; Power and BCD output remain available in system.

Transducers: 40 kHz: Model 7510 hull mount, 20° beamwidth
200 kHz: Model 200T5A hull mount, 8° beamwidth (standard).
Model 7245A hull mount, 3° beamwidth (optional).

All transducers adaptable for convenient over-the-side mounting.

Operating Specifications:

Primary Voltage: 110 VAC to 130 VAC (47 to 65 Hz). System is insensitive to 47 to 65 Hz variation.

Optional Voltages: 11.5 VDC to 14.8 VDC or 23.0 VDC to 29.0 VDC

Power Input: 200 W—270 W with inverter

Environmental Parameters:
1. Temperature: 0° to 50°C
2. Humidity: 0-95% (excluding recorder paper)
3. Vibration: Mil-Std-167 Type 1 (Modified)
4. Shock: 50 g, 11 ms

Dimensions: 17.25" W x 18" H x 13.5" D (43.8 cm W x 45.7 cm H x 34.3 cm D)

Weight: 80 lbs. (36.3 kg)

Mounting: • Standard unit in "stand-alone" ruggedized case with carrying handles.
• Can be wall or table mounted. • Slides available for rack mounting.

Safety: • Fuses • Diode protection
• 3-wire AC cord • OSHA safety guide
• Terminal lug for ground wire to case

Options:

Remote Display: A four-digit display consisting of seven segment red filaments similar to main display.

Remote Event Marker Switch

Narrow Beam Transducer: Model 7245A (3° beamwidth), 200 kHz.

AC to DC inverter for operation from 11 to 14 VDC and 22 to 28 VDC

For specific information on price and delivery, or for applications assistance, contact Raytheon Company, Ocean Systems Center, West Main Road, Portsmouth, RI 02871. Telephone: (401) 847-8000. TWX: 710-382-6923.

RAYTHEON

Outside U.S.A. and Canada, contact: Raytheon Company, International Affairs, 141 Spring Street, Lexington, MA 02173. Telephone: (617) 862-6600. TWX 710-324-6568. Cable: RAYTHEONEX

RAYTHEON

FATHOMETER® DEPTH SOUNDERS

PRODUCT DATA

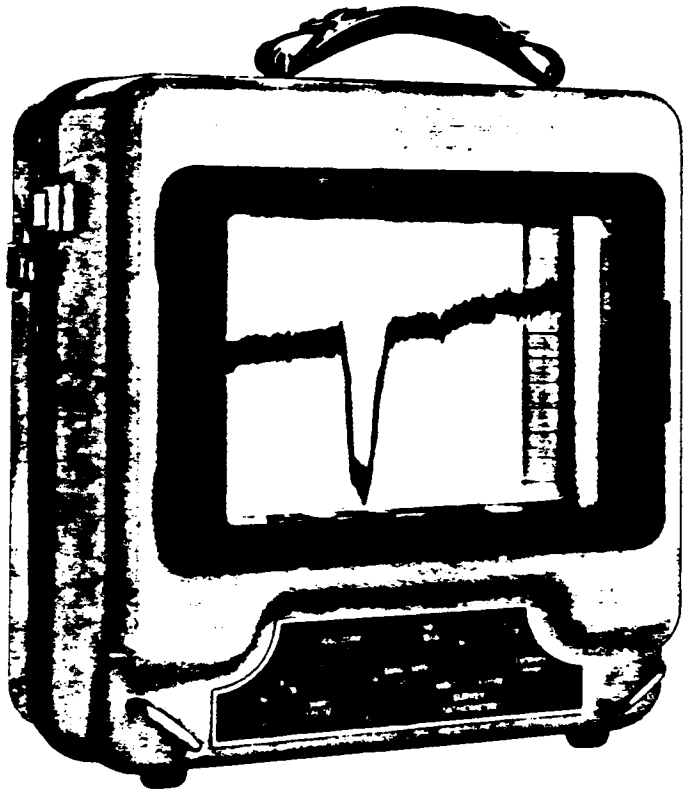
Model DE-719

DESCRIPTION

The Raytheon Model DE-719 Fathometer® Depth Sounder has been designed for use as a portable survey instrument to provide accurate, detailed permanent recordings of underwater topography. Its low power consumption, portability, ease of set-up and rugged construction make it ideal for use on small boats.

The complete system consists of a transducer and recorder. The transducer mount and rigging are stowed in the recorder case when not in use. In operation, the transducer is mounted on the sectional tube supplied and the tube is then secured to the side of the boat. When the battery cable has been connected, the equipment is ready to operate.

The DE-719 is advance design equipment utilizing completely solid state circuitry, magnetic keying and electronically controlled stylus speed. The equipment is housed in a splash-proof aluminum cabinet required for operation in unprotected locations.



Model DE-719 Fathomer® Depth Sounder

High resolution chart recordings result from a combination of very narrow transducer beamwidth, high sounding rate, fast stylus speed and fast chart paper speed.

The DE-719's flexibility is increased by a front panel tide and draft adjustment, speed of sound control and four paper speeds. Calibration markers that indicate phase in use, tide/draft and sound speed compensation are permanently recorded on the chart for future reference. Equipment can be adjusted to either foot or metric scale recording with use of chart paper of appropriate scale.

FEATURES

- Portable, compact, lightweight
- Calibration marker
- Tide and draft adjustment
- Four selectable chart speeds
- Hinged chart window for running chart notations
- Fix Marker switch
- Phase Marker
- Remote fix-mark receptacle
- Foot or metric scale calibration
- Completely solid state
- Available for 12V DC, 115/230V AC operation, 50-60Hz
- Plug-in printed circuits
- Magnetic keying
- Belt driven stylus
- New stylus design – long life, quick replacement
- Chart paper speed adaptable to external control.

DE-719 SPECIFICATIONS

*Depth Range	0-55, 50-105, 100-155, 150-205 Feet 0-16.5, 15-31.5, 30-41.5, 45-61.5 Meters
Sounding Rate	534 Soundings per minute
**Voltage Input	12 Volts DC
Current Input	2.5 Amperes
Accuracy	0.5% ± 1" of indicated depth
Operating Frequency	200kHz
Transducer	Barium titanate – model 2445AD
Transducer Beamwidth	8° at the half power points
Chart Paper Speed	1, 2, 3, 4 inches per minute
Chart Paper	7 inches X 60 feet
Recorder Dimensions	Height (including handle) – 18" Width 15-3/8" Depth 9-1/16"
Net Weight	Recorder w/transducer and rigging 47 lbs. Recorder only – 38 lbs.

*All of the above basic depth ranges may be multiplied by two by means of the range doubling switch.

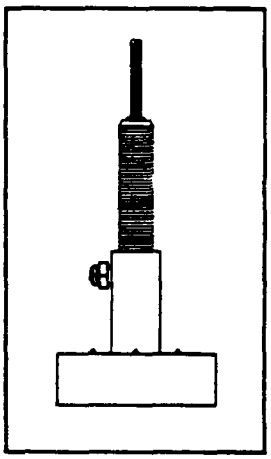
**The system will operate within specifications between 11.5 and 14.8V DC input. On order, the equipment can be furnished with a built-in power converter. The converter will permit operation on 115/230V AC, 50 to 60Hz, in addition to 12V DC.

Tide and Draft Adjustment: A minus 5 to plus 30 foot adjustment may be set in by means of a control knob. This varies the position on the chart of the transmitter signal, but allows a sharp fixed reference zero-line to remain at the chart zero calibration line.

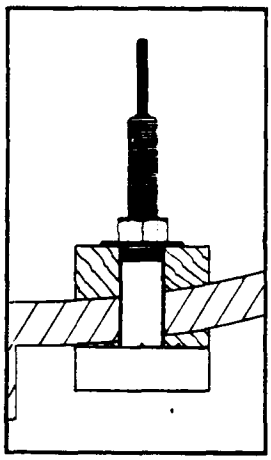
Sound Speed Compensation: A control is provided to compensate for water temperature and salinity content. Adjustment of the control permits the recording accuracy to be calibrated to a "check-bar" reading. A calibration marker, that indicates the degree of compensation, is permanently recorded on the chart.

Fix-Mark: A front panel switch is provided to inscribe a solid, vertical reference line on the chart. This line is used as an event marker or time reference. A receptacle is included to permit connection of an external fix-mark switch, available as an accessory.

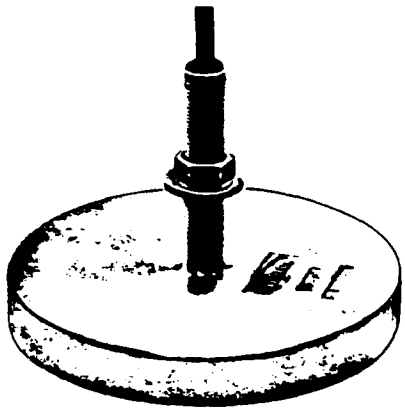
Transducer: The DE-719 is supplied with the 2445AD transducer which may be fitted to the six foot section tube for outboard mounting or permanently installed through the hull. In situations where extreme bottom definition is required, the model 7245 narrow beam transducer is recommended.



2445AD Transducer



Thru-hull Mounting



7245 Narrow-Beam Transducer

MARINE PRODUCTS • 676 ISLAND POND ROAD • MANCHESTER, N. H. 03103

Raytheon Factory Sales & Service Facilities: Seattle; South San Francisco; Wilmington (Los Angeles); New Orleans; Tampa; Jacksonville; Norfolk; Baltimore; Washington, D.C.; Brooklyn; Allston (Mass.); Cleveland • IN EUROPE: Raytheon Service Co., 6-8, Siljangade, 2300 Copenhagen S, Denmark, Telephone: AM 3311 • OTHER WORLD AREAS: Raytheon Company, International Sales & Services, Lexington, Massachusetts 02173, U.S.A., Telephone: VO 2-6600.

EG&G

SPECIFICATION BULLETIN SP-13

SEISMIC PROFILING SOUND SOURCES

Varied types of Sound Source transducers have been developed by EG&G for a wide range of Seismic Profiling applications. The basic Sound Sources are inter-changeable and modular in design to be used with the standard EG&G Energy Source Components, Hydrophones, and Seismic Recorder.

UNIBOOM ™

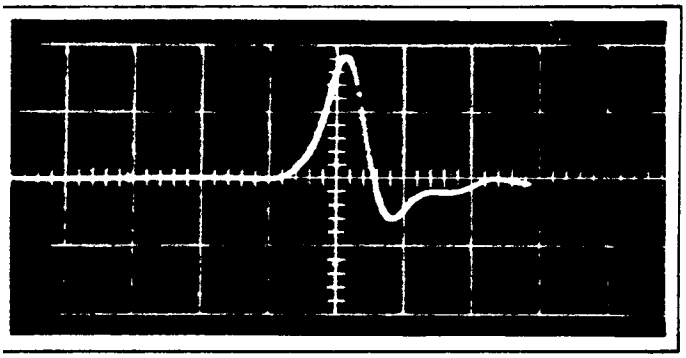
The Model 230 UNIBOOM Unit Pulse Boomer is a *moderate penetration, high resolution* Sound Source transducer utilized for widely varied seismic profiling applications. The electromechanical sound transducer is mounted on a catamaran and is designed to operate with the EG&G capacitance Energy Sources, Seismic Recorder and matching Hydrophone streamer.

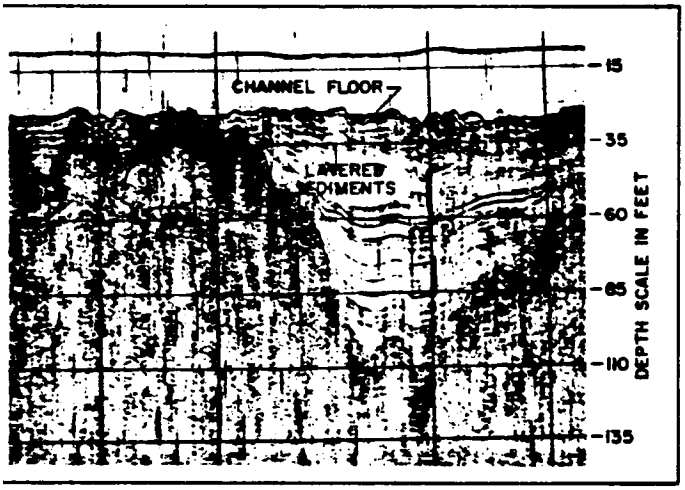
The unique electromechanical assembly consists of an insulated metal plate and rubber diaphragm adjacent to a flat-wound electrical coil. A short duration, high power electrical pulse discharges from the separate Energy Sources into the coil and the resultant magnetic field explosively repels the metal plate. The plate motion in the water generates a single broad band acoustic pressure pulse.

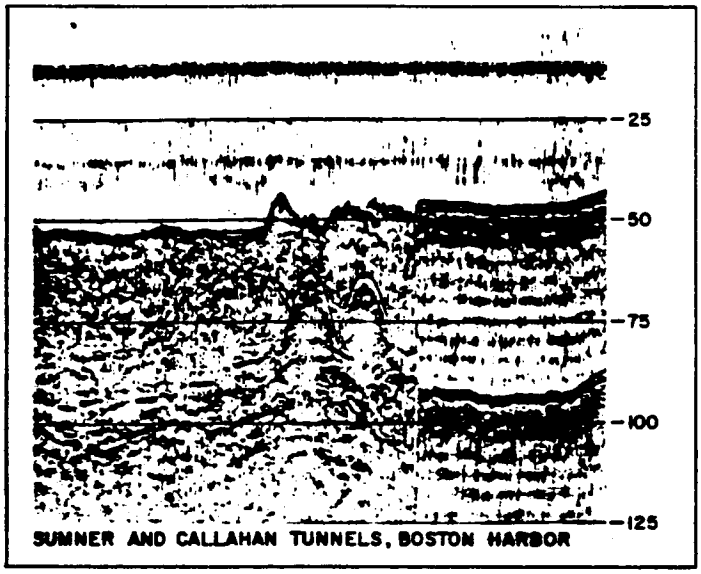
The elimination of the strong cavitation or ringing pulse associated with standard Boomers and Sparkarrays — combined with the broad band frequency spectrum, (1) permits the bottom echo to appear as a fine line; (2) provides a clear cross-sectional record of the sub-bottom interfaces; and (3) penetrates most types of marine materials, including hard-packed sand, up to 75 meters. The UNIBOOM operates equally well in salt water or fresh water.

Applications for the Model 230 Unit Pulse Boomer include reconnaissance geological survey, mineral exploration, foundation studies for offshore platforms, harbor development and cable/pipeline crossing surveys.

UNIBOOM™ (continued)

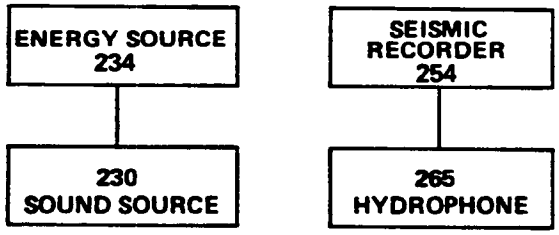




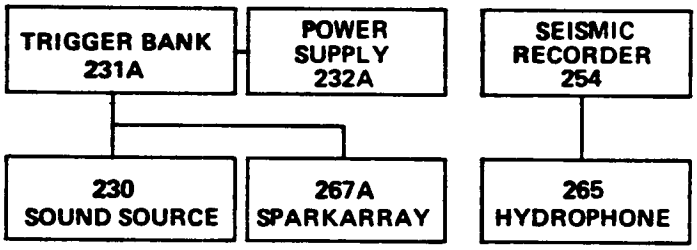


SUMNER AND CALLAHAN TUNNELS, BOSTON HARBOR

UNIBOOM SYSTEM



UNIBOOM SYSTEM & 1000 WATT-SECOND SPARKER



SPECIFICATIONS

Pulse Character

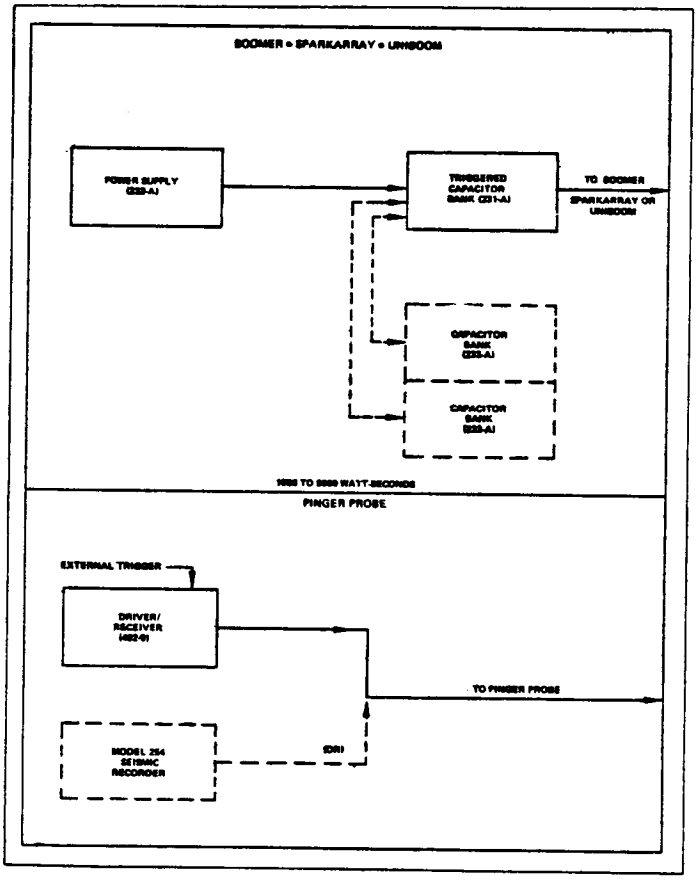
Energy Level:	@100 watt-seconds	@200 watt-seconds	@300 watt-seconds
Duration:	0.2 milliseconds	0.2 milliseconds	0.2 milliseconds
Source Level:	95 db ref. 1 microbar at 1 meter	104 db ref. 1 microbar at 1 meter	107 db ref. 1 microbar at 1 meter
Spectrum:	700 Hz to 14 kHz	500 Hz to 10 kHz	400 Hz to 8 kHz
Repetition Rate:	6 pulses/second	4 pulses/second	2 pulses/second

Dimensions:	84 cm (W) to 59cm(H) x 158cm (L) (33" x 23" x 62")
Weight:	90 kg (200 lbs.)
Cable Length:	25 meters (80ft.)
Towing Speed:	2 to 8 knots

EG&G

SPECIFICATION BULLETIN SP-11

SEISMIC PROFILING ENERGY SOURCE COMPONENTS



GENERAL

The EG&G Seismic Profiling systems utilize modular electrical energy components for the Sparkarray, Boomer, UNIBOOM ™, and Pinger Probe Sound Source transducers. The 5kHz Pinger Probe is powered by either the Model 254 Seismic Recorder or the Model 402-9 Driver/Receiver. The remainder of the Sound Source transducers use the Model 231-A Triggered Capacitor Bank, the Model 232-A Power Supply, and the Model 233-A Capacitor Bank, in various combinations to achieve power levels required.

The combination of one Power Supply and one Triggered Capacitor Bank provides 1000 watt-seconds of energy output. Adding two Capacitor Banks increases the level to 8000 watt-seconds. Typical systems producing power outputs from 180 watt-seconds to 24,000 watt-seconds capability are shown below.

The modular flexibility of the system permits various electrical energy component combinations to be used with the different types of Sound Source transducers and Seismic Recording systems. This enhances its effectiveness for varied seismic profiling applications.

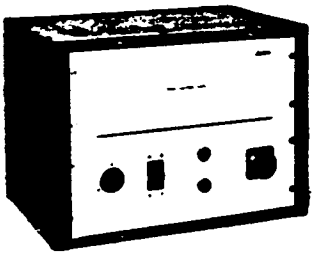
OTHER EG&G SYSTEM COMPONENTS

Model 254 Seismic Recorder
Model 260 Series Seismic Hydrophones
Model 402-9 Driver/Receiver (Pinger Probe only)
Basic Sound Source (Boomer,Sparkarray, UNIBOOM, or Pinger Probe)

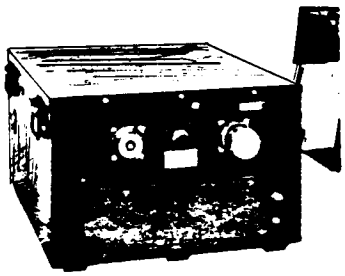
TYPICAL COMPONENT SYSTEMS

ENERGY LEVEL	REPETITION RATE Pulses per Second	MODEL 232-A	MODEL 231-A	MODEL 233-A
180 watt-seconds	6	1	1	0
360 watt-seconds	4	1	1	0
500 watt-seconds	2.5	1	1	0
1000 watt-seconds	1.2	1	1	0
1000 watt-seconds	2	1	1	0
3000 watt-seconds ("Super Three')	2	3	3	0
8000 watt-seconds	0.25	1	1	2
16,000 watt-seconds	0.25	2	2	4
24,000 watt-seconds	0.25	3	3	6

GENERAL SPECIFICATIONS

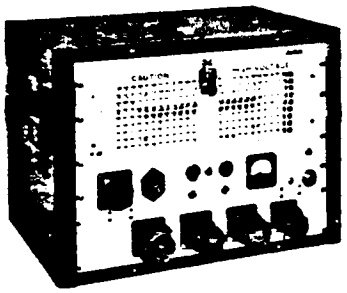


POWER SUPPLY (MODEL 232-A)



CAPACITOR BANK (MODEL 233-A)

PINGER PROBE DRIVER/RECEIVER
(MODEL 402-9)



TRIGGERED CAPACITOR BANK
(MODEL 231-A)

POWER SUPPLY (MODEL 232-A)

The Model 232-A Power Supply is a high voltage source for charging capacitor banks, such as the Model 231-A Triggered Capacitor Bank and the Model 233-A supplementary Capacitor Bank. It is ruggedly constructed and completely safety interlocked for operator protection.

SPECIFICATIONS

Input Voltage:	110, 120, 220, 230, and 240 VAC, 50-60 Hz single phase
Input Power:	average 3.3 kv, peak 14.4 kvA
Output Voltage:	3.8 kv DC maximum
Charging Rate:	0.5 seconds per 1000 watt-seconds
Size:	40cm (H) x 55cm (W) x 39 cm (D) (15-3/4" x 21-3/4" x 15-1/4")
Weight:	75 kg (165 pounds)

CAPACITOR BANK (MODEL 233-A)

The Model 233-A Capacitor Bank is an auxiliary energy storage unit used with the Model 232-A Power Supply and the Model 231-A Triggered Capacitor Bank. It is normally connected in parallel with, and controlled by, the Triggered Capacitor Bank. A safety interlock relay is provided.

SPECIFICATIONS

Capacitance:	500 microfarads
Energy Storage:	3600 watt-seconds at 3.8 kv
Size:	33cm (H) x 51cm (W) x 65cm (D) (13" x 20" x 25-3/4")
Weight:	132 kg (290 pounds)

TRIGGERED CAPACITOR BANK (MODEL 231-A)

The Model 231-A Triggered Capacitor Bank is a combination capacitor bank and high energy switching device which is charged by the Model 232-A Power Supply. It provides over 1000 watt-seconds of energy storage and is capable of controlling and switching 9000 watt-seconds of energy. The additional storage is obtained from the supplementary Model 233-A Capacitor Banks. The patented RAILGAP high energy switch is an extremely reliable device requiring little adjustment for electrode wear.

Automatic and manual triggering provisions are included. Operator safety interlocks are an integral feature.

SPECIFICATIONS

Trigger Input:	Contact closure or 12 VDC positive pulse (from Model 254 Seismic Recorder)
Capacitance:	150 microfarads
Energy Storage:	1000 watt-seconds at 3.8 kv
Size:	40cm (H) x 55cm(W) x 39 cm (D) (15-3/4" x 21-3/4" x 15-1/4")
Weight:	58 kg (128 pounds)

PINGER PROBE DRIVER/RECEIVER (MODEL 402-9)

The Model 229 Pinger Probe Sound Source does not utilize the standard capacitive Energy Sources. It uses either the built-in Driver/Receiver in the EG&G Model 254 Seismic Recorder, or, for use with other recorders, the Model 402-9 Driver/Receiver.

The Model 402-9 is a dual interface unit providing adjustable energy input for driving the sound source output and for amplification of the returned acoustic signal. Automatic triggering is supplied by the system recorder. Manual triggering may also be used.

SPECIFICATIONS

Input Voltage:	105-120 VAC, 50-60 Hz
Input Current:	1/2 amp
Size:	19cm (H) x 42cm (W) x 23cm (D) (7-1/2" x 16-1/2" x 9")

AMPLIFIER UNIT

Maximum Undistorted Output:	1 v rms
Gain Adjustment Range:	+10 to +90 db
Frequency Response:	10Hz to 6kHz
Output Impedance:	< 100 ohms
Input Impedance:	15k ohms

DRIVER UNIT

Output Energy:	0.1 to 0.4 joules
Output Power:	2000 watts maximum from Model 229 Pinger Probe
EXTERNAL TRIGGER REQUIREMENT:	switch closure or positive 15-volt pulse

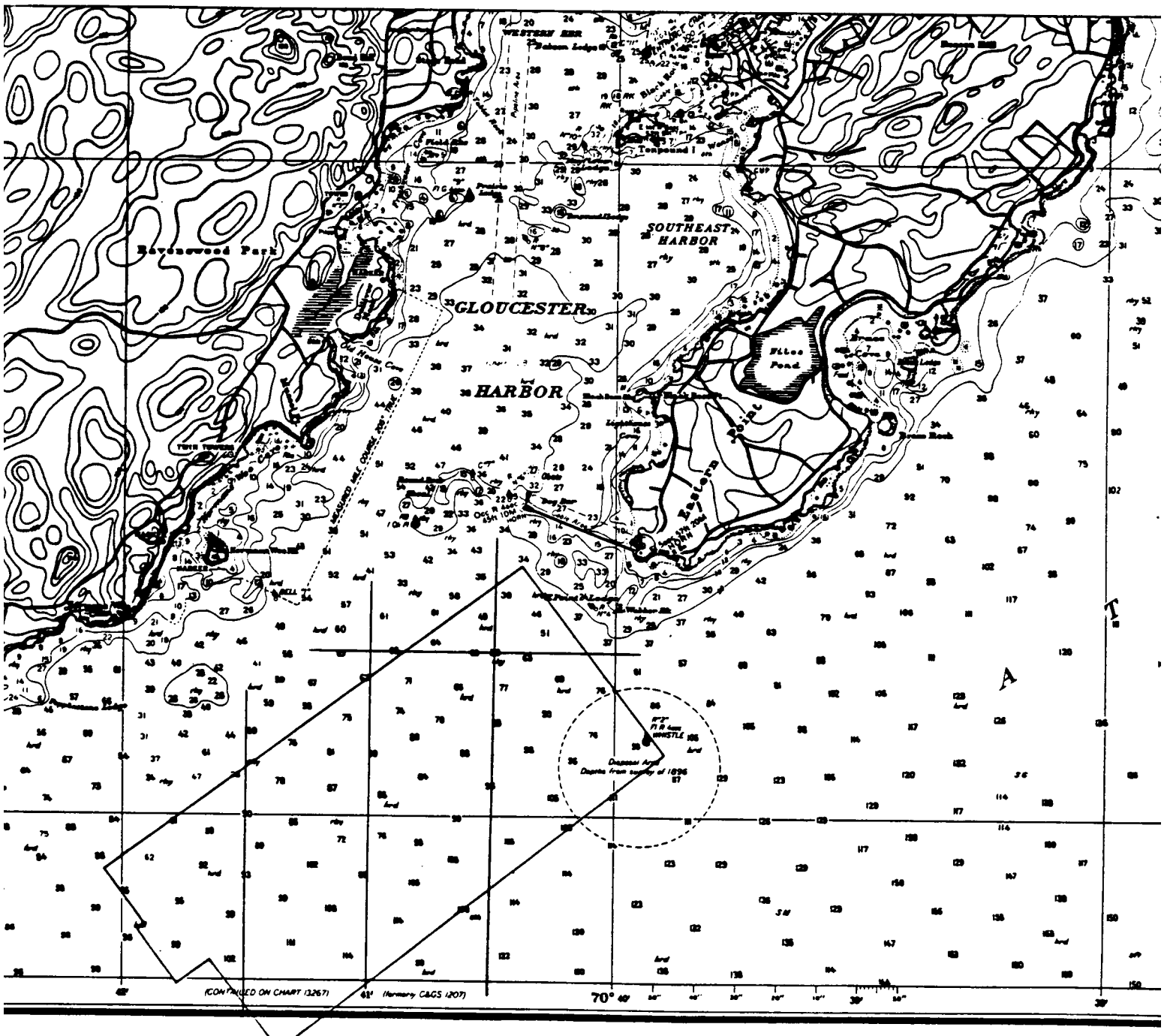
EG&G

ENVIRONMENTAL EQUIPMENT DIVISION
51 Bear Hill Road, Waltham, Mass. 02154 • Tel: (617) 899-3710 • TWX: (710) 324-7648 • TELEX: 92-3429 • Cable: EGGINTER
WEST COAST: 1360 Rosecrans Street, San Diego, Cal. 92106 • Tel: (714) 224-2932 • TWX: (910) 335-2071

EG&G

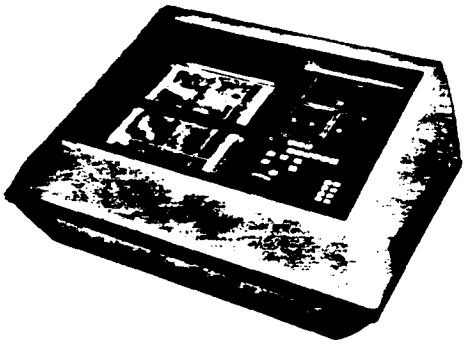
The New SMS 960 Seafloor Mapping System

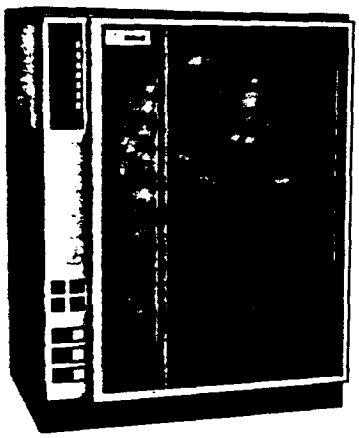
The first system to give you a real time plan view of the seafloor

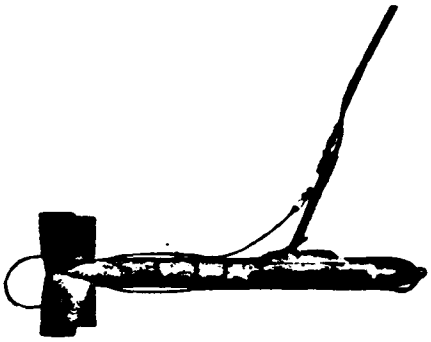


EG&G

SPECIFICATIONS







System Patents Pending

ENVIRONMENTAL EQUIPMENT DIVISION
151 Bear Hill Road
Waltham, Massachusetts 02154
(617) 890-3710 TELEX: 92-3429

GENERAL

Range	100 MT.	150 MT.	200 MT.	300 MT.	400 MT.	500 MT.
Scale	1000:1	1500:1	2000:1	3000:1	4000:1	5000:1

RESOLUTION: 1/400 of range
TOW FISH HEIGHT: 1% to 45% of horizontal range
TOWING SPEED: 2 to 15 knots

MODEL SMS 960 SEAFLOOR MAPPING SYSTEM

GRAPHIC RECORDING MECHANISM
TYPE: Digital, gray tone graphic printer
LINE WIDTH: 0.125 mm
DOT SIZE: 0.125 mm diameter
NUMBER OF GRAY TONES: 16
NUMBER OF DATA POINTS PER LINE: 2,048

DISPLAY FORMAT
SEAFLOOR MAP: 20 cm wide
SEAFLOOR PROFILE: 5 cm wide

RECORDING PAPER
TYPE: Dry, electrosensitive
SIZE: 28 cm wide by 50 m long roll
DYNAMIC RANGE: 23 dB from black to white (16 gray tones)

SPEED CORRECTION
AUTOMATIC ROTATOR: Provided with system
200 PULSES PER NAUTICAL MILE: From variety of standard logs
MANUAL: From system keyboard

SLANT RANGE CORRECTION
AUTOMATIC: From sonar data
MANUAL: From system keyboard

AMPLITUDE CORRECTION
AUTOMATIC: Time varied gain
MANUAL: (After tape)
GAIN: 3-dB steps over a 30-dB range
CONTRAST: 32, 24, 16, or 12 dB
POLARITY: Normal or reversed

INTERFACES
ANALOG TAPE RECORDER: 2-channel, FM, 0 to 3 kHz
REMOTE EVENT MARK: TTL or contact closure (master or slave)
SPEED: TTL or contact closure
Variety of other analog and digital interfaces available.

INPUT POWER
VOLTAGE: 105 to 125 or 210 to 250 VAC (selectable)
FREQUENCY: 47 to 63 Hz
POWER: 500 watts
DIMENSIONS: 94 × 72 × 45 cm (37 × 28 × 18 inches) overall
WEIGHT: 75 kg (165 pounds)

MODEL 9000 DIGITAL MAGNETIC TAPE DECK

REEL SIZE: 10½ inches
TAPE WIDTH: ½ inch
TAPE SPEED: 15 inches per second
RECORDING MODE: NRZ1
RECORDING DENSITY: 800 bits per inch
NUMBER OF TRACKS: 9
INPUT POWER
VOLTAGE: 105 to 125 or 210 to 250 VAC (selectable)
FREQUENCY: 47 to 63 Hz
POWER: 500 watts
DIMENSIONS: 51 × 46 × 64 cm (20 × 18 × 25 inches)
WEIGHT: 55 kg (120 pounds)

MODEL 272 SAF-T-LINK TOW FISH

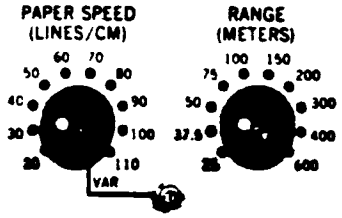
OPERATING FREQUENCY: 105 ± 10 kHz
PULSE LENGTH: 0.1 msec
PEAK OUTPUT: 128 dB ref 1 μbar at 1 meter
HORIZONTAL BEAM WIDTH: (3 dB points) 1.2°
VERTICAL BEAM WIDTH: 50°, tilted down 20°
MAXIMUM DEPTH: 600 meters (2000 feet)
WEIGHT: 25 kg (55 pounds)
DIMENSIONS: 140 cm (55 inches) long, 30 cm (12 inches) tall, 11.4 cm (4.5 inches) diameter

TOW CABLE

TYPE: Double armored, steel
DIAMETER: 0.95 cm (0.375 inch)
LENGTH: 150 meters (500 feet) or 600 meters (2000 feet)
STRENGTH: 5000 kg (11,000 pounds)
WEIGHT: 0.35 kg/m (0.244 lb/ft)

TYPE: Lightweight, flexible
DIAMETER: 1.2 cm (0.50 inch)
LENGTH: 50 meters (150 feet)
STRENGTH: 400 kg (900 pounds)
WEIGHT: 0.3 kg/m (0.2 lb/ft)

KLEIN SIDE SCAN SONAR—
DUAL CHANNEL RECORDER MODEL 421



Now with
TEN Range Scales
and
TEN Paper Speeds
PLUS Continuously Variable Paper Speed!

SPECIFICATIONS:

SONAR FREQUENCY:	100KHz (standard). 50 KHz or 200 KHz (optional). Others available for bottom profiling or other applications.
RANGE SCALES:	25, 37.5, 50, 75, 100, 150, 200, 300, 400 and 600 Meters. The Recorder may also be calibrated for 31.25, 37.5, 62.5, 75, 125, 150, 250, 300, 500, 600 Meters.
PAPER SPEEDS:	20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120 Lines/Cm and continuously variable.
SIZE:	Height—25.4 Cm. (10") Width—84.4 Cm. (33¼") Depth—59.7 Cm. (23½")
WEIGHT:	43.5 Kg. (96 lbs.) without A.C. Supply 51.7 Kg. (114 Lbs.) with A.C. Supply
INPUT VOLTAGE:	D.C. 23-30 Volts (Input protected from reverse voltage or overvoltage) A.C. (with optional Model 401-010 A.C. supply) 105-125 Volts or 210-230 Volts, 47-63Hz
D.C. INPUT CURRENT:	2-5 Amperes (3 Amperes average)
PAPER WIDTH: WRITING WIDTH:	28 Cm (11 Inches) 12.7 (5 Inches) (Each Channel)
SCALE LINES:	Every 15 Meters (Adjustable from 2 to 25 Meters)
RECORDING COLOR: PAPER CAPACITY:	Sepia (standard) or black (optional) 91.4 Meters (300 Feet). Standard paper roll is 35 meters (120 Feet)

MODEL 402 TOWFISH — SPECIFICATIONS

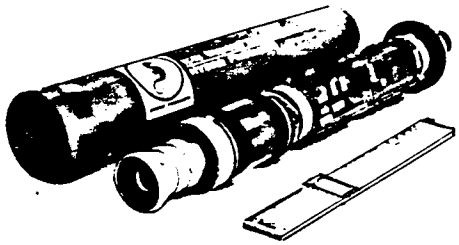
MODEL NUMBER: ALUMINUM 316 STAINLESS	402A-001 402S-001	402A-001A 402S-001A	402A-001B 402S-001B	402A-001C 402S-001C
APPLICATION	Higher Resolution Lower Tow Speeds	General Purpose	Less Resolution Higher Tow Speeds	Higher Resolution, Less Range Shallow Water
HORIZONTAL BEAMWIDTH	3/4°	1°	1½°	3/4°
WEIGHT IN AIR ALUMINUM UNITS STAINLESS UNITS	15.9Kg(35Lb) 23.5Kg(51.9Lb)	13.6Kg(30Lb) 20.2Kg(44.5Lb)	12.2Kg(27Lb) 18.1Kg(40Lb)	12.2Kg(27Lb) 18.1Kg(40Lb)
WEIGHT IN WATER ALUMINUM UNITS STAINLESS UNITS	8.4Kg(18.5Lb) 16Kg(35.4Lb)	7.3Kg(16Lb) 13.6Kg(30Lb)	6.6Kg(14.5Lb) 12.5Kg(27.5Lb)	6.6Kg(14.5Lb) 12.5Kg(27.5Lb)
LENGTH	127Cm(50")	106.7 Cm(42")	96.5Cm(38")	96.5Cm(38")
OUTPUT FREQUENCY	100KHz			200 KHz
PULSE LENGTH	0.1Millisecond			.05 Millisecond
VERTICAL BEAMWIDTH	40° Tilted Down 10° From Horizontal			20° Tilted Down 10° From Horizontal
COVERAGE	400 to 1000 Meters (Note 1) (200 to 500 Meters to Either Side)			200 to 600 Meters (Note 1) (100 to 300 Meters to Either Side)
ACOUSTIC OUTPUT	128 db (peak) Reference One Microbar at One Meter			
BODY DIAMETER	8.9 Cm (3½")			
TAIL DIAMETER	30.5 Cm (12")			
MAXIMUM TOW SPEED	16 Knots (Note 2)			
MINIMUM TOW SPEED	0 Knots			
DEPTH RATING	670 Meters (2200 Feet) (Deeper Units on Special Order)			

Note 1: The coverage of a side scan system will be dependent on many factors including bottom conditions, thermal gradients in the water, bubbles in the water, and sources of outside interference.

Note 2: Although the sonar towfish are stable at speeds in excess of 16 knots, we recommend towing at relatively low speeds for best results.

Specifications Subject to Change Without Notice

TC-125 Miniature Underwater Television Camera



TC-125 Camera

Features TC-125 Camera :

Truly engineered for the environment by people with over 12 years' experience in supplying underwater television equipment

Completely self-contained in a miniature underwater housing

Dynamic range greater than 10,000:1

Numerous options to the basic TC-125 will optimize it for virtually any underwater or environmental application

Easy maintenance — only three plug-in electronic circuit boards

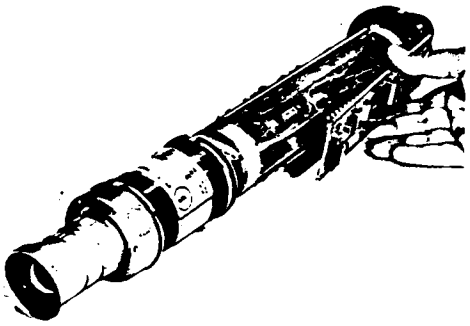
A safe 12 VDC operates the camera

Remote focus control

Hydro Products' TC-125 Television Camera represents twelve years of experience supplying underwater television equipment. As in all Hydro cameras, the self-contained design is optimized to perform underwater viewing tasks from optics to electronic circuitry to pressure housing. Each component has been maximized for the highest reliability and ease of operation.

The TC-125 is totally self-contained including target control, video and sweep circuits, and remote optical focus all powered by a safe, low DC voltage. Nothing complicated, only five conductors control the camera including focus from 3 inches to infinity.

From the surface, the TC-125 is simple to control. Power switch, focus control, and standard monitor controls are all that are required. The system is easier to operate than your home television set giving the operator the maximum performance possible in the harsh underwater environment.



TC-125 plug in circuit boards

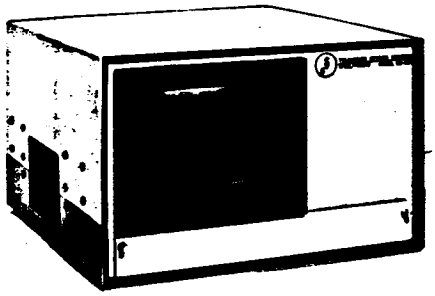
The Model TC-125 is designed utilizing highly reliable integrated circuits. This miniaturization of the circuits has resulted in an easily maintained camera constructed with only three major plug-in circuit boards.

TC-125 options:

The TC-125 was not just designed to a set of specifications. It is the result of years of field experience, resulting in a camera that has eliminated every normal viewing problem encountered. The modular aspect of the TC-125 provides available options to optimize virtually every underwater application.

Is Hydro Products' equipment reliable?

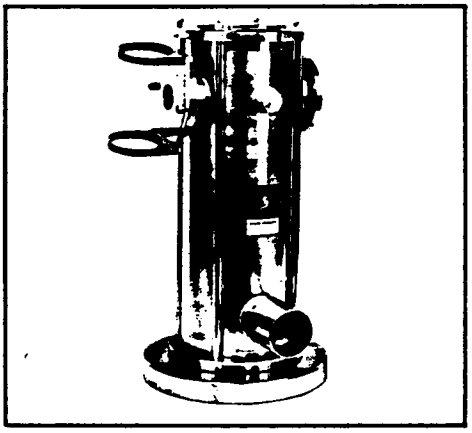
The Pan and Tilt, Camera, and Light shown above were recently recovered after 6 years on the bottom of the ocean at a depth of 1800 ft. off the Bahama Islands. All three units were still operating perfectly when recovered.



SC-303 System Control Unit

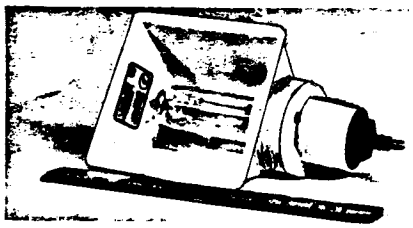
The SC-303 System Control Unit is a rugged, splashproof module ideally suited for shipboard or offshore drilling rig applications. The unit contains a nine-inch transistorized monitor, a low voltage constant current television camera power supply and a lamp ballast power supply to operate any of Hydro Products' 250-watt mercury vapor or thallium iodide lights.

The SC-303 can also include optional push-button pan and tilt controls or a diver communications module as described in the UDATS Diver Inspection System on Page 4.



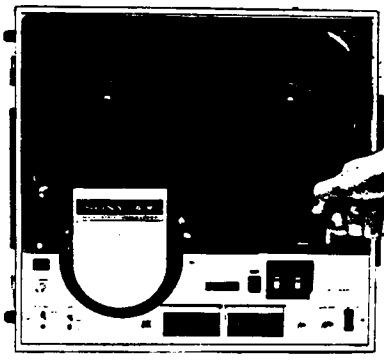
RP-3 Pan and Tilt

Hydro Products' RP-3 Pan and Tilt mechanism is a rugged, precision, remote-controlled manipulator for directing a Hydro Products' television or photographic camera to any desired orientation at any depth. The pan and tilt develops a minimum of 18 foot-pounds of torque to accommodate heavy, unbalanced loads in strong currents. All exterior parts are nickel-chrome plated marine brass or stainless steel to provide maximum resistance to the corrosive effects of salt water. The RP-3 can provide remote panning control up to 350° and remote tilting control up to 190°.



L-7 Series light with wide angle parabo reflector. Available in quartz iodide, me vapor, and thallium iodide configuratio

The L-7 Series are Hydro Products' stan line of moderate and deep ocean lights. The same housing can be used with man different light elements, allowing the san housing and reflector to be used as an L quartz iodide 500-watt, L-7 mercury vapo 250-watt, or LT-7 thallium iodide 250-wat light. The lights have been designed to operate to depths of 4,570m (15,000 ft.). L-7 Series lamps are available for depths to 12,000 m (40,000 ft.).



AV-3650 Video Recorder

The AV-3650 is a compact, portable EIA Type 1 video tape recorder with capstar servo electronic editing, a feature ordina found only in larger, more expensive machines. It provides one hour of audio monochrome video recording and playb on ½-inch tape and offers automatic control of both audio and video levels fo exceptional ease of recording. Playback be performed in the normal, slow-motion or stop action modes.

Hydro Products
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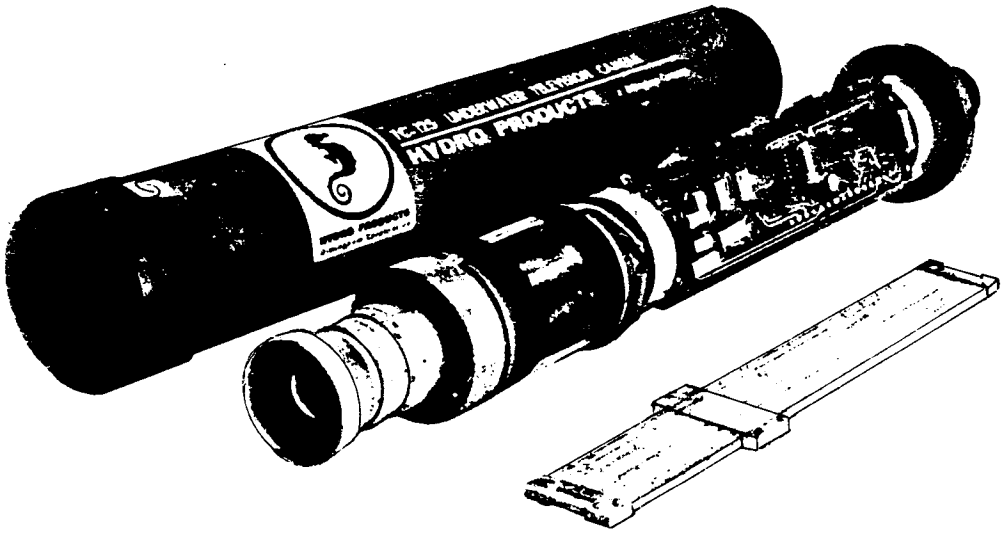
MINIATURE UNDERWATER TELEVISION CAMERA



TC 125

FEATURES

- TRULY ENGINEERED FOR THE ENVIRONMENT BY PEOPLE WITH OVER 15 YEARS' EXPERIENCE IN SUPPLYING UNDERWATER TELEVISION EQUIPMENT
- COMPLETELY SELF-CONTAINED IN A MINIATURE UNDERWATER HOUSING
- DYNAMIC RANGE GREATER THAN 10,000:1
- NUMEROUS OPTIONS TO THE BASIC TC 125 WILL OPTIMIZE IT FOR VIRTUALLY ANY UNDERWATER OR ENVIRONMENTAL APPLICATION
- EASY MAINTENANCE – ONLY THREE PLUG-IN ELECTRONIC CIRCUIT BOARDS
- A SAFE 12 VDC OPERATES THE CAMERA
- REMOTE FOCUS CONTROL
- STANDARD HYDRO PRODUCTS' UNCONDITIONAL 1 YEAR WARRANTY
- INDIVIDUALLY VIBRATION/SHOCK TESTED

DESIGN

The ultimate in underwater viewing can be obtained with the Hydro Products' TC 125 Television Camera Fifteen years of experience produced this practical tool for the underwater researcher or engineer. As in all Hydro cameras, the self-contained design is optimized to perform underwater viewing tasks from optics to electronic circuitry to pressure housing. Each component has been maximized for the highest reliability and ease of operation.

The Model TC 125 is designed utilizing highly reliable integrated circuits. This miniaturization of the circuits has resulted in an easily maintained camera constructed with only three major plug-in circuit boards.

The TC 125 is totally self-contained including target control, video and sweep circuits, and remote optical focus all powered by a safe, low DC voltage. Nothing complicated, only five conductors control the camera including focus from 3 inches to infinity.

From the surface, the TC 125 is simple to control. Power switch, focus control, and standard monitor controls are all that are required. The system is easier to operate than your home television set giving the operator the maximum performance possible in the harsh underwater environment.

Every feature of this camera has been designed for ease of operator use without sacrificing the special performance and circuitry required to view underwater.

The Hydro Products' Model TC 125 Underwater Television Camera is the most reliable and versitile available in the world today. OVER FIFTEEN YEARS OF HISTORY PROVES IT!

SPECIFICATIONS

ELECTRICAL

ELECTRICAL CONDUCTORS:	To maximize reliability, camera operates with only Coax, plus one #18 wire. Two additional #18 wires for remote focus.
POWER REQUIREMENT:	600 ma constant current, nominal voltage at camera – 13V.
PROTECTION:	Any connection may be electrically connected to any other without damage.
SAFETY:	Housing isolated from all connections. A minimum of 10 megohms when measured with a megger at 500 Volts potential.
COMPOSITE VIDEO SIGNAL:	Overall signal 1.2 Volts peak to peak. 0.9V video, 0.3V sync.
RESOLUTION:	Horizontal 600 TV line minimum.
SHADES OF GREY:	10 in accordance with EIA standard RS-170.
VIDEO BAND WIDTH:	DC to 8 megahertz minimum.
SCANNING STANDARD:	525 line double interlaced scanning, U.S. (EIA) standard. (625 line European standard optional).
CAMERA SYNC:	Crystal controlled master oscillator and binary frequency decoders providing 15.75 kHz horizontal, 60 Hz vertical sync (optionally 50 Hz). Master oscillator stability ±0.01% over temperature range specified.
TARGET CONTROL:	Fully automatic over dynamic light range greater than 10,000:1.
LIGHT LEVEL SENSITIVITY:	1.0 footcandles at vidicon gives full 600 TV lines and 0.1 footcandles gives 400 lines.
CAMERA CIRCUITRY:	All solid state components, mounted on 3 plug-in glass epoxy circuit boards.
VIDICON:	Type 7262A peaks in green at 5500 Angstroms to maximize underwater viewing.

ELECTRICAL CONTROLS:

The following electrical control adjustments are provided within the camera for optimizing vidicon and circuit operation.

Control	Function
Beam	Setting vidicon beam current
Target	Optimizing vidicon target operation
Vert. Pos.	Adjustment of vertical position of vidicon raster scan.
Hor. Pos.	Adjustment of horizontal position of vidicon raster scan.
Vert. Size	Adjustment of vertical size of vidicon raster scan.
Hor. Size	Adjustment of horizontal size of vidicon raster scan.
Elect. Focus	Optimizing electrostatic focus on vidicon.
Mag. Focus	Optimizing magnetic focus on vidicon.
H V	Sets regulation point on high voltage power supply.

CRITICAL CIRCUIT REGULATION STABILITY:	High voltage regulation – ±0.2% Magnetic focus current regulation – ±0.5%

OPTICAL

LENS:	9 element, color corrected, f/1.4, 12.5 mm, standard "C" mount.

ANGLE OF VIEW:	In Air	In Water
Diagonal	64°	46°
Horizontal	53°	38°
Vertical	41°	30°

NOTE: With -C option the angle of view in water is the same as in air.

FOCUS RANGE: 3 inches to infinity.

FOCUS CONTROL: ±12 VDC nominal, 5 watts maximum.

MECHANICAL

LENGTH:	21 inches (53.3 cm) including connector guard.
DIAMETER:	3 inches (7.62 cm).
WEIGHT:	12 lbs. (5.4 Kg) in air, 8 lbs. (3.6 Kg) in water.
HOUSING MATERIAL:	6061-T6 Aluminum, hard anodized with epoxy paint. Stainless Steel and Titanium optional.
CONNECTORS:	Bulkhead, XSL-5-BCR, Cable Mate, XSL-5-CCP for external sync (-E option use -6-).

ENVIRONMENTAL

TEMPERATURE RANGE:	-13° F. to +122° F. (-25° C. to +50° C).
OPERATING DEPTH:	Standard, 2,000 feet (610 m) Option -10, 10,000 feet (3,050 m) Option -40, 40,000 feet (12,000 m) All with 50% Safety Factor.

Options Available in TC 125:

Long Line Amplifier (-A)

Provides compensation for losses in coaxial cable when lengths exceed 1,500 feet. Up to 5,000 feet RG/59 Coax. By proper cable selection and using special post amplifiers, Hydro Products' cameras can be operated over cable lengths to 20,000 feet without in-line amplifiers.

Full EIA Broadcast Sync (-B) (No charge option)

This option provides Full Broadcast Sync in accordance with EIA Standard RS-170. The output of a camera equipped with this option can be used while directly connected to commercial broadcast facilities or after video recording on magnetic tape. With this option, optimum operation can be expected when interfacing with virtually any monitor or video tape recorders.

External Sync (-E)

Provides for operation of multiple camera system from single external sync source. If external sync is lost, camera automatically switches to internal sync.

Helium Atmosphere Certification (-HC)

The TC-125 can be specially sealed to operate in a helium atmosphere such as SEALAB habitat environment. Helium leak rate certification is less than 10^{-8} cc/sec at 1000 psi resulting in operation life greater than 6 months.

Wide Angle Lens (-W)

Focal Length:	7.9 mm in water
Iris:	f/1.5
Diagonal viewing angle:	80° (minimum in water)
Horizontal:	66°
Vertical:	52°

Zoom Lens (-Z)

Lens option with remote control of zoom, iris, and focus.

Focal length range:	13 mm to 52 mm
Iris:	f/2 to f/22
Focusing range:	3 feet to infinity
Control motors (3):	Zoom, focus and iris

(Remote Control box included)

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Hydro Products
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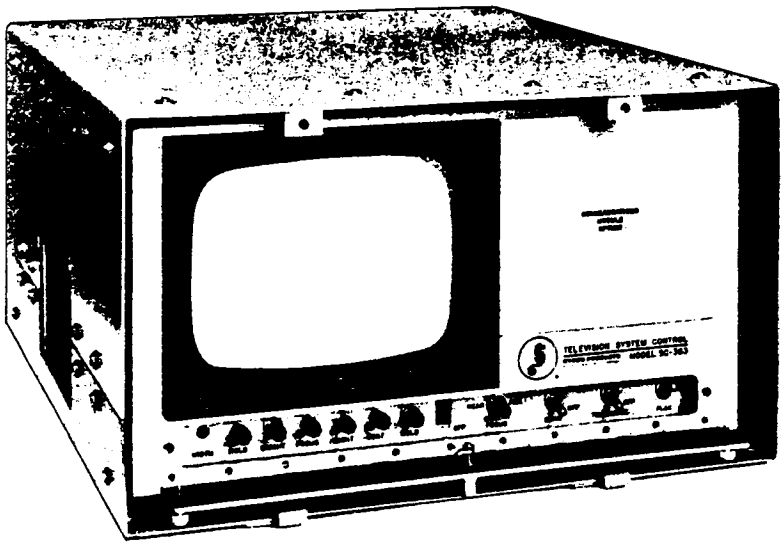
TV SYSTEM CONTROL UNIT
MODEL SC 303



FEATURES

- SPLASH-PROOF CA3INET
- RUGGED CONSTRUCTION
- COMPLETE UNDERWATER TELEVISION SYSTEM CONTROL
- PORTABLE

PERFORMANCE

The Model SC303 Television System Control Unit is engineered for rugged and reliable performance. The unit is ideally suited for shipboard and offshore drilling rig applications. The SC303 contains a transistorized nine-inch monitor of full broadcast quality with a video response of up to 10 MHz, assuring a full 800-line resolution.

Also included in the SC303 is a television camera power supply. It is a constant current power source which will power any of the Hydro Products' underwater TV cameras. This supply also provides power for the camera focus motor. A ballast transformer is included and is designed to provide starting voltage and current control required to operate any of Hydro Products' 250 watt gas discharge lamps. All these items are included in a rugged, splash-proof and portable case. Controls are easily accessible from the front panel, and large, waterproof milti-pin MS type connectors on the rear panel provide ease of system set up. Optional pan and tilt controls, or a diver communication module are also available.

Convenient carrying handles make the unit quite portable, and provisions are made for rack mounting if desired. Construction of the unit insures a splash-proof container, with easy access into the unit when desired. The rugged and compact package of the SC303 simplifies the operation of an underwater TV system and makes the unit a real working tool. The SC303 will work with all of Hydro Products' underwater television cameras and the L7 and L8 light sources.

June 1973

SPECIFICATIONS

SC303 TELEVISION SYSTEM CONTROL UNIT

ELECTRICAL

INPUT POWER:	115 VAC, 60 Hz, 400 watts (nominal); optional 230 VAC, 50 Hz, 200 watts

MECHANICAL

DIMENSIONS:	26.0 cm high x 45.7 cm wide x 50.7 cm deep (10.25" x 18.0" x 19.88")
WEIGHT:	31.8 kg (70 lbs.) net; 36 kg (80 lbs.)

ENVIRONEMNTAL

TEMPERATURE:	-10°C to +55°C
HUMIDITY:	0 to 95%

RECOMMENDED ACCESSORIES

LIGHTS:	Models L7 or L8 mercury vapor or thallium iodide lights
UNDERWATER TELEVISION CAMERAS:	Models TC100, TC110, TC125, TC150 or TC303

SUBASSEMBLY SPECIFICATIONS

ELECTRICAL

MONITOR

INPUT POWER:	65 W at 120/240 V, 60Hz (525/60 U.S.) or 50 Hz (625/50 CCIR); all performance specifications will be met while the line voltage varies from 105 to 130 VAC at any rate
VIDEO SIGNAL:	0.3 volt p-p (minimum for 50 volts at kinescope); sync negative at monitor input
VIDEO INPUT:	High impedance bridging (equivalent to 50 ohms in parallel with 15pF) can be terminated by an internal 75 ohm load (±1%) through a switch located on rear apron
VIDEO RESPONSE:	10 MHz ± 1 db; differential gain below 5% with 75 V kinescope drive
DC RESTORATION:	100% or zero, sync tip clamp
LINEARITY:	Within 2% of picture height

MECHANICAL

DIMENSIONS:	21.6 cm wide x 21 cm high x 37.5 cm deep (8.5 x 8.2 x 14.75 in.)
WEIGHT:	8.4 kg (18 lbs.)

CAMERA POWER SUPPLY

ELECTRICAL

CIRCUIT DESCRIPTION:	Step-down transformer, full wave bridge rectifier, RC filter, constant voltage regulator, followed by constant current regulator
POWER REQUIREMENTS:	115/230 VAC, 50/60 Hz, 25 W maximum
OUTPUTS:	Constant Current: Adjustable over minimum range of 200 to 800 mA (into 25 ohm load) Open Circuit Output Voltage: 28 ± V (with 25 ohm load) Focus Power: ± V unregulated, 5 W maximum for remote control of camera focus

MECHANICAL

CONTROLS:	On/off power control switch)on front panel SC303); near/far focus control; current level control; current level meter (0-1 amp scale); fuse ½ ampere with spare
DIMENSIONS:	7.8 cm high x 17.9 cm wide x 10.7 cm deep (3.1 x 7.1 x 4.2 in.)
WEIGHT:	Approximately 1.4 kg (3 lbs.)

LIGHT BALLAST UNIT

ELECTRICAL

INPUT POWER:	115 VAC, 60 Hz, 300 watts (nominal), 230 VAC, 50 Hz available
OUTPUT POWER:	Starting Voltage – 280 VAC Operating Voltage – 135 VAC Operating Current – 2.5 amperes

MECANICAL

DIMENSIONS:	13 cm wide x 13 cm high x 23.5 cm deep (5.1 x 5.1 x 9.25 in.)
WEIGHT:	10.4 kg (23 lbs.)

Hydro Products
A TETRA TECH COMPANY

PAN AND TILT UNIT
MODEL RP-3

FEATURES

- PERFORMS IN ANY UNDERWATER ENVIRONMENT TO DEPTHS OF 40,000 FEET
- POSITIONS PAY-LOAD TO ANY AZIMUTH AND ELEVATION ANGLE DESIRED BY THE SURFACE OBSERVER
- ACCOMMODATES PAY-LOADS UP TO 200 LBS.
- DEVELOPS 18 FT.-LBS. OF TORQUE FOR OVERCOMING CURRENT FORCE AND UNBALANCED LOADS
- FULLY WARRANTED FOR ONE YEAR

DESIGN

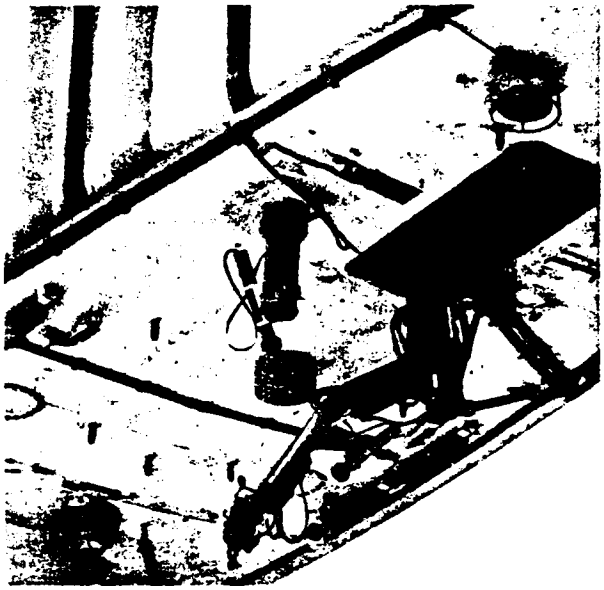
Hydro Products' Pan and Tilt Mechanism is a rugged, precision, remote-controlled manipulator for directing a Hydro Products television or photographic camera to any desired orientation at any depth. It is commanded by a surface operator using an integrated joy-stick controller. The pan and tilt mechanism develops a minimum of 18 foot-pounds of torque to accommodate heavy, unbalanced loads in strong currents.

It is made of marine brass, aluminum, and stainless steels, with all exposed parts chrome-plated to afford maximum resistance to the corrosive effects of salt water. Powerful motors and ball-bearing mounted gears and shafts result in smooth, precise control with no overshoot, jerking, or backlash.

PERFORMANCE

Applications include remote control of television on the TRIESTE and the ALUMINAUT; use on the R/V PROSPECTOR to direct both a Hydro Products television camera and a Shipek photographic camera, and many other applications in offshore drilling, underwater construction, and research.

This underwater tool is fully guaranteed to meet all specifications in the most extreme environments for a period of one year from the date of purchase. Alternate configurations are available.



SPECIFICATIONS

ELECTRICAL

Input Power:	117VAC, 150 watts

PERFORMANCE

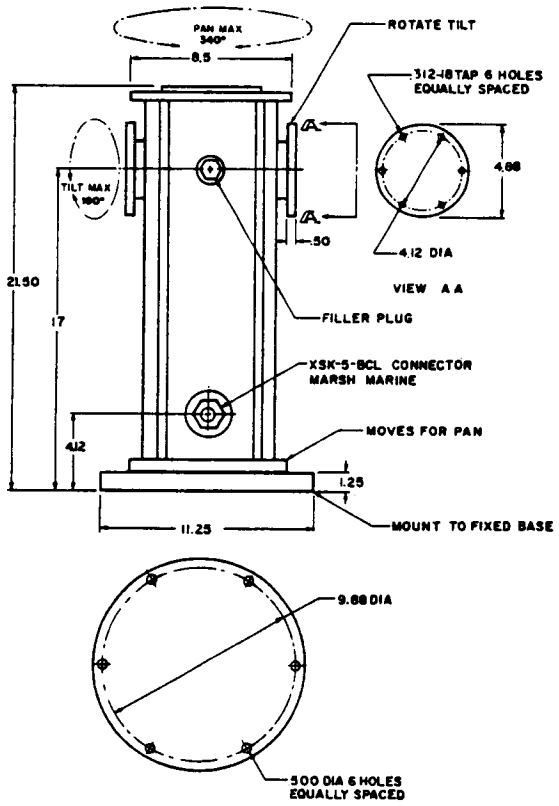
Drive Torque:	18 ft.-lb. minimum
Angular Speed:	6°/second
Travel Range:	340° pan axis – 190° tilt axis
Dead Torque:	200 ft.-lb. when de-energized

MECHANICAL

Weight:	120 lbs. in air – 94 lbs. in water
Height:	21-1/2 inches
Diameter:	11-1/4 inches (overall)
Connector:	Marsh Marine, XSK 5 BCL

ENVIRONMENTAL

Pressure:	0 to 24,000 psi (oil filled, pressure equalized)
Temperature:	0° F to 140° F



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Hydro Products
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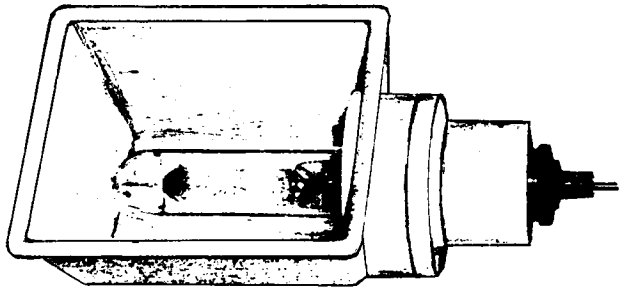
UNDERWATER LIGHTS
MODEL L7 SERIES



FEATURES

- INTERCHANGEABILITY OF INCANDESCENT, MERCURY VAPOR AND THALLIUM IODIDE LAMPS
- RUGGEDLY BUILT WITH DEPTH CAPABILITY TO 4,570 METERS (15,000 FEET)
- PARABOLIC REFLECTOR GIVES TRUE FLOOD OF LIGHT – NO HOT SPOTS
- 10,000 OPERATING HOURS OF TESTING INSURE RELIABILITY

DESIGN

Hydro Products' Model L7 Series Underwater Lights are the result of extensive engineering and an environmental test program never before conducted on any underwater light. Tests included thousands of pressure/temperature cycles and life tests with documentation on over 10,000 operating hours.

The first production units of the L7 Series were delivered for use on the U.S. Navy's DSRV program, and the rigorous testing was required to meet stringent specifications.

The light configuration is extremely compact. Weighing 1.8 kg (4 lbs.), it is 25.4 cm (10 in.) long and 15 cm (5.9 in.) wide at the reflector face. It produces a beam pattern which is a uniform flood, approximately 90° square with no hot spots.

PERFORMANCE

The L7 Series has been designed so that the same housing can be used with many different light elements. The light bulb is easily replaceable simply by unplugging, allowing the same housing and reflector to be used as a quartz iodide (500 watts), mercury vapor (250 watts), or thallium iodide (350 watts) light. The basic housing and lamp configurations have been designed to operate to depths of 4,570 m (15,000 ft.).

The lamp elements are the latest in design with plug-in electrical connectors and a flat O-ring pressure seal. This design enhances the ease of replacement and protects all electrical connecting surfaces from corrosion and damage. The thallium iodide lamp is the most advanced, providing over four times the light energy in sea water as an incandescent lamp of equivalent wattage. The mercury vapor lamp provides light energy at a level twice that of the incandescent lamp, and will continue efficient operation for 5,000 hours. For color photography, the quartz iodide incandescent lamp provides the best color balance.

SPECIFICATIONS

MODEL L7 UNDERWATER LIGHT

ELECTRICAL

INPUT POWER REQUIREMENTS:	115 VAC, 60 cps, 300 watt nominal, normally supplied from standard 250 watt mercury vapor ballast transformer
LAMP OPERATING POWER:	250 watts nominal when used with Hydro Products' Model LB250 ballast transformer

OPTICAL

LIGHT OUTPUT:	2,800 minimum centerbeam candelapower
REFLECTOR CHARACTERISTICS:	Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity

MECHANICAL

DIMENSIONS:	25.4 cm (10 in.) long, including connector x 15.7 cm (6.2 in.) wide at reflector face
WEIGHT:	Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water Stainless Steel unit: 4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water
HOUSING MATERIAL:	Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number)

PERFORMANCE

MAXIMUM OPERATING DEPTH:	4,750 m (15,000 feet)
WARM-UP TIME:	12 minutes maximum
AVERAGE LIFE:	5,000 hours
REPLACEMENT BULB TYPE:	Model MV7 250 watt

MODEL LT7 UNDERWATER LIGHT

ELECTRICAL

INPUT POWER REQUIREMENTS:	115 VAC, 60 cps, 300 watt nominal, normally supplied from standard 250 watt mercury vapor ballast transformer
LAMP OPERATING POWER:	250 watts nominal when used with Hydro Products' Model LB250 ballast transformer

OPTICAL

LIGHT OUTPUT:	4,000 minimum centerbeam candelapower
REFLECTOR CHARACTERISTICS:	Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity

MECHANICAL

DIMENSIONS:	25.4 cm (10 in.) long, including connector x 15.7 cm (6.2 in.) wide at reflector face
WEIGHT:	Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water Stainless Steel unit: 4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water
HOUSING MATERIAL:	Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number

PERFORMANCE

MAXIMUM OPERATING DEPTH:	4,750 m (15,000 feet)
WARM-UP TIME:	12 minutes maximum
AVERAGE LIFE:	500 hours minimum
REPLACEMENT BULB TYPE:	Model T17 250 watt

LQ7 UNDERWATER LIGHT

ELECTRICAL

INPUT POWER REQUIREMENTS:	115 VAC/DC, 500 watts (higher voltage may be required to compensate for line losses
LAMP OPERATING POWER:	120 VAC/DC, 250 or 500 watts nominal

OPTICAL

LIGHT OUTPUT:	2,000 minimum centerbeam candelapower
REFLECTOR CHARACTERISTICS:	Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity

MECHANICAL

DIMENSIONS:	24.5 cm (10 in.) long including connector x 15 cm (6.2 in.) wide at reflector face
WEIGHT:	Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water Stainless Steel Unit: 4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water
HOUSING MATERIAL:	Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number)

PERFORMANCE

MAXIMUM OPERATING DEPTH:	4,750 m (15,000 feet)
WARM-UP TIME:	Less than 1 second
AVERAGE LIFE:	1,000 hours
REPLACEMENT BULB TYPE:	Model Q17 watt

Hydro Products
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VIDEOCASSETTE RECORDER

VO-1800

TECHNICAL SPECIFICATIONS

● General

Video recording system	Rotary two-head helical scan system Luminance: fm recording Color signal: converted subcarrier direct recording
Video signal system	EIA Standard, NTSC color signals (American system for color telecasts)
Storage temperature	−4°F to 140°F
Operating temperature	41°F to 104°F
Antenna system	300 ohms, balanced, external antenna connector
RF output signal	Channel 3 or Channel 4, selectable, 75 ohms, unbalanced
Power requirements	120 V ± 5 V, 60 Hz ± 0.5%
Power consumption	98 W
Weight	59 lb, 8 oz
Dimensions	24¼"(w) × 8⅛"(h) × 18¼"(d)

❷ Video signal

Input	0.5−2.0 V (p−p), sync negative, 75 ohms, unbalanced
Output	1.0 V (p−p), 75 ohms, unbalanced
Horizontal resolution	Monochrome: more than 300 lines Color: more than 240 lines
Signal-to-noise ratio	better than 40 dB

❸ Audio signal

Input (both channels)	Microphone: −72 dB to −30 dB, 600 ohms, unbalanced LINE IN connectors: −22 dB to + 10 dB, 100 k ohms, unbalanced
Output	LINE OUT connectors (both channels): 0 dB, 10 k ohms, unbalanced AUDIO MONITOR connector: 0 dB, 10 k ohms, unbalanced HEADPHONE: −24 dB or −34 dB, selectable, 8 ohms, unbalanced
Crosstalk	better than 40 dB
Frequency response	50 Hz−12 kHz
Signal-to-noise-ratio	better than 40 dB
Audio dubbing	new sound onto track 1

❹ Tape transport

Tape speed	3¾ ips ± 0.2%
Wow and flutter	less than 0.2% rms
Recording or playback time	60 min. (using Sony KC-60) 30 min. (using Sony KC-30)
Fast forward time	Approx. 3 min. (using KC-60)
Rewind time	Approx. 3 min. (using KC-60)

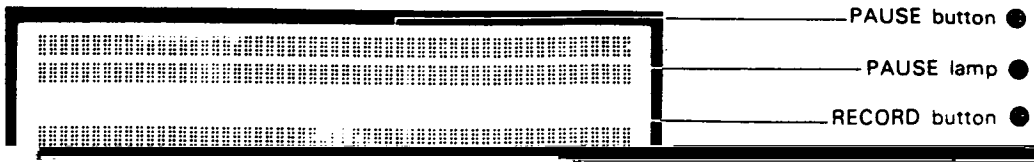
❺ Accessories supplied

AC power cord
VHF output cable with 300-ohm matching transformer EAC-20W
External antenna connector EAC-13W
VIDEOCASSETTE tape KC-10
Polishing cloth
Dust cover

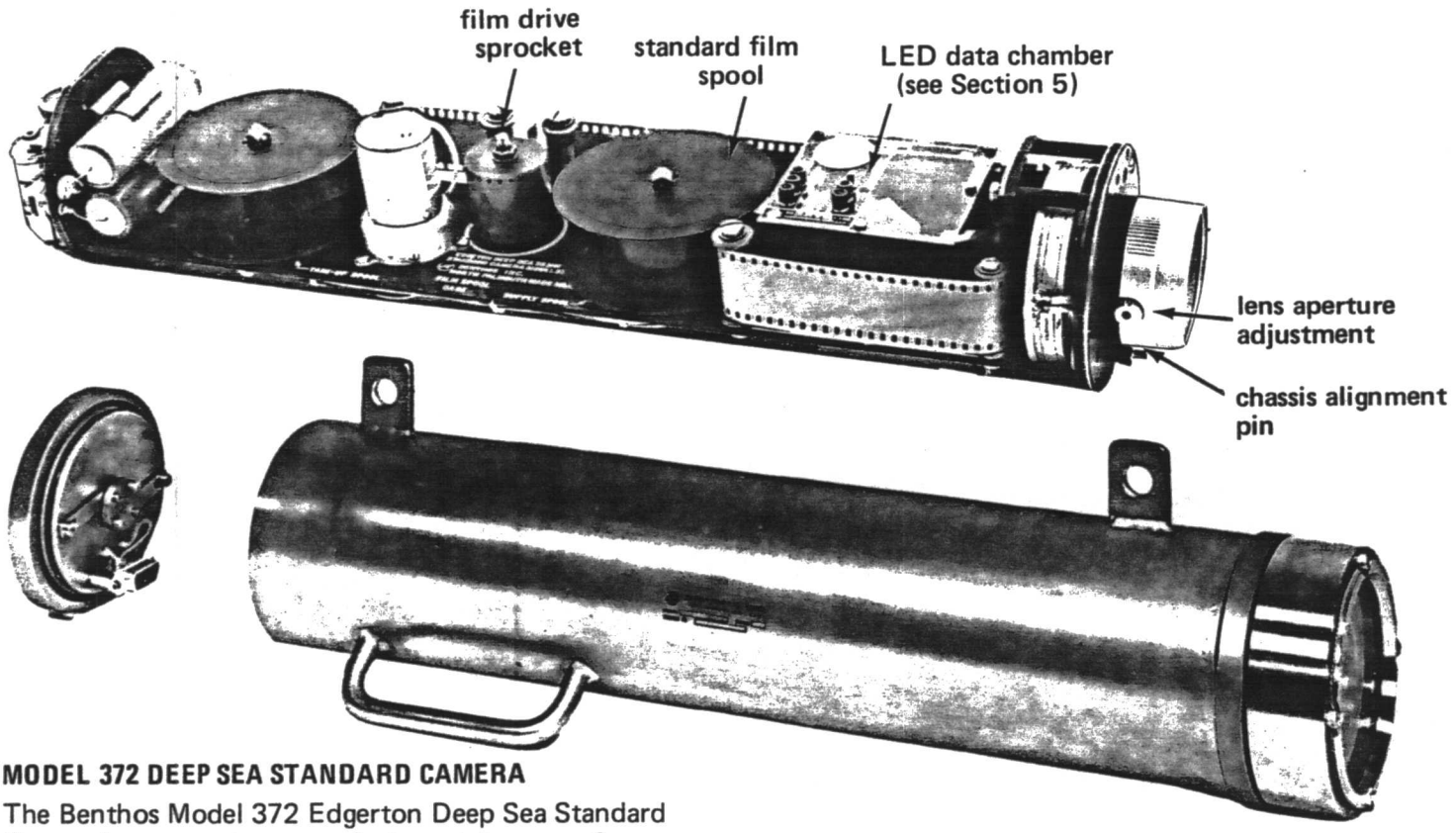
Design and specifications subject to change without notice.

LOCATION OF PARTS AND CONTROLS

Front panel



3 EDGERTON DEEP SEA 35 MM



MODEL 372 DEEP SEA STANDARD CAMERA

The Benthos Model 372 Edgerton Deep Sea Standard Camera is a general purpose instrument proven for use in a variety of deep ocean applications. The camera takes 800 or more exposures per loading. A data chamber with a light emitting diode digital display, furnishing date, time (hours, minutes, seconds) and run number information on each photo frame, is available as an option.

When used with a Benthos Model 382 Edgerton Deep Sea Standard Flash, the camera becomes a pre-programmed, automatic system. The camera can also be used with the Benthos Model 383 Hi-Intensity Flash (see Section 4) and companion power packs for applications where greater camera-to-subject distances require more light. Stereo photographs can be obtained by spacing two Model 372's with their axes parallel. Precision orientation of the camera chassis in its housing maintains proper alignment for stereo photography.

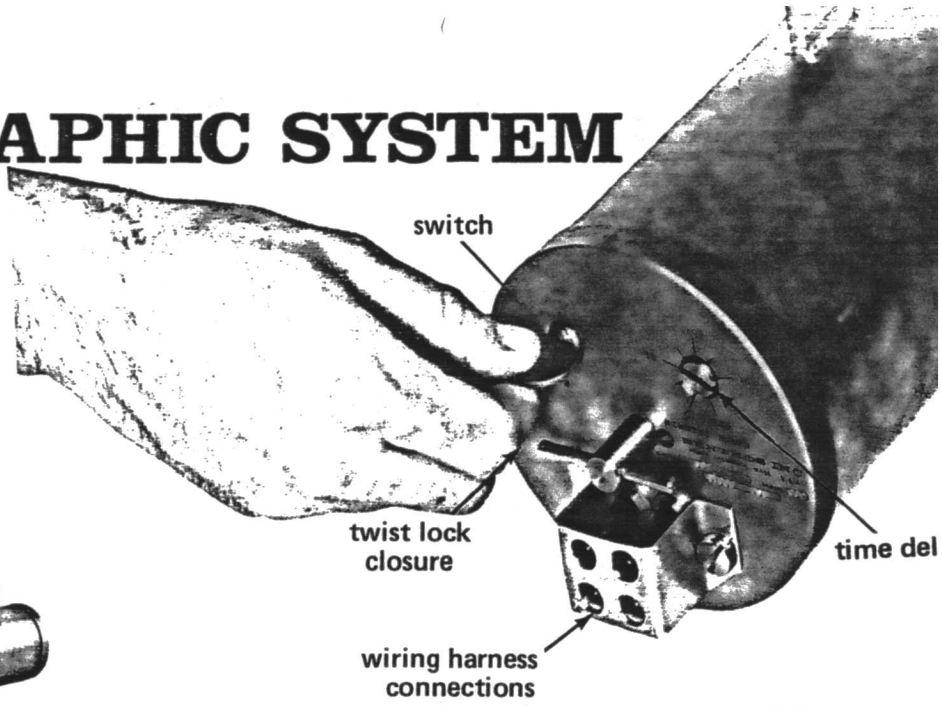
Specifications — Model 372 Camera

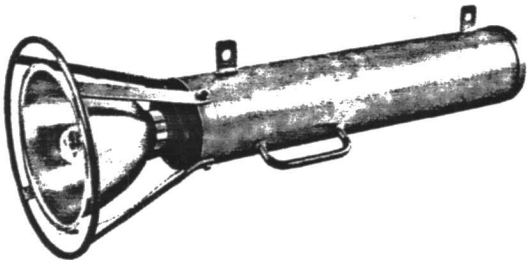
Number of exposures per loading using standard film	800
Number of exposures per loading using thin base film	1600
Film length using standard film:	30.5 meters (100 feet) min.
Film length using thin base film:	61 meters (200 feet) min.
Spool type:	Standard Kodak No. 10
Spool diameter:	9.3 cm (3.6 inches)
Dimensions:	
Length:	64.3 cm (24.4 inches)
Diameter:	12.5 cm (4.9 inches)
Weight in air:	21 kg (46 pounds)
Weight in water:	16 kg (35 pounds)
Shutter speed:	Controllable from 1/50th to 2/5th second from Model 382 Flash or external programmer
Power required:	28 ±5 VDC at 1 amp peak, supplied from external source or Model 382 Flash
Data chambers available:	Optical, digital or remote (see Section 5)

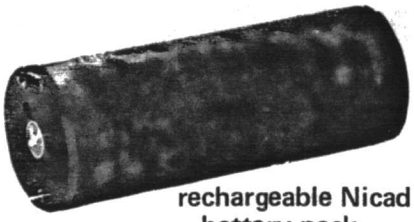
BENTHOS, Inc.
NORTH FALMOUTH, MASS. 02556 U.S.A.
Telephone (617) 563-5917 Telex 94-0884

PHOTOGRAPHIC SYSTEM

up to 1600 exposures per loading

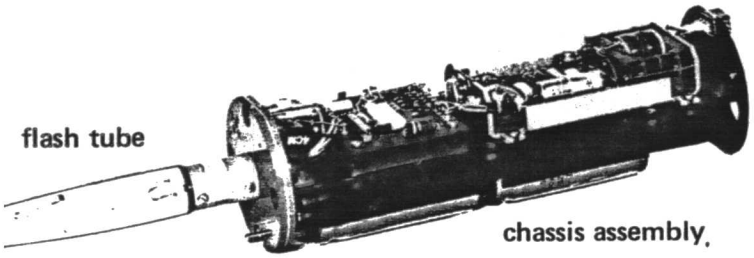






programmer end cap

rechargeable Nicad battery pack



MODEL 382 DEEP SEA STANDARD FLASH

The self-contained, 100-watt-second Flash is designed as a companion unit to the Model 372 Camera or for use with other Benthos cameras. It contains a solid state electronic camera programmer that puts out electrical impulses at preset intervals causing the camera to take pictures and advance its film. Adjustment of the interval between exposures and for the shutter speed are provided on the internal printed circuit board. The flash also features an externally adjustable electronic timer to delay the start of picture taking while the camera system is being lowered to the desired depth. A switch control on the outside of the rear end cap can be turned to three positions to start the delay, restart the delay or to turn the system on immediately for test. The flash contains a rechargeable nickel-cadmium battery pack which supplies power for both the flash and camera.

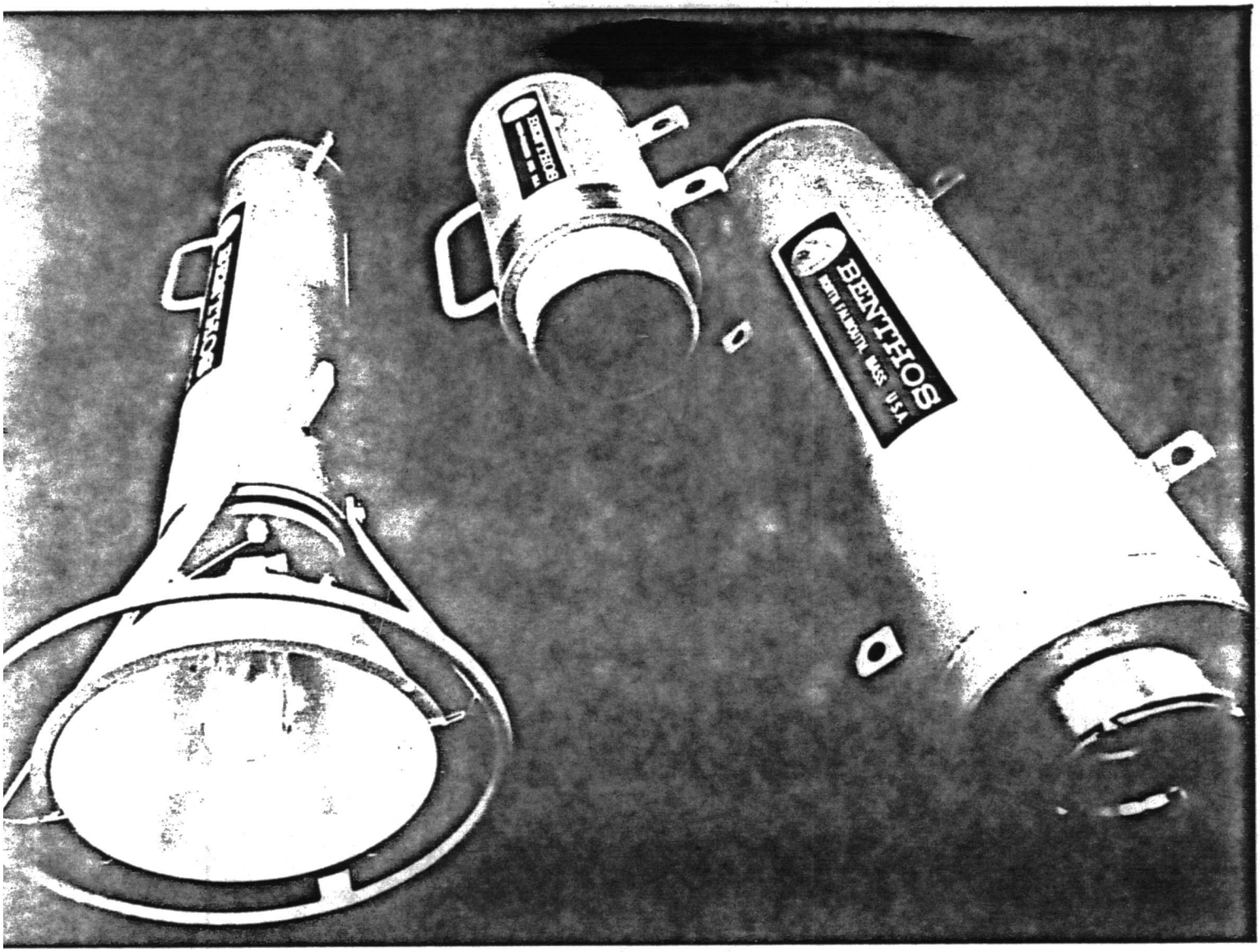
*Intervals to 32 hours are available using the Benthos 380-30 low power programmer option. Contact Benthos for application details.

Specifications — Model 382 Flash

Power source:	Benthos Model 389 Battery Pack mounted in Flash housing. 28 VDC Nicad rechargeable type rated at 4 ampere-hours
Flash tube input energy:	100 watt-seconds
Number of flashes:	Over 3200 with charged battery
Flash duration:	Approximately 1 ms
Dimensions:	
Overall length:	90.5 cm (35.6 inches)
Housing diam.	21 cm (8.2 inches)
Weight in air:	31 kg (69 pounds)
Weight in water:	23 kg (50 pounds)
Turn-on delay setting:	0 to 200 minutes
Camera exposure duration adjustment:	40 to 400 ms
Exposure interval adjustment:	3 sec to 2 minutes between* photos or manual

BENTHOS Inc.
NORTH FALMOUTH, MA 02556 USA 617-563-5917 Telex: 940884

Height Recording Deep Sea Camera System



Flash **Model 2110 Altimeter** **Camera**

It's one thing to take pictures of the ocean floor, but another to know the size of the objects in the photos. For accurate determination of object size, one needs to know how far the camera is from the ocean floor when each photo is taken.

The problem is that most ocean photos are taken with a camera suspended or towed below a ship on a wire several kilometers long. As the ship rolls and pitches, the camera moves up and down. Every picture is taken at a different height above the bottom making it difficult to determine the size of objects in the area covered by the photo.

This problem is now solved by the Benthos Model 2110 Altimeter, a short-range acoustic sounding device which is similar in principle to a small boat echosounder, except that it is designed for full ocean depth. Each time the camera takes a photo, it records in digits what the camera to ocean floor distance is in meters and tenths of meters in the left-hand bottom corner of the photo, along with the date, time, and any other digital information required to help interpret the resulting photographs.

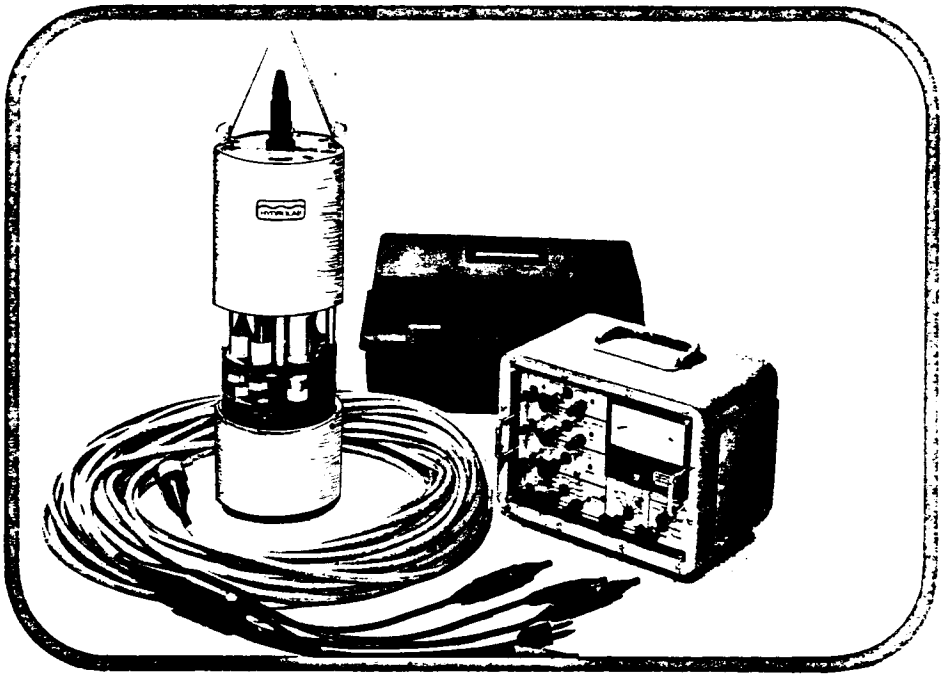
HYDROLAB

SURVEYOR MODEL 6D

in-situ WATER QUALITY ANALYZER

APPLICATIONS

- Wide-ranging surveys to establish "normal" waterway conditions
- Real-time, detailed studies of stratification, stratified flows, merging, mixing
- Power plant siting studies, environmental impact statements
- Early detection and investigation of deteriorating or substandard conditions
- Guidance and support for biological observations, mariculture
- Establishing optimum locations for fixed-station waterway monitors
- Gathering supplementary, control, and follow-up data on permanently-monitored waterways
- Short-term automatic monitoring in remote areas
- Contamination source location
- Evaluation of impoundment de-stratification measures



The Hydrolab Model 6D SURVEYOR a multi-parameter *in-situ* water analysis instrument system suited to both survey and automatic monitor applications. Analyses for D.O., conductivity, pH, ion concentrations or ORP, and temperature can be made simultaneously by the system to depths of 100 meters (330 feet) in either fresh, salt or estuarine waters. Temperature-corrected subsurface data, including the depth at which measurements are being made, are made continuously available at the surface for observation as functions of depth and/or time. Data signals for each parameter, plus depth, are available as system outputs for recording or other processing.

The battery-powered SURVEYOR is a portable, all-weather field instrument designed for both boat and shore operations under difficult conditions. All components, including the surface unit, are sealed to tolerate direct exposure to mud, spray, fog, and rain.

Response Times: Approximately 15 secs for step change in ion concentration, 30 secs for step change in temperature.

Output Data Signal: 0-10 millivolts; output resistance 500 ohms.

TEMPERATURE

Range: -5°C to +45°C.

Sensor: Thermistor probe.

Calibration Standard: Internal.

Accuracy, Overall, Output Data Signal: ±0.2°C for temperatures between -5°C and +25°C; ±0.4°C for temperature between 25°C and 45°C.

Accuracy, Overall, Meter Reading: Same as output data signal accuracy ±0.25°C.

Response Time: 10 secs for step change in temperature.

Output Data Signal: 0-10 millivolts; output resistance 500 ohms.

DEPTH

Ranges: 0-100 meters with 2100 probe, 0-20 meters with 2020 probe.

Sensor: Temperature compensated pressure transducer.

Accuracy, Overall, Output Data Signal: ±1.5% of range.

Accuracy, Overall, Meter Reading: ±2% of range.

Output Data Signal: 0-10 millivolts; output resistance 500 ohms.

SONDE

Dimensions: Length 53 cm; 21 inches. Diameter 17 cm; 6 3/4 inches.

Weight: 7 kg; 15 lbs.

Working Depth: 100 meters; 330 feet.

Power (circulator): 12 volts dc.

Probe Complement: Accommodates temperature, DO, conductivity, pH, reference, ion or ORP, and depth probes.

Exposed Materials: PVC, passivated stainless steel, nickel plated brass.

CABLE

Type: urethane—jacketed, multiconductor, filled and water-blocked cable.

Breaking Strength: >300 kg; 650 lbs.

Standard Length: 10, 20, 50, 100, meters; 33, 65, 165, 330 feet.

Surface Connector: Military grade, multi-pin, locking type; waterproof.

Subsurface Connectors: Molded neoprene oceanographic type.

Breakouts: Molded urethane.

EQUIPMENT LIST: MODEL 6D SURVEYOR BASIC SYSTEMS INCLUDE THE FOLLOWING ITEMS;

- Surface Unit
- Sonde
- Instrument Cable, (length optional)

PROBES

- D.O.
- conductivity
- pH
- reference
- temperature
- depth
- ion or ORP (optional specific ion electrodes)

ACCESSORIES

- maintenance kit
- instruction manual
- (D.O.) calibration adapter
- outboard platform (pH, ion, ORP)
- field case for probes/accessory storage
- dummy plugs for underwater cable receptacles

Please refer to attached ordering information sheet for options, price information.

HYDROLAB®

TELEPHONE (512)837-2050

HYDROLAB CORPORATION
12921 F.M. 1325 P.O. Box 9406 Austin, Texas 78766

SPECIFICATIONS

SURFACE UNIT

Meter: Precision 4½" taut-band with mirror scale; 0.5% of full scale accuracy.

Internal Supply Batteries: TR132R, E132N, or H132R Mercury cells. For ambients below 5°C use Mallory 317515-2 mercury cells. No internal batteries are required when operating with external power pack.

Battery Life (internal): 300 to 400 hours; decreases at low ambient temperatures.

Ambient Temperature Range (recommended): 0°C to 50°C.

Case: Hermetically sealed; positive bouyancy. Durable light blue vinyl paint finish.

Dimensions: 36 x 25 x 23 cm; 14 x 10 x 9 inches.

Weight: Approximately 5.4 kg; 12 pounds.

DISSOLVED OXYGEN

Ranges: 0-10 and 0-20 ppm.

Sensor: Temperature compensated passive polarographic cell.

Temperature Compensation Accuracy (refer to standard O_2 solubility table, *Standard Methods*, 12th Ed.): ±1.5% of reading, 0°C to 45°C water temperature.

Calibration Standards: Atmospheric oxygen or Winkler-standardized oxygen solutions.

Accuracy, Overall, Output Data Signal: ±2% of reading.

Accuracy, Overall, Meter Reading: ±2% of reading ±0.5% of range.

Output Data Signal: 0-10 millivolts; output resistance 500 ohms.

CONDUCTIVITY

Ranges: 0-100, 0-1,000, 0-10,000 micromho/cm with low range probe or 0-1,000, 0-10,000, 0-100,000 micromho/cm with high range probe.

Sensor: Temperature compensated four-electrode ac cell, pure nickel electrodes.

Temperature Compensation Accuracy: ±1.5% of reading for salinities up to 34 ppt, temperature between 0°C and 45°C.

Calibration Standards: Internal instrument standard or standard KCl solution.

Accuracy, Overall, Output Data Signal: ±2.5% of reading for internal calibration or ±1.5% of reading for standard solution calibration—salinities to 34 ppt, temperatures between 0°C and 45°C.

Accuracy, Overall, Meter Reading: Output data signal Accuracy ± 0.5% of range.

Response Time: 2 secs to step change in conductivity, 10 secs to step change in temperature.

Output Data Signal: 0-10 milivolts; output resistance 500 ohms.

pH

Range: 2 to 12 pH.

Sensor: pH electrode, reference electrode pair.

Temperature Compensation: Standard slope correction plus offset suppression, 0°C to 45°C.

Pre-amplifier Input Resistance: 10^{12} ohms.

Calibration Standard: Standard buffer solutions.

Accuracy, Overall, Output Data Signal: ±0.05 pH.

Accuracy, Overall, Meter-Reading: ±0.1 pH.

Response Time: 10 secs for step change in pH, 20 secs for step change in temperature.

Output Data Signal: 0-10 millivolts; output resistance 500 ohms.

SPECIFIC ION/ORP

Ranges: 3 decades of activity or concentration, log scale for ion; 0 to +1,000 millivolts, 0 to -1,000 millivolts linear scale, for ORP.

Sensors: Specific ion electrode, reference electrode pair or platinum electrode, reference electrode pair.

Temperature Compensation: Standard slope correction plus offset suppression, 0°C to 45°C.

Pre-Amplifier Input Resistance: 10^{12} ohms.

Calibration Standards: Standard ion solution.

Accuracy, Overall: ±10% of activity or concentration for monovalent ions; ±20% of activity or concentration for divalent ions; ±5 millivolts for ORP.

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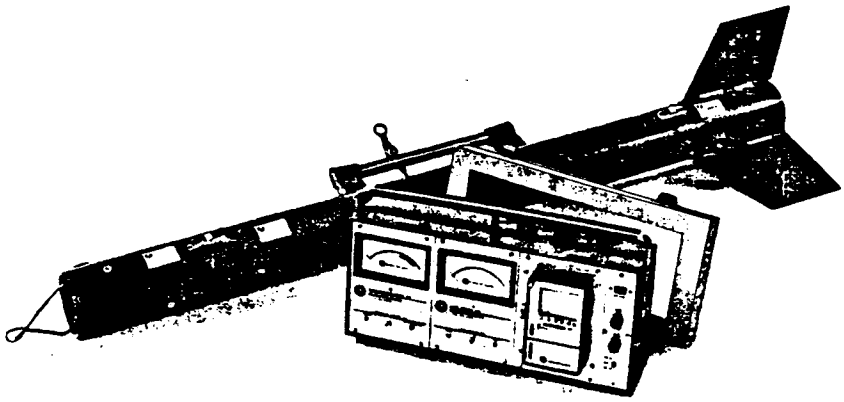
912S TRANSMISSOMETER SYSTEM



FEATURES

- SENSOR CAN EASILY BE CHANGED TO MEASURE TRANSMISSIBILITY OVER A 10 CENTIMETER OR 1 METER PATH LENGTH
- TEMPERATURE COMPENSATED ELECTRONICS OPERATE UNDER CONDITIONS FROM −5°C to +55°C
- MECHANICAL AND OPTICAL CONSTRUCTION MAKE SENSOR INSENSITIVE TO INCLINATION AND SHOCK
- DECK UNIT IS PORTABLE AND SPLASHPROOF WITH SEE-THROUGH LID

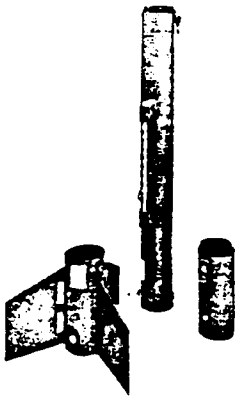
PERFORMANCE

The 912 Sensor has a rugged ¼ inch aluminum housing to insure optical and mechanical stability. The system features external 12 VDC or optional 115/230 VAC operation, temperature compensation, and analog output 0-1 VDC for external recording. Both sensor and deck unit are lightweight and portable, and can be used from small boats for making vertical or horizontal turbidity contours.

DESIGN

The design of the 912 is unique in that a one meter optical light path is formed in the sensor when the detector, projector, and extension tubes are clamped together (shown at right), and a ten centimeter path when only the detector and projector tubes are clamped together. Changing the optical light path can be accomplished in the field in a matter of seconds. Seating of each tube is positive and assured by detent, self-locking clamps.

The projector and detector assemblies use a derated long life incandescent lamp and temperature compensated photo cell with appropriate field stops and lenses, to insure a collimated narrow beam. Optics in the projector housing present a light beam collimated sufficiently to illuminate only the detector optics. The detector optics are such that only light coming directly from the projector is "seen." The precision optical arrangement and the enclosed light path minimize effects of forward and backscatter due to ambient and divergent beam light.



The 912 sensor includes a projector unit, a detector unit, and an extension tube. The projector and detector together provide a ten centimeter path length. When used with the extender tube, a one meter path length is provided.

912S TRANSMISSOMETER SYSTEM

APPLICATIONS

Hydro Products' transmissivity sensors allow a water sample to circulate freely into the optical path where transmissivity is determined. Transmissivity is defined as

$$T = \frac{I_2}{I_1} \times 100$$

where: T = transmissivity in percent

I_1 = intensity at projector

I_2 = intensity at detector

This measurement is related to the average optical attentuation coefficient of the water (α) by the exponential equation:

$$T = 100e^{-\alpha d}$$

where: α = attenuation coefficient in Ln/Meter

d = path length in meters

Utilizing this relationship, the instrument can be used for measuring water pollution, sediment suspension and plankton concentrations. It is also extremely useful in plotting river or sewer outflows, measuring the visibility range for underwater photography, television, and lighting requirements, and for submersible or diver operations.

The 912 Sensor was designed to be lowered from a static platform or towed from a moving boat at speeds up to 5 knots. This allows the user to make a systematic survey of any area where he wants to detect or measure differences in water clarity or turbidity.

SPECIFICATIONS

TRANSMISSIBILITY RANGE:	0-100% over 10 cm or 1 meter path length
USEFUL RANGE OF AVERAGE ALPHA MEASUREMENT:	0.1 to 2.6 meter^{-1} for 1 meter path length 1 to 26 meters^{-1} for 10 centimeter path length
OVERALL SYSTEM ACCURACY:	±2% of full scale
OPERATING DEPTH:	0 to 1,000 feet (305 meters). Greater depths available.
OPERATING TEMPERATURE:	−5°C to +55°C
TOWING SPEED:	Up to 5 knots
OPERATING POWER:	External 12 volts DC (external automobile battery) or optional 115/230 VAC, 50-400 Hz
AVERAGE LAMP OPERATING LIFE:	1000 hours continuous operating time (easily replaceable)
SURFACE STATION SWITCH POSITION:	OFF, BATTERY TEST, CURRENT ADJUST, OPERATE

SENSOR WEIGHT:	In Air	In Water
10 centimeter	12 pounds (5.4 Kg)	10.5 pounds (4.8 Kg)
1 meter	22 pounds (10 Kg)	20 pounds (9.1 Kg)

SURFACE STATION WEIGHT:	14 pounds (6.4 Kg)
SURFACE STATION DIMENSIONS:	18 inches (46 cm) × 7.5 inches (19 cm) × 7 inches (17.8 cm)
SENSOR DIAMETER:	4.25 inches (10.8 cm)
SENSOR LENGTH:	
10 centimeter	18 inches (45.7 cm)
1 meter	54 inches (137 cm)
SENSOR MATERIAL:	Hard anodized 6061T6 aluminum epoxy painted
REQUIRED INTERCONNECTING CABLE:	18 gauge, 6 conductor S.O. Neoprene (supplied with Model 912S System including necessary molds and connectors)

ORDERING INFORMATION

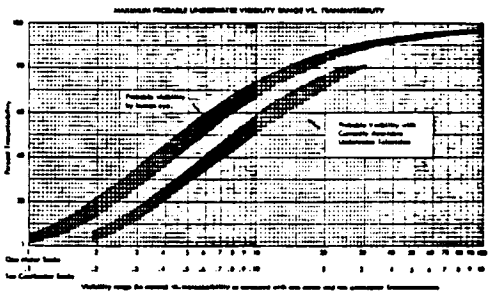
Each Model 912S Transmissometer System consists of:

- Dual 10 centimeter and 1 meter sensor
- 912 Surface Station readout in splashproof carrying case
- System instruction manual
- System interconnecting cable, including underwater molds and connectors
- External DC power cables

ACCESSORY EQUIPMENT

- Model 902 Depth System
- Model 901S Temperature System
- AC operation. 115/230 VAC, 50-400 Hz

FREE VISIBILITY CHART

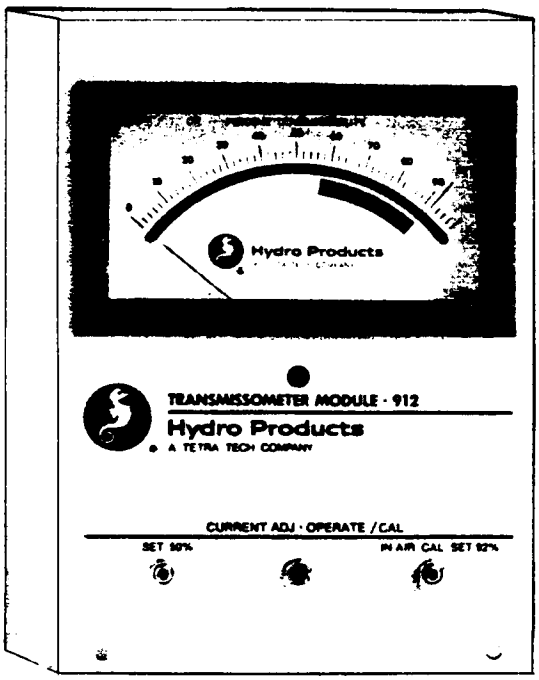


Underwater visibility range can be predicted by divers, submersible operators, and television observers by use of a chart that can be obtained from Hydro Products.

The visibility chart related visibility range for a human observer and a television observer to the measurement of transmissibility made by a transmissometer.

Hydro Products
A TETRA TECH COMPANY

POST OFFICE BOX 2528 · SAN DIEGO, CALIFORNIA · TELEPHONE (714) 453-2345 · TWX 910-322-1133



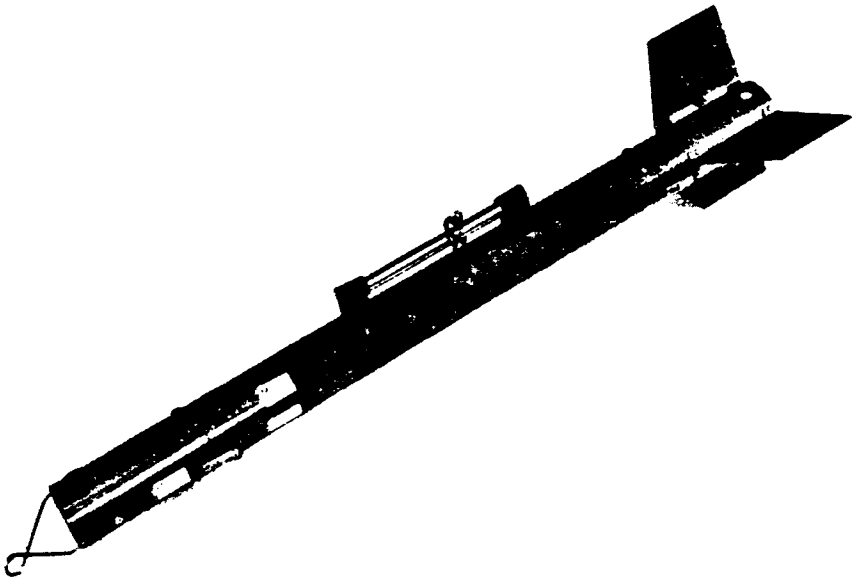
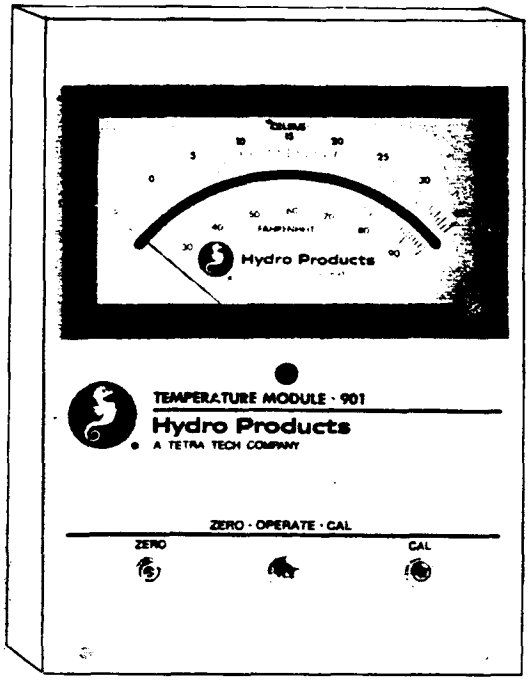


Figure 1-1 Model 912S Transmissometer System



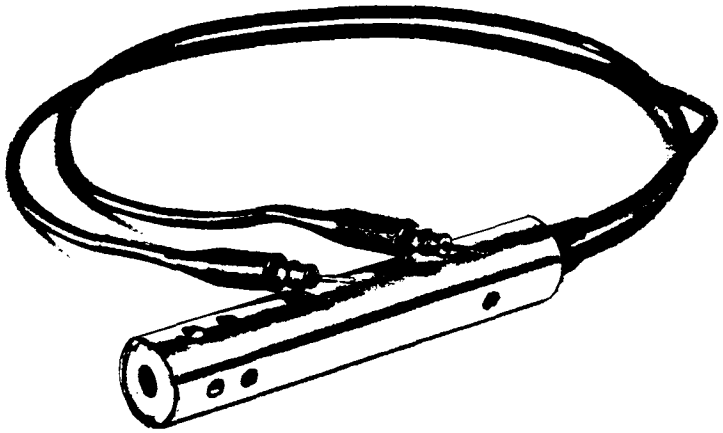
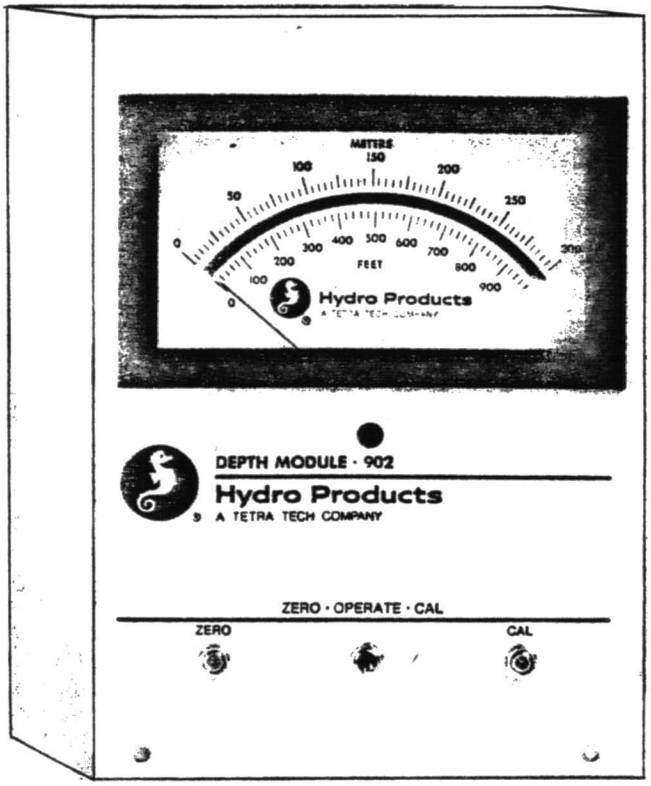


Figure 1-1 Model 901S Temperature Measuring System



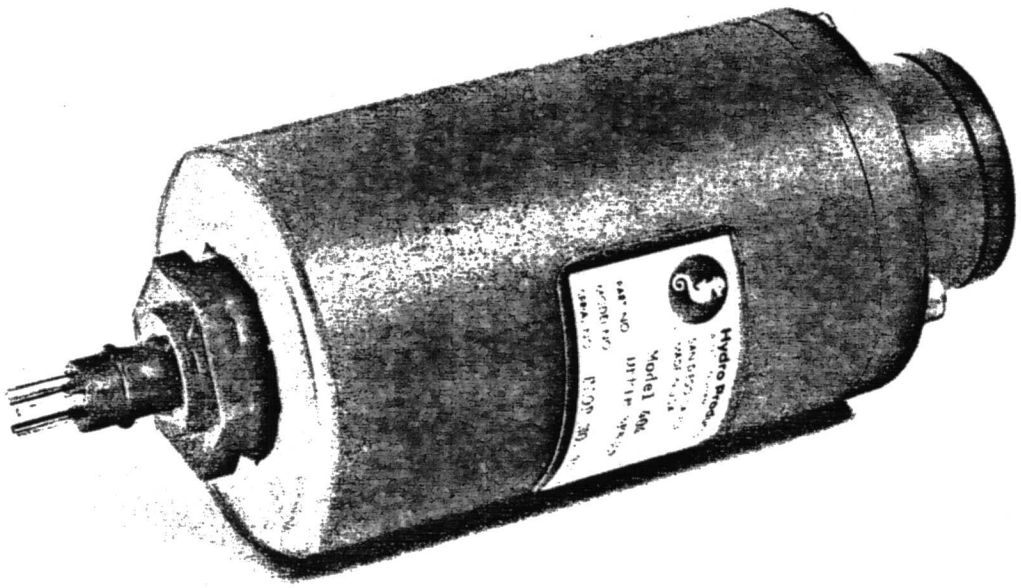


Figure 1-1 Model 902 Current Depth Measuring System

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.