E. D. Cokelet

Cruise Report
NOAA Ship MILLER FREEMAN Cruise MF-93-03
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Cruise Dates: 25 March - 1 April 1993.

FOCI Cruise: 1MF93

Itinerary and Area: Kodiak to Dutch Harbor, AK (Fig. 1). Transit Kodiak to Peggy Bering Sea mooring site, 90 nm NW of Dutch Harbor. Conduct oceanographic studies in the area. Return to Dutch Harbor.

Participating Organizations: NOAA Pacific Marine Environmental Laboratory (PMEL), Alaska Fisheries Science Center (AFSC) and Western Environmental Technology (WET) Laboratories.

Scientific Personnel: E.D. Cokelet, Steven Bograd, Carol DeWitt, Dave Kachel and John Shanley (PMEL). Douglas Hankins (WET Labs.).

Goal: To understand the biological and physical processes that cause variability of recruitment to commercially valuable walleye pollock (*Theragra chalcogramma)* stocks in the Bering Sea.

Objectives:

1. To deploy 2 current-meter moorings - Peggy Bering Sea (a surface PROTEUS mooring) and a subsurface ADCP mooring,
2. To conduct CTD and ADCP transects in areas of interest to transport studies,
3. To collect zooplankton and microzooplankton samples in support of modelling and other biological studies, and
4. To continue acquisition of long-term biological and physical time series.

Mooring Deployment: The Peggy Bering Sea mooring (Fig. 2) was deployed on the second attempt at 0854 29 Mar 93 UTC. It settled at 54°47.48'N, 168°32.05'W in 2139 m of water as shown in Figure 3, a topographic chart constructed from a local echo-survey of the area using the 12-kHz echosounder.

The first mooring deployment failed because the 5/8 inch stainless steel ring attaching the acoustic release bridle to the anchor chain broke, dropping the anchor and allowing the emergency flotation to rise to the surface. This ring's design strength (approx. 70,000 lbs) was much greater than the anchor weight (approx. 6,000 lbs) and the calculated forces. Since the ring itself was not recovered the reason for failure cannot be determined. Subsequent to the deployment, two identical rings were pull-tested at PMEL with loads of 20,000 lbs. They did not break, but rather distorted into long ovals. With the railroad-wheel anchors lost, the 6-month-long buoy deployment was in jeopardy. Special thanks are due CDR Robert J. Pawlowski, Commanding Officer of the MILLER FREEMAN, and the deck crew led by Chief Boatswain Rick Pietrusiak for suggesting and fashioning a new anchor from two spare trawl doors and the subsurface mooring's railroad-wheel anchor.

The subsurface ADCP mooring (Fig. 2) was deployed at 0504 30 Mar 93 UTC at 54°47.49'N, 168°36.57'W in 2155 m of water (Fig. 3). Its deployment was in jeopardy of being aborted because we used the anchor on Peggy's second deployment. However we were able to use three sediment trap anchors that were aboard for the next cruise. Thanks to Bill Parker's (PMEL) arrangements, spares were built in Dutch Harbor and delivered to the ship at the next port call so that no scientific observations were lost.

A preliminary data analysis from the 1992 deployment indicated that the region has energetic internal waves with 15 to 20 min. periods. Since most of the instruments sampled at 10-minute to hourly intervals, this posed the possibility of frequency aliasing. Battery capacity and internal storage limitations dictated that the sampling frequency could not be increased to once every 5 minutes. Therefore as a compromise, the Seacats were programmed to sample once per 10 minutes, plus to burst sample once per 2 minutes for 24 hours every 42 days. Similarly, the Neil Brown Acoustic Current Meter at 38 m was programmed to calculate 1-minute averages, as opposed to 10-minute averages on the other Neil Brown's, for the duration of the deployment.

<u>CTD Casts</u>: Seventeen CTD casts were made on this cruise (Fig. 4, Table 1). The first 11 were a time series at the Peggy Bering Sea site with a nominal spacing of 1.5 hr and to a depth of 1000 m. Cast 12 was intended to be for calibration at Peggy, but it had to be aborted due to a bad CTD termination. Casts 13-16 to bottom or 1500 m constituted a widely spaced transect of the Aleutian north slope flow. A finer spacing was planned for this transect, but we had to interrupt sampling due to a storm and take shelter behind Unalaska Island. Cast 17 to 400 m was taken at the Peggy site for calibration purposes. It included light meter and fluorometer measurements, and chlorophyll samples at 0, 11, 20, 30, 39, 50, 60, 70, 80, 90 and 100 m.

<u>ADCP Transects</u>: The 150 kHz RDI VM-ADCP collected data for the entire cruise. There was one dedicated ADCP transect from the north side of the Aleutians to the Peggy site and a backtrack-L calibration maneuver near the end of the cruise (Fig. 4). The gyrocompass was calibrated with sextant sightings when possible with the result that one must subtract 1.5° from the gyro to obtain the true direction.

Net tows and trawls: Two sorts of net tows were planned at the Peggy site - CalVET tows and Tucker trawls. However the storm interrupted the biological sampling from 1826 30 March to 1935 31 March. No CalVET tows were made, one Tucker depth test and two Tucker trawls were taken (Fig. 4, Table 1). On the Tuckers, net 1 nominally sampled from 1000 to 100 m, and net 2 sampled from 100 m to the surface. Unfortunately the storm moved in rapidly, and the cod end from the shallow sample of the second Tucker trawl was lost as it hit the side of the ship in rough seas.

We conducted an experiment to determine the relationship of the Tucker trawl depth to the winch wire out. It is difficult to know the depth of the Tucker trawl since it has no pressure-measuring capability. A pressure sensor cannot be hung on the wire above the nets because it will block the transit of the messenger weights. A pressure sensor attached directly to the net frame is at risk of being smashed by chains controlling the opening/closing mechanism. We deployed the Tucker with three 333 µm mesh nets with cod ends attached. A Seacat with pressure sensor was attached just above the Tucker, and the first net remained open throughout the tow. We recorded depth as a function of wire-out during the descent of 50 m/minute, while the winch was held steady for 30 seconds as the net stabilized, and during the ascent at 20 m/minute. The wire angle varied between 40 and 50°.

The Tucker calibration results are shown in Figure 5. For both descent and ascent there is a near-linear relationship between depth and wire-out. The slopes of the best-fit curves constrained to pass through the origin are shown. The deepest two points were excluded from the ascent fits as the net depth adjusted. To a very good approximation the depth on descent at 50 m/min is 86% of the wire out, and on ascent at 20 m/min the depth is 80% of the wire out.

JRC Colorscope: The water depth for the Peggy Bering Sea mooring had to be estimated very accurately so that the mooring line could be cut to the correct length. The error tolerance was +/- 20 m. To best estimate the depth it was imperative to know what sound velocity is assumed by the JRC Colorscope in converting acoustic travel time to depth. It was also useful to scale the Colorscope output so that it displayed the correct sound-velocity-adjusted depth. Before the cruise we contacted the manufacturer and found that the assumed sound velocity was 1500 m/s. Appropriate depth scaling was implemented, and the details are given in the Appendix.

GPS: In the past both (bridge and plot room) Magnavox 4200 GPS receivers were programmed to output the same NMEA 0183 sentences - GGA for position and VTG for course and speed. However the plot room (GPS #1) messages were recorded once per second by SCS in support of the ADCP measurements, and the bridge (GPS #2) messages were recorded once per 30 seconds to save disk storage space. This has the advantage that should GPS #1 fail, SCS could be reprogrammed to record GPS #2 at the higher rate for ADCP use.

However this year the SeaPlot navigation display system was installed and hooked to GPS #2 which was then reprogrammed to output a set of Transit sentences incompatible with ADCP needs. Therefore, should GPS #1 fail, GPS #2 would not be available as a backup for ADCP use. To overcome this we reprogrammed GPS #2 via the Control Port and SCS program SETUP_4200.FOR with configuration file 4200_NAVSOFT_GGA_VTG.CFG to output the GGA and VTG sentences from its Control and Equipment Ports. Then we successfully reconfigured SeaPlot to read these messages. Thus the potential for SCS and the ADCP to rely on GPS #2 should GPS #1 fail, was restored. But for some reason the GPS #2 messages could not be read by SCS. We suspect that the GPS #2 messages were not making it onto the Vax network, perhaps owing to a bad connection. **This needs to be fixed.**

Discrete Sample Data Base: This was the first cruise to use the newly modified FOCI DSDB forms and R:Base PC program application. The forms worked well with an all-encompassing array of data and sampling types to circle, but the R:Base application would not work. Consequently the data forms had to be entered into the data base back at the lab. Table 1 gives a summary of the sampling.

Shipboard Equipment Problems: Three different sorts of equipment failures caused us inconvenience on this cruise.

The steam heating system sprang about three new leaks per day. Although this did not lead directly to lost sampling time on this cruise, it kept the engineers so busy that their capacity to deal with repairs to scientifically important gear was reduced.

The CTD wire on the port winch had to be spooled off and reterminated at the winch end twice in Kodiak to locate and fix an open circuit. This put the Chief Survey Tech. behind in his tasks, and as a result we were not as prepared for some of the biological sampling as we could have been.

The port CTD winch hydraulic motor was replaced near the beginning of the cruise owing to excessive noise and vibration. On the next CTD cast the replacement motor would not work at all. The CTD was moved to the starboard winch which worked better than in the recent past. (Its controls are still touchy, and the winch operator cannot see the spool turning.) After the port winch had been fixed we moved the CTD back to there. Unfortunately the seaward CTD termination leaked due to a slight nick in the wire insulation that showed up as the CTD was lowered under pressure. We had to abandon the station because a storm was upon us, and there was not time to reterminate the wire and resume the cast. Thus we lost some scientific sampling time. Experiments by the Chief Scientist and Electronics Technician revealed how difficult it is to strip several feet of firmly bonded, black, polypropylene shielding from the wires. **Perhaps a different brand of wire or a better termination method should be considered.**

TABLE 1. MF-93-03 CRUISE SUMMARY

Physical Oceanography — 25 March - 01 April 1993

Date (JD)	Date (GMT)	Time (GMT)	Sta. No.	FOCI ID	Depth (m)	Latitude	Longitude	Comments
084	25-Mar	2300				57° 43.8' N	152° 30.7' W	Depart Kodiak
086	27-Mar	0900			91	54° 59.1' N	160° 34.0' W	Start hydrotrack
086	27-Mar	1300			138	54° 34.5' N	161° 46.2' W	End hydrotrack
087	28-Mar	0645	001	ADCP1	848	53° 45.1' N	167° 31.1' W	Begin ADCP transect
087	28-Mar	1314	002	ADCP1	2284	54° 51.9' N	168° 38.0' W	End ADCP transect
088	29-Mar	0229	003	PEGGY93	2131	54° 47.4' N	168° 31.2' W	Deployed PEGGY93
088	29-Mar	0854	003	PEGGY93	2132	54° 47.4' N	168° 32.3' W	Re-deployed PEGGY93
088	29-Mar	1109	004	CTD001	2123	54° 46.6' N	168° 30.1' W	CTD
088	29-Mar	1241	004	CTD002	2140	54° 46.7' N	168° 30.3' W	CTD
088	29-Mar	1422	004	CTD003	2148	54° 46.5' N	168° 30.5' W	CTD
088	29-Mar	1552	004	CTD004	2126	54° 47.0' N	168° 30.3' W	CTD
088	29-Mar	1743	004	CTD005	2128	54° 46.7' N	168° 29.5' W	CTD
088	29-Mar	1901	004	CTD006	2123	54° 47.0' N	168° 29.9' W	CTD
088	29-Mar	2020	004	CTD007	2106	54° 46.6' N	168° 29.7' W	CTD
088	29-Mar	2134	004	CTD008	2082	54° 46.1' N	168° 29.1' W	CTD
088	29-Mar	2249	004	CTD009	2106	54° 46.4' N	168° 30.6' W	CTD
089	30-Mar	0020	004	CTD010	2092	54° 46.4' N	168° 29.5' W	CTD
089	30-Mar	0141	004	CTD011	2129	54° 47.0' N	168° 30.6' W	CTD
089	30-Mar	0504	005	PEGGY93	2150	54° 47.5' N	168° 36.0' W	Deployed PEGGY93 subsurface
089	30-Mar	0700			2073	54° 44.7' N	168° 33.3' W	Tucker Trawl test
089	30-Mar	1155	006	Tuck1	2127	54° 47.1' N	168° 28.6' W	Tucker
089	30-Mar	1441	006	Tuck2	2103	54° 48.3' N	168° 28.4' W	Tucker
089	30-Mar	1720	006	CTD012	2121	54° 47.4' N	168° 30.7' W	CTD
089	30-Mar	1826	006		2120	54° 47.4' N	168° 30.7' W	Broke off ops (storm warning)
090	31-Mar	1935	007	CTD013	850	53° 44.9' N	167° 30.7' W	CTD
090	31-Mar	2253	008	CTD014	1640	54° 05.9' N	167° 52.7' W	CTD
091	1-Apr	0234	009	CTD015	1351	54° 27.5' N	168° 14.0' W	CTD
091	1-Apr	0614	010	CTD016	2183	54° 48.8' N	168° 36.5' W	CTD
091	1-Apr	0745	011	CTD017	2131	54° 47.4' N	168° 31.1' W	CTD
091	1-Apr	1325	012	ADCP2	1389	54° 15.8' N	167° 07.6' W	Begin ADCP Backtrack-L
091	1-Apr	1503	012	ADCP2	1497	54° 13.7' N	167° 07.9' W	End ADCP Backtrack-L
091	1-Apr							Arrive Dutch Harbor

Appendix

How to Define a New Unit of Depth on the JRC ColorScope
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The MILLER FREEMAN's echosounder uses a JRC Model JFV-200 ColorScope as a video display unit. The measured depth can be displayed in several different units, i.e. meters, fathoms, feet, hiros (a Japanese depth unit) and a user-definable depth unit. The latter is useful if one wishes to make precise depth measurements and the vertically averaged sound velocity differs from 1500 m/s which the ColorScope assumes when converting acoustic travel time to depth. To utilize this option the user must do 2 things: (1) define the new unit of depth, and (2) select it for display purposes.

1. <u>To define a new unit of depth</u>: Using the keypad behind the door on the lower right front of the unit

Press	Action
#	To select the OPTION menu.
10 ENT	To select INITIAL SET.
->	as needed to move to OPTION.
~~1.0419~~ 1.0149	for example (with an implied decimal point), to define the new depth unit. This number represents the ratio of the speed of sound assumed by the JRC (1500 m/s) to the actual speed of sound desired by the user (1478 m/s, in this example).
ENT	to enter the value.
# ENT	to exit the OPTION menu.

2. <u>To select the new unit of depth for display purposes</u>:

Press	Action
AUX	to toggle on the Auxiliary menu.
->	as needed to move to the DEPTH UNIT menu.
↓	as needed to move to the **:OPTION unit.
AUX	to toggle off the Auxiliary menu.

When selected, the use of the optional unit of depth will be indicated by ** following the numeric value of depth on the bottom left side of the screen. To switch back to meters (assuming a sound velocity of 1500 m/s) follow the directions in item (2) above, but move up the DEPTH UNIT menu to meters.

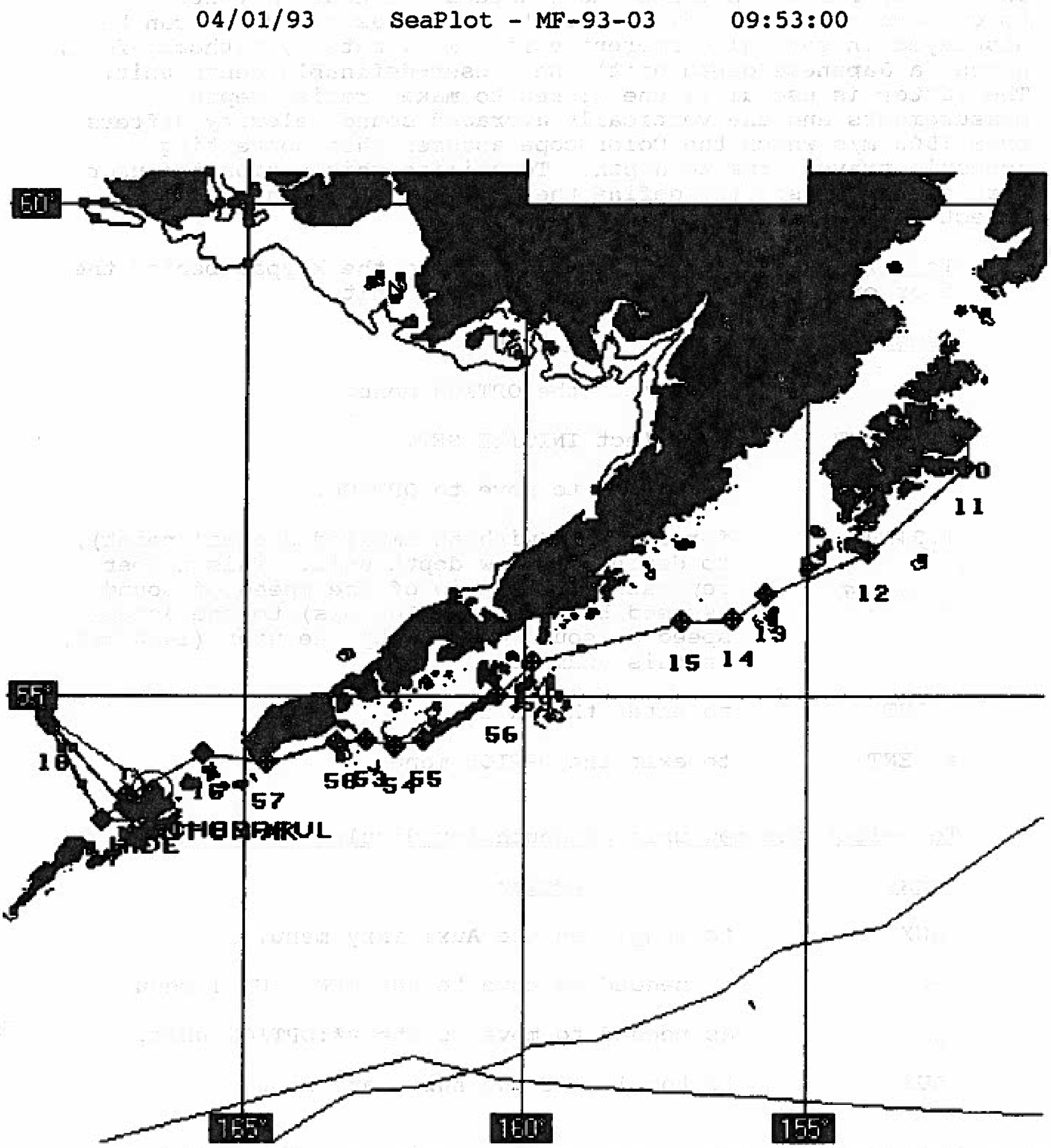

Figure 1. Cruise track for MF-93-03. Annotated numbers represent way points, not station numbers.

Peggy Bering Sea

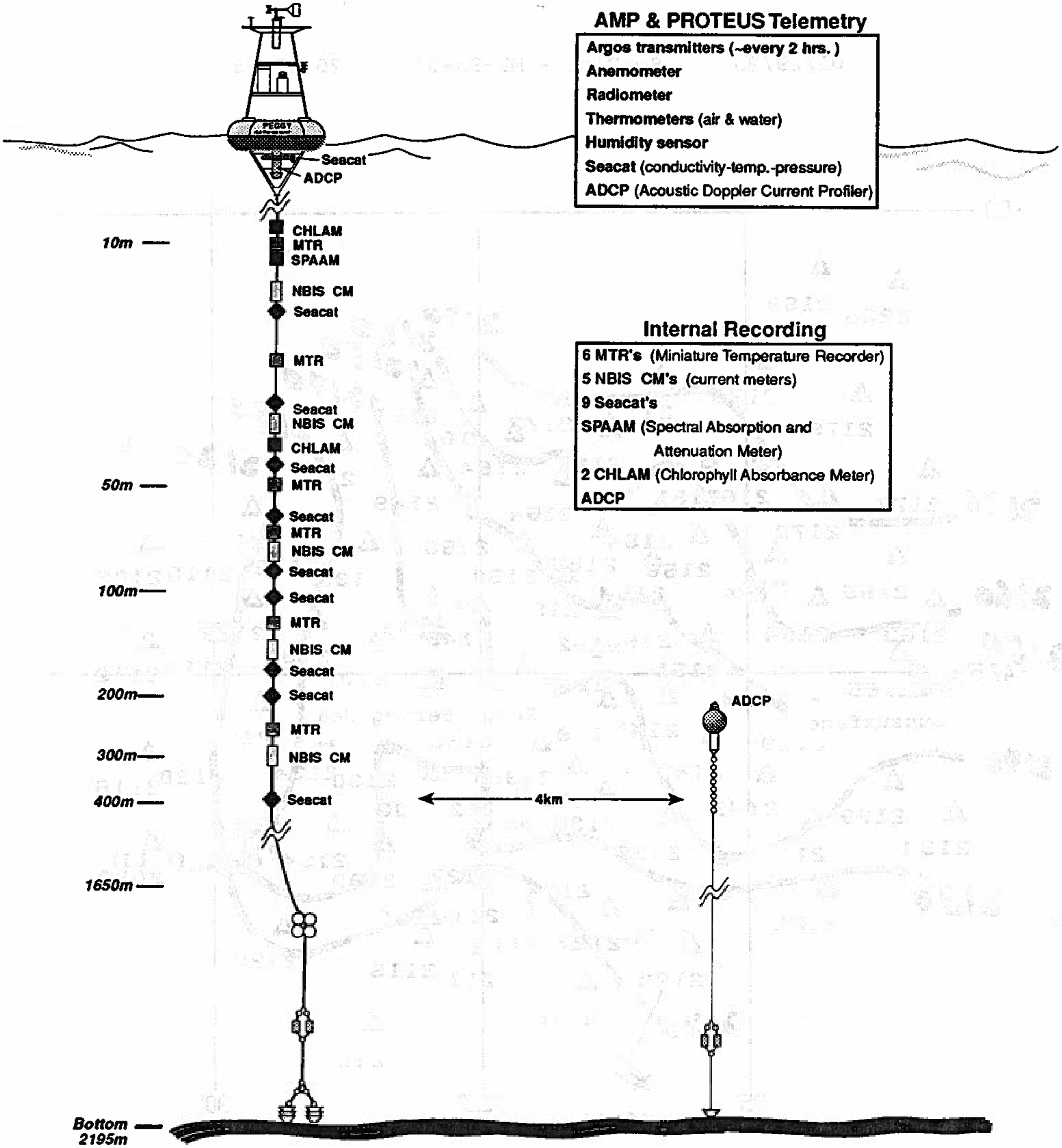

Figure 2. Schematic diagram of Peggy Bering Sea mooring and accompanying subsurface ADCP mooring.

Depth values should be multiplied by $\frac{1.0419}{1.0149} = 1.0266$ due to transposing digits error.

$1.0266 \times 2139 = 2196$ m

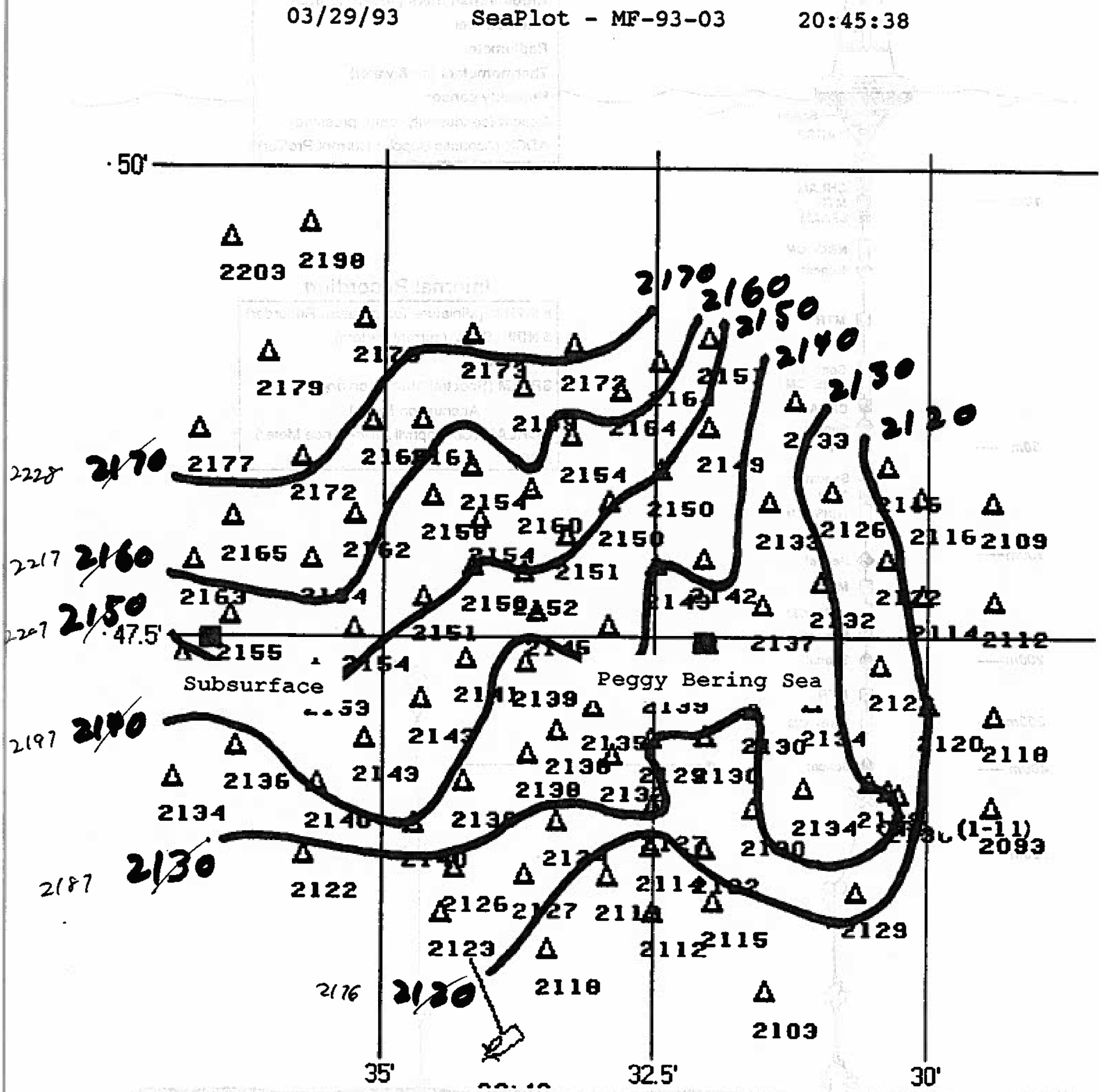

Figure 3. Bottom survey of Peggy Bering Sea mooring site conducted with the 12 kHz echosounder, the JRC ColorScope and the SeaPlot software. Depths in meters.

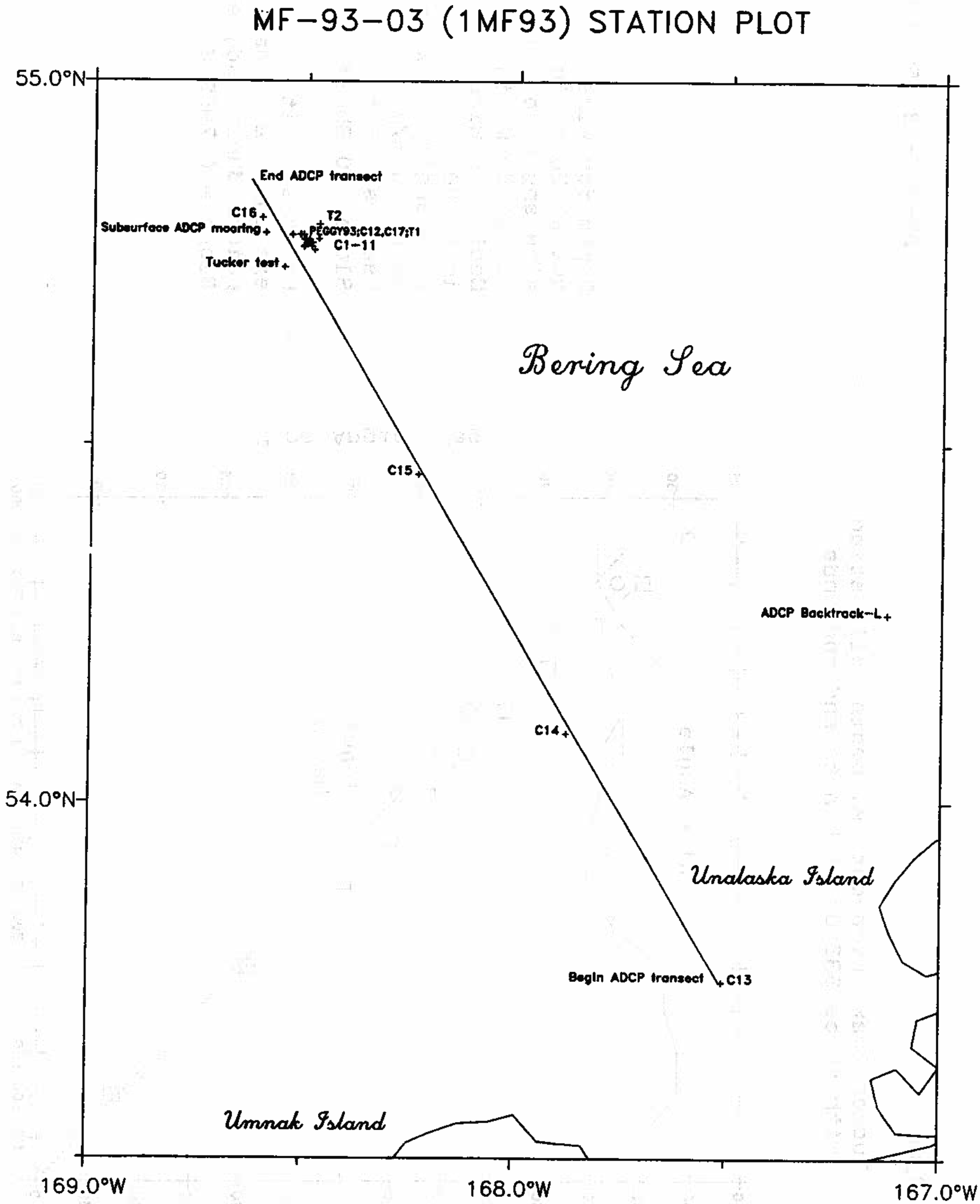

Figure 4. Chart showing locations of the ADCP transect and backtrack-L calibration maneuver, CTD stations (C##), tucker trawls (T#), and the Peggy Bering Sea mooring.

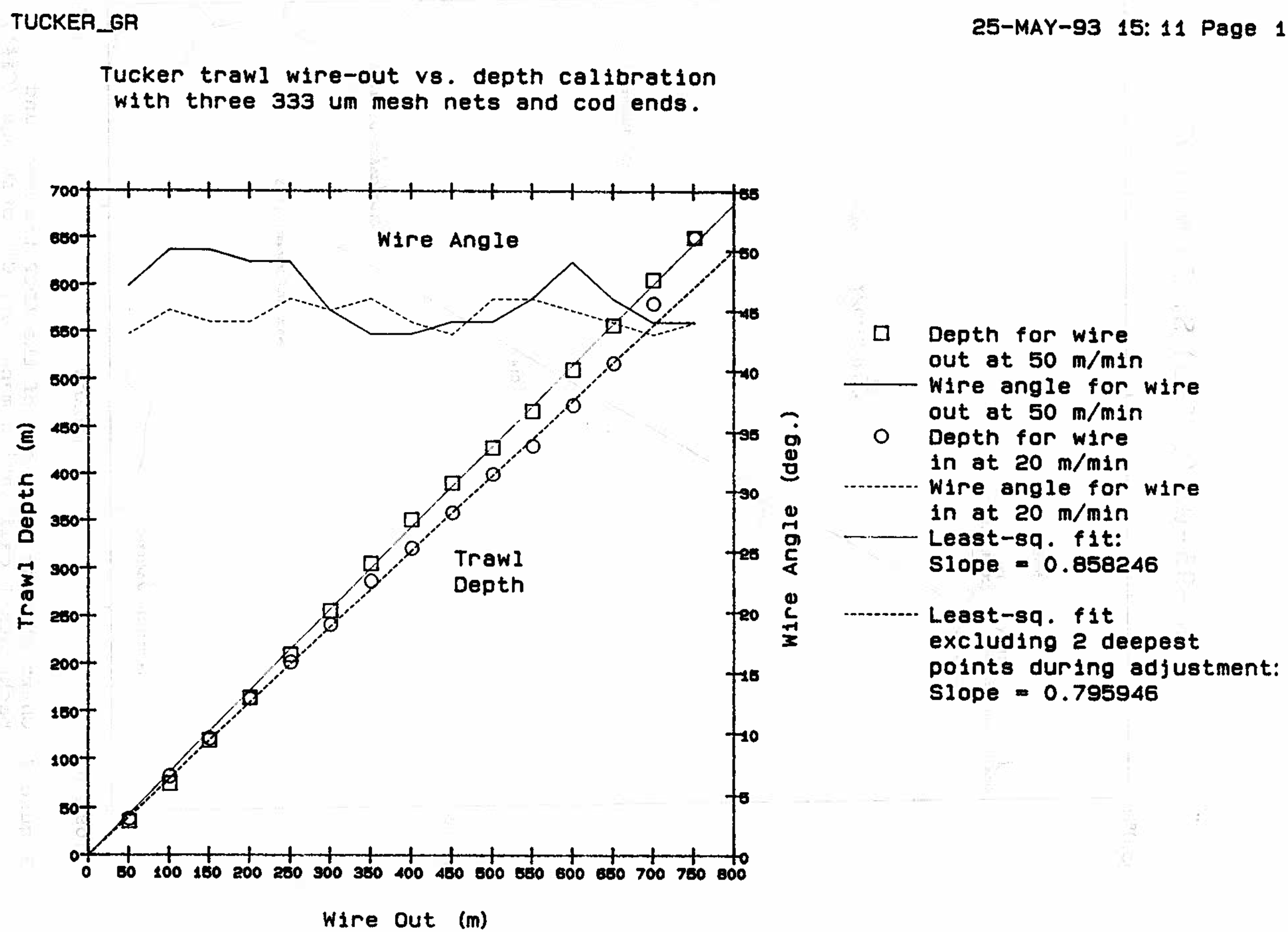

Figure 5. Wire-out vs. depth calibration for Tucker trawl with three 333 µm mesh nets and cod ends.