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CRUISE REPORT

Ship Name: R.V. VEMA

Cruise No: V36-12

Departure: 24 May, 1980 (Date) from Guam (Port)

Arrival: 25 June, 1980 (Date) at Guam (Port)

Days at Sea: 32
(Count day of departure but not day of arrival in port)

Days Foreign Port: 2
(number of days in arrival port before next leg)

Area of Operation:

Northwest Pacific east of Japan (25°-35°N; 150°-165°E, see map).

Program Description: Conduct geological and geophysical surveys of three candidate sites for sub-seabed nuclear waste disposal. The three areas are approximately 1°x1° in size (see maps). Underway data collected included 3.5 kHz echograms, seismic reflection profiles (air gun), sonobuoys, magnetics, and gravity.Station data included piston cores, 4" diameter gravity cores, digital heat flow, and pinger-hydrophone.

Program supported by what contract: DOE SANDIA LABS SL-13-9988

Participants: (All L-DGO unless otherwise specified)

Name	Title
J.E. Damuth	Chief Scientist
R.D. Jacobi	Co-Chief Scientist
R.D. Flood	Acoustic Studies
J.A. Kostecki	Sedimentologist-Core Studies
M.F. Coffin	Core Studies-Heat Flow Studies
W.D.Bolles	Camera/Nephelometer Tech.
D.C. Roach	Heat Flow Tech.
R. Roessler	E.T.
S. Hudson	Res. Asst.
D. Medlicott	Computer Operator
W.J. Robinson	Computer Operator
M. Boleikinaulau	Core Bosun
R.Davies (URI)	E.T.
G. Walker (URI)	Core Studies
C. Lopez (OSU)	Core Studies

All inquiries regarding cruise should be made to the chief scientist.

CRUISE NARRATIVE AND PROGRAM RESULTS

Vema 36-12 departed Guam on 24 May 80 and returned to Guam on 25 June 80 after steaming a total of 5400 miles (Figs. 1 and 2). The purpose of this cruise was to conduct detailed marine geological and geophysical surveys of three 1° x 1° (latitude x longitude) areas of the sea floor that are being evaluated as potential candidate sites for subseabed high-level nuclear waste disposal. The three areas surveyed were (1) C_1 (Fig. 3), 30°15'-31°00'N; 151°15'-152°35'E; (2) B_1 (Fig. 4), 33°-34°N; 151°30'-152°30'E; and E_2 (Fig. 5), 32°05'-32°40'N; 163°15'-165°E. These surveys were conducted according to the program determined during pre-cruise planning sessions by the SSSC (see Final Cruise Prospectus); however time loss caused by fuel constraints and equipment failures forced some planned station work to be cancelled and the underway survey in area B_1 to be somewhat shortened. We had originally planned to average 9.5 kts throughout transits and underway surveys but the great distance between Guam and the survey areas imposed fuel constraints which only permitted and average speed of 8.5 kts. This caused at least 2 days of planned working time to be lost. We also lost at least an additional day due to equipment malfunctions mainly the breakdown of the hydro/STD winch hydraulic system (see details below).

The first area surveyed was area C_1 (30°15'-31°00'N; 151°15'-152°35'E, Fig. 3). The 3.5 kHz echograms from this area revealed that the top 8 to 10 fms of the sea floor are acoustically well-stratified. Within this zone four prominent acoustic reflectors could be continuously traced throughout the area. Penetration beneath this zone was an additional 15-25 fms with the top 5-10 fms semi-stratified and the remaining underlying portion transparent. The base of this transparent zone was marked by a faint, discontinuous sub-bottom below which there was no penetration. The 3.5 kHz echograms also revealed the presence of several small basement outcrops or sediment-covered knolls which rise up to 100 fms above the sea floor and are up to a few miles in diameter. Small, localized mass-wasting deposits (slumps, slides, debris flows) are associated with some of the knolls. Six piston cores and two gravity cores (Fig. 3) were raised and all consisted of brown clay to brown siliceous clay (one core (37, sn 78) recovered only 10 cm of sediment because the come-along on the trigger-arm of the corer slipped down the wire during lowering). Digital heat-flow measurements were made at coring sites (Fig. 3). Preliminary heat-flow values calculated on board ship were 37-40 mW/m^2 and thermal gradients were linear at each station. A hydrophone-pinger station was attempted in this area but the STD winch malfunctioned (see below) when the hydrophone was near the bottom. This prevented wide-angle expanding-spread experiments; however we were able to conduct vertical-incidence experiments. Four sonobuoys were recorded during underway operations.

The second area surveyed was area B_1 (33°-34°N; 151°30-152°30'E, Fig. 4). The 3.5 kHz echograms from this area revealed that the top 10 to 20 fms of sea floor are very well-stratified acoustically. The four prominent acoustic reflectors observed in area C_1 can be traced to this upper zone in B_1 where they are observed throughout much of the survey area but are separated by thicker sediments which return additional reflectors. THis thicker section suggests a higher sedimentation rate (productivity) for B_1 than for C_1. Below this upper highly reflective zone, 10-15 fms of semi-stratified to semi-transparent sediments are observed. The entire area is smooth to gently rolling. Strong surface currents of 0.5 to >2 kts were encountered throughout much of the area. These currents generally set from southeast to southwest, seem to be time variable, and are apparently eddies along the southern edge of the Kuroshio/North Pacific Current. Due to time constraints (see below) we had to somewhat shorten the underway survey and station work planned for this area. Only 4 piston cores and one gravity core were attempted and one of the piston cores (40) recovered only 10 cm of sediment because again the come-along on the trigger arm allowed the corer to slip down the wire during lowering. The sediments of this area consist of alternating brown and gray siliceous clays. Heat flow values range from 36 to 48 mW/m^2 and thermal gradients appear to be linear. Four sonobuoys were also recorded from area B_1.

The third area surveyed was area E_2 (32°05'-32°40'N; 163°15'-165°E. Fig.5). The 3.5 kHz echograms from this area revealed that the top 10 fms of seafloor are acoustically well-stratified. This zone is underlain by a transparent zone approximately 20 fm thick. The base of this zone is marked by a very strong, continuous reflector below which there is no penetration. This reflector is presumed to be a chert layer (Ross Heath, personal communication). The entire region is smooth to very gently rolling with only a few sediment-covered knolls of less than 50 fm relief. Three very small (1 mile) mass-wasting deposits were observed. Six piston cores and two gravity cores were recovered and all consisted of homogeneous brown (red) clay. Five heat-flow measurements ranged from 38 to 42 mW/m^2 and showed linear thermal gradients. Six sonobuoys were recorded from the area; three of these were recorded using the large-volume air guns. The large-volume air guns were utilized along the center east-west profile across the area in order to identify the depth of acoustic basement.

Based on our preliminary shipboard interpretation of the data, all three sites seem to qualify as potential candidate sites for subseabed waste disposal and should be studied in more detail. Potential negative aspects of each area are as follows: (C_1) several small basement knolls and mass-wasting deposits; (B_1) apparent high biological productivity and strong, variable surface currents; and (E_2) dense chert (?) layer at 25-30 fms below sea-floor.

During the transit back to Guam, we passed over area D_1 (Fig. 1), an alternate candidate site. This area has gently rolling topography with some gentle hills. The 3.5 kHz echograms showed that the upper 20-40 fm of sediments are generally transparent. The base of this zone is marked by an irregular, undulating, strong reflector which is only semi-conformable to the sea floor.

During the cruise the entire scientific crew carried out their duties cheerfully, diligently and with great competence. We are grateful to Capt. Peter Cunningham and his entire ship's crew (especially the coring crew) for their cooperation, advice, and help in achieving our scientific objectives.

EQUIPMENT REPORT

In addition to the loss of working time due to time constraints imposed by fuel limitations, equipment faulures caused the loss of at least an additional day of working time and also prevented us from conducting two important station programs which were originally scheduled, ie. camera/nephelometer and near-bottom pinger-hydrophone experiments. The following paragraphs explain these problems in more detail.

Precision depth recorders and UGRs. Of the 5 recorders (3 UGR's and 2 PDR's) on board none worked consistently or well at the beginning of the cruise. The PDR recorders worked marginally at first and kept breaking down. One unit finally worked consistently but gave only mediocre records and so was used throughout the cruise as a back-up PDR. The two UGR units were used as the primary 3.5 kHz recorders but during the first few days of the cruise they had problems also, especially the programming modules, and required much repair time and switching back and forth from one recorder to another. After the first few days, however, one recorded consistently, gave excellent to good 3.5 kHz records throughout most of the cruise. The 12 kHz transceiver doesn't work well and was useless to us.

Seismic profilers: The two recorders generally worked well; however, the mechanical linkage in each recorder is about worn out. The logic module in B recorder doesn't work. The air gun worked well throughout the entire cruise. The large-volume air guns were used for approximately 18 hrs. and worked well. Of 5 eel sections on board, only one worked. The only cable aboard has at least two breaks and hence the eel had to be towed short (about 350'). This shorter cable caused very noisy records on the lower frequency (<50) filter settings. The higher-frequency settings produced generally good records most of the time.

Magnetometer. The cable is too short (approximately 250' long). This results in large errors in north-south vs. east-west tracks.

Gravimeter: This system worked well.

Real-time data acquisition system: Generally worked well.

SATNAV: The unit on the bridge worked well. THe back-up unit in the upper lab gives erroneous messages.

Loran-C: This unit worked well.

Core Winch: This unit generally worked well except during the first station the water brake malfunctioned and had to be replaced. For the next two or three stations,the new brake didn't work well at high speeds, but this was finally adjusted and afterwards the winch worked normally. There were also some problems with the counter for a few stations. All of these problems generally caused the loss of several hours of working time.

Piston Corer: Two-pipe cores were taken throughout the cruise. All but three of the cores were taken in plastic liners. Two cores failed because the come-along on the trigger arm didn't hold the wire tight so that the corehead slipped down the wire to the piston during descent. The come-along was changed and the problem did not recur.

HYDROWINCH/STD WINCH: During our first lowering of the STD winch the main hydraulic pump failed with 3200 fm of wire out. The winch could neither be lowered nor raised. The hydraulic system could not be repaired and after the better part of a day, the main hydraulic system of the ship was hooked up to the winch and the wire retrieved. In the process, however, the wire was broken at about 3200 fms and was not level-wound onto the reel. In addition to the winch hydraulic system, the Jordan control unit also failed. Attempts to repair the hydraulic system of the winch met with failure and thus the STD and Hydrowinches could not be used throughout the remainder of the cruise. This prevented us from taking any camera/ nephelometer stations and any further pinger-hydrophone stations. Details on these problems have been sent to the L-DGO Marine office.

Camera/Nephelometer. At the first station, we were going to deploy the camera, but when tested on board the strobe wouldn't flash so the camera was not tried that station. At the second station (a pinger-hydrophone station) the hydro/STD winch hydraulic unit malfunctioned (see above) and the winch was inoperative throughout the rest of the cruise. Hence we had no further opportunities to deploy the camera.

Pinger-hydrophone experiment and 3.5 kHz pingers:

During the first deployment of the pinger-hydrophone the STD winch malfunctioned (see above) when the hydrophone was about 10 fms above the bottom. Vertical incidence data were recorded for approximately 1 hr, then a transistor failed in the pinger. We then rhcorded pings from the surface 3.5 Hz pinger for the next four hours until the hydrophone failed due to dragging on the bottom. No other pinger-hydrophone stations could be taken during the cruise because of the inoperative hydro/std winch. The 3.5 kHz pingers were used on the core wire during each core station. Both Datadyne 3.5 kHz pingers developed a problem with continued lowering. The PVC plate on each transducer leaked oil. These pingers must be returned to the factory for repair and/or redesign.

Digital Heat-Flow: This unit worked well throughout the cruise. However, the ship-board 12 kHz transceiver which records the telemetered heat-flow data from the sea-floor worked only moderately well.

URI Mini-sparker. This unit arrived in damaged condition. The unit was repaired and appeared to be operative; however, the sparker unit repeatedly tripped the 30 amp circuit breaker on the ship's electrical line. The cause of this was uncertain and the Captain was reluctant to install a larger circuit breaker. Thus the mini-sparker could not be utilized during the cruise (contact Rod Davies at URI for details).

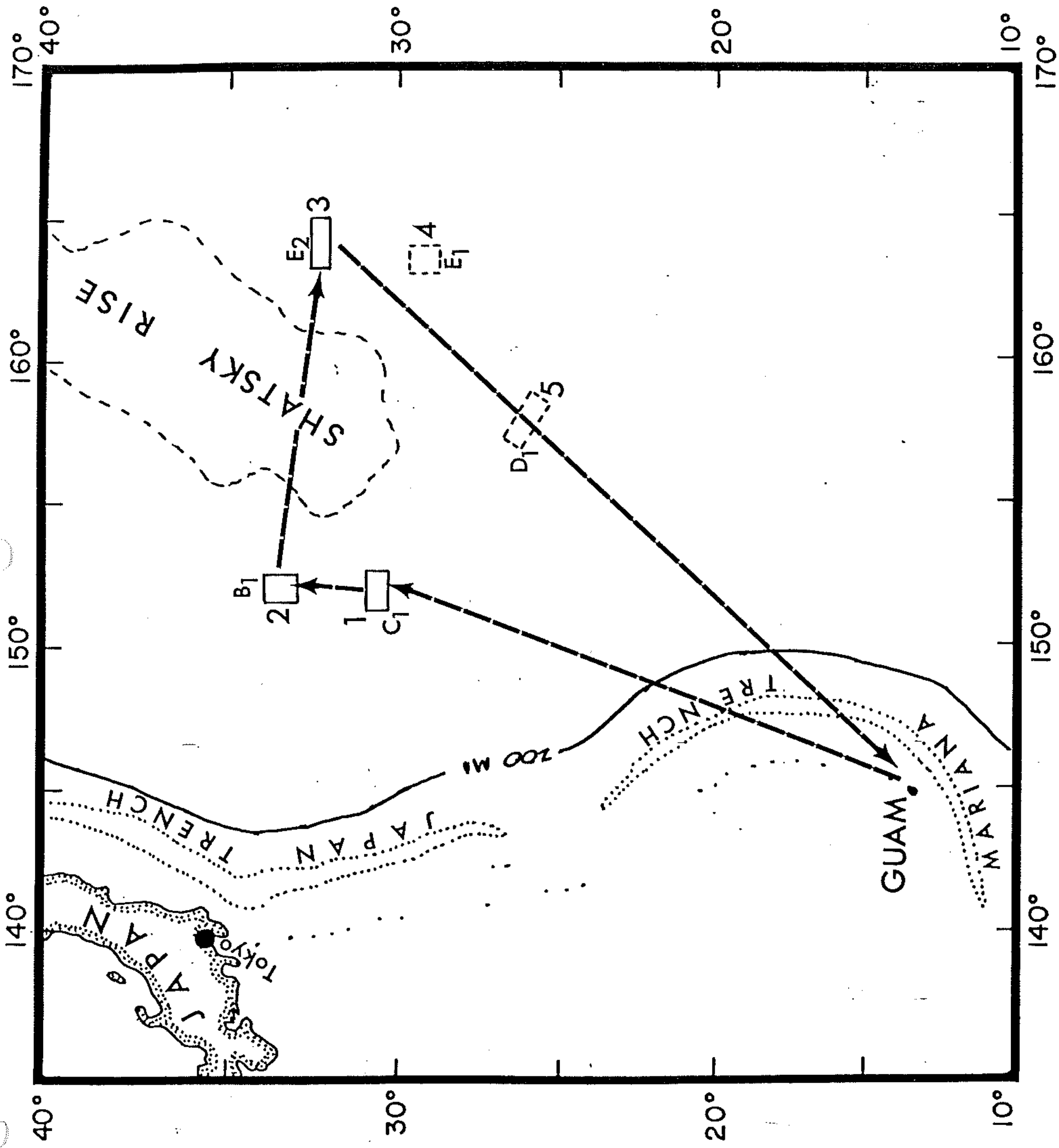

FIG. 1. PROPOSED CRUISE TRACK FOR V36-12

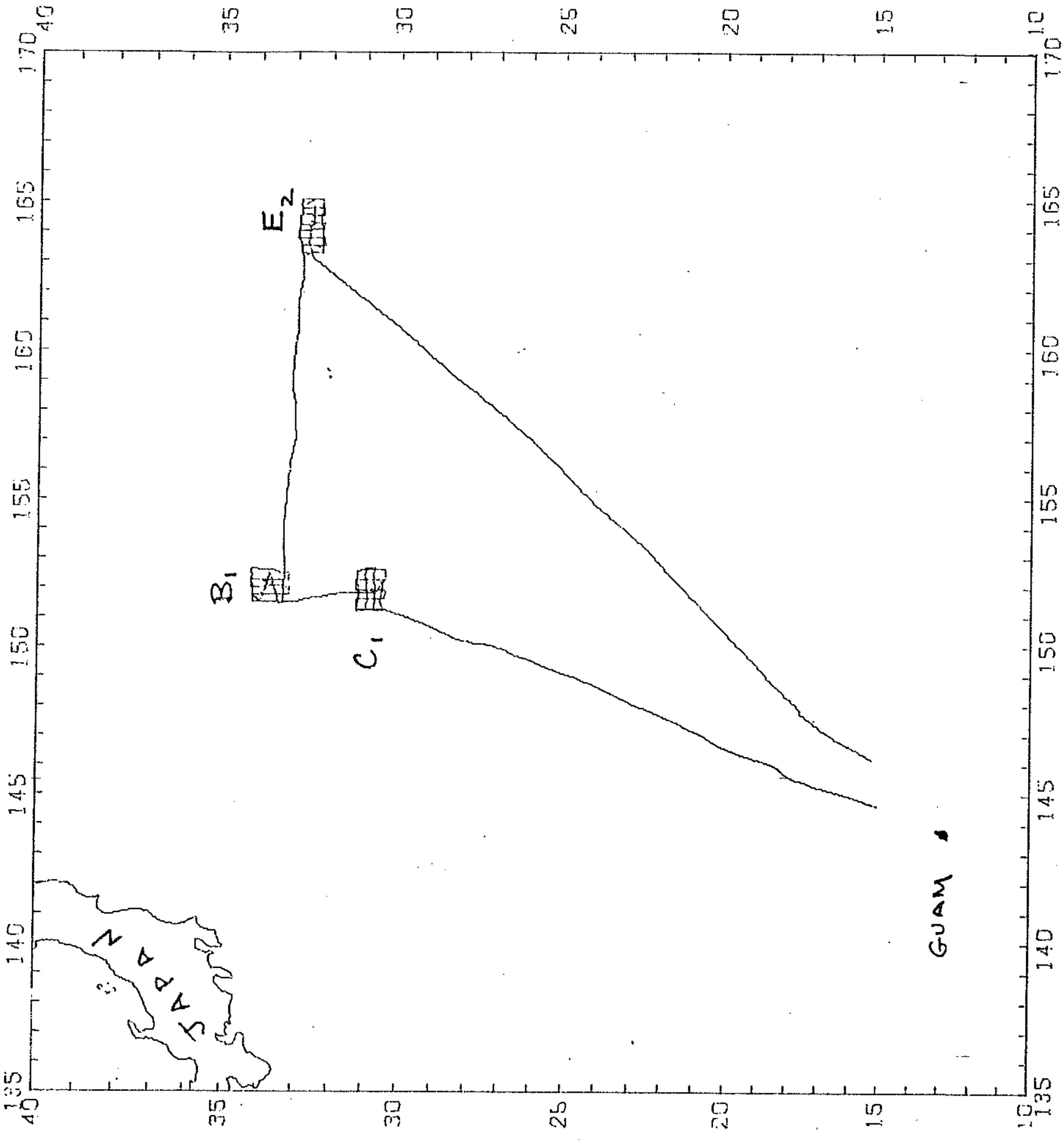

FIG. 2. COMPUTER PLOT OF ACTUAL SHIP TRACK FOR V36-12.

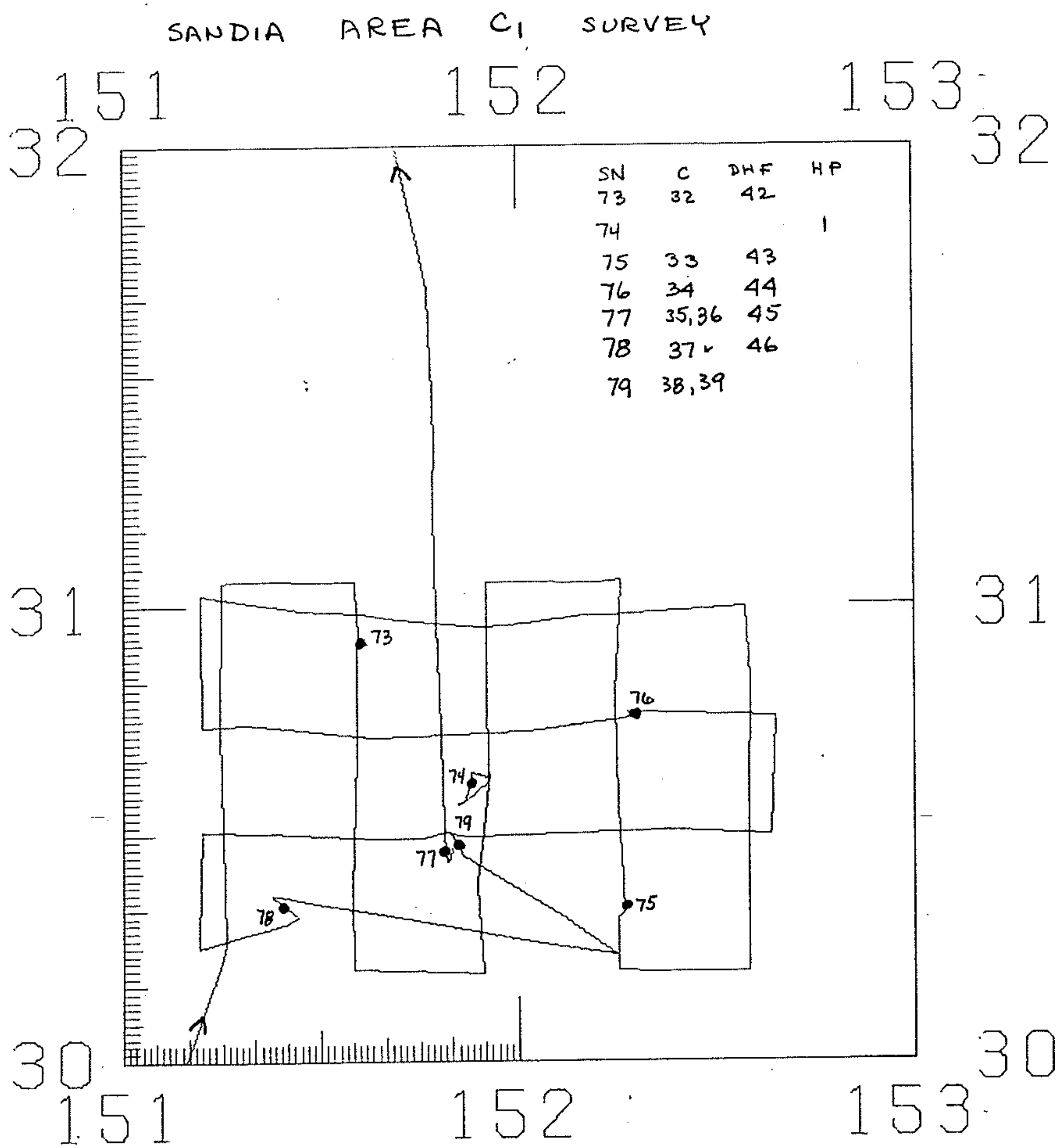

FIG. 3. COMPUTER PLOT OF SHIP TRACK FOR SURVEY OF AREA C_1. DOTS SHOW STATION LOCATIONS; TABLE SHOWS DATA COLLECTED AT EACH STATION.

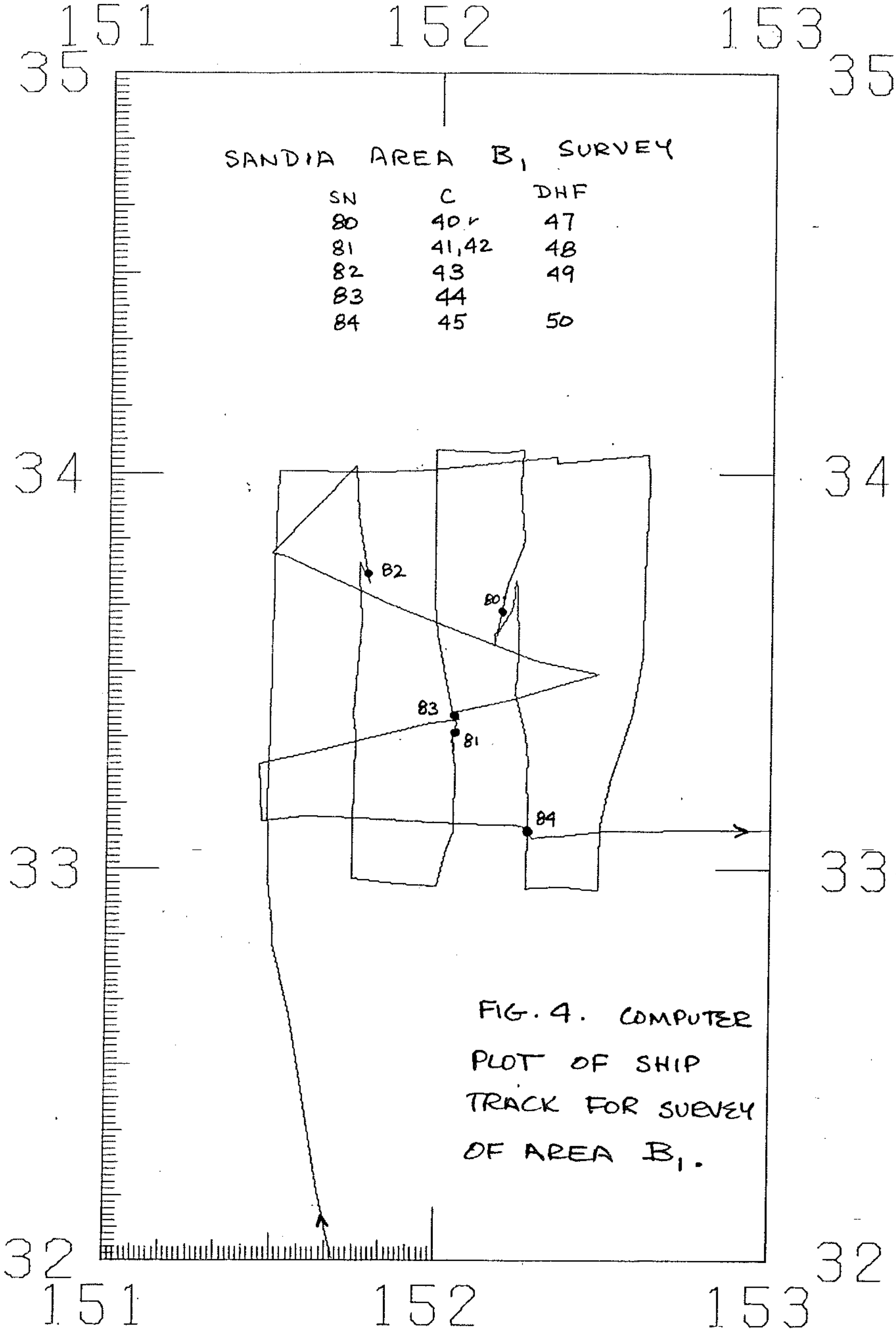

FIG. 4. COMPUTER PLOT OF SHIP TRACK FOR SUEVEY OF AREA B_1.

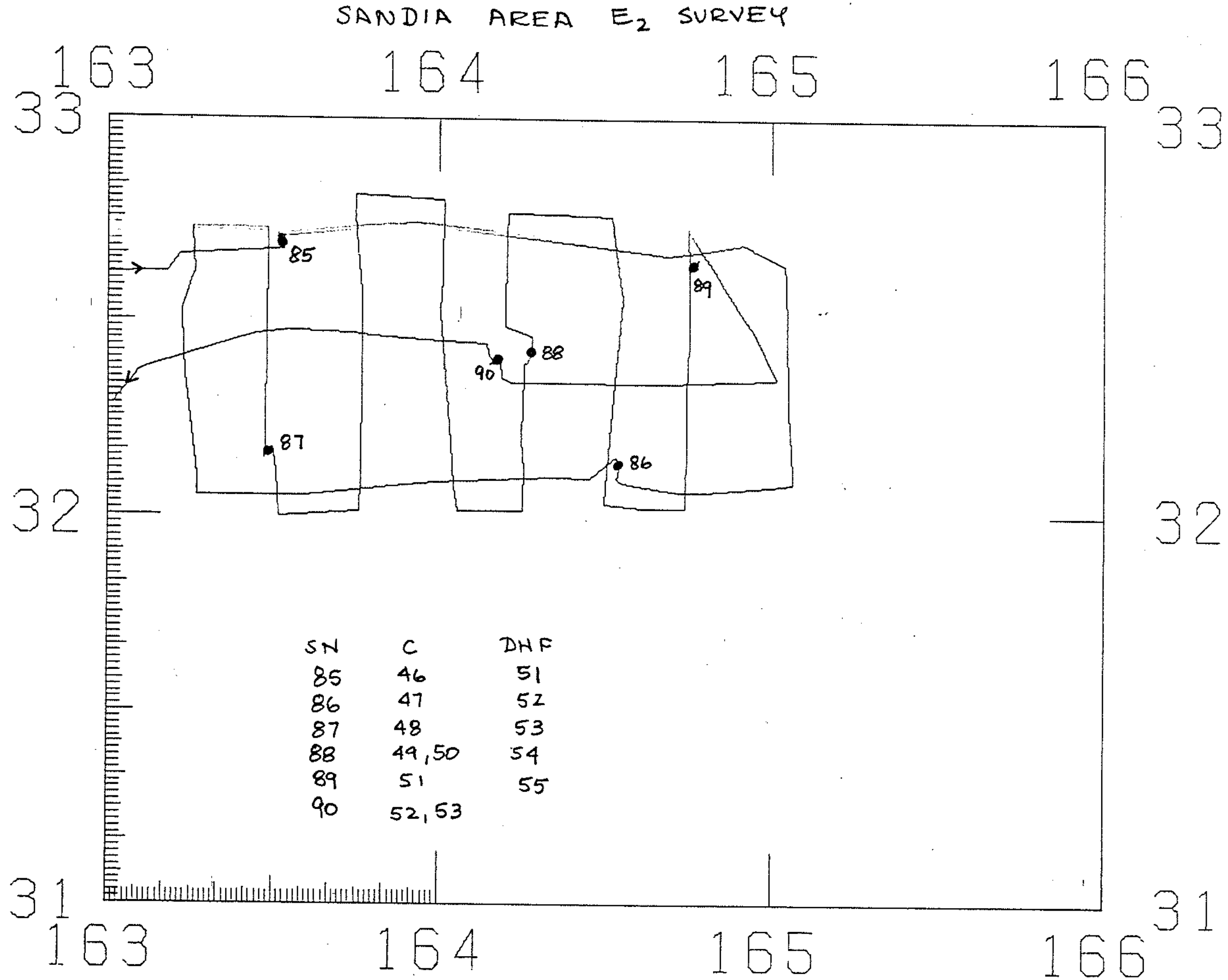

FIGURE 5. COMPUTER PLOT OF SHIP TRACK FOR SURVEY OF AREA E_2