

IOS CRUISE REPORT

FARNELLA 87-5

BLAKE ESCARPMENT

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BAHAMAS

MAY 10-27, 1987

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*Dillon*

FARNELLA EEZ SCAN

USGS/IOS/RVS

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Blake Escarpment and Outer Ridge

FARNELLA CRUISE 5/1987

R.V. Farnella  
Leg 5/87  
Norfolk to Nassau



KS PV CF BD MB GL DB  
DJ  
LS EW CD QH

Contents:

	page no.
1) Itinerary	2
2) Cruise participants	3
3) Cruise Objectives	4
4) Narrative	4
5) Equipment reports	9
6) Results	11

1) Itinerary

--- NOTE: ALL TIMES ARE LOCAL (LOCAL = GMT-4 hrs)---

Sailed Norfolk	1600hrs 9 May (day 130) 1987
Started survey	1540hrs 10 May (day 131) 1987
Completed survey	1600hrs 27 May (day 147) 1987
Arrived Nassau (Bahamas)	0800hrs 28 May (day 148) 1987

2) Cruise participants

USGS personel:

Boyle	Mike	Technician
Diaz	Renato	Geologist
Dillon	Bill	Co-Chief scientist
Scanlon	Kathy	Co-Chief scientist
Sheetz	Linda	Geologist
Valentine	Paul	Geologist

IOS personnel:

Bishop	Derek	Gloria
Flewellen	Chris	Gloria
Huggett	Quentin	Co-Chief scientist
Jones	Daniel	Computing
Lake	Graham	Technician
Woodward	Emma	Geologist

### 3) Cruise objectives

This cruise was part of a joint United States Geological Survey (USGS) / Institute of Oceanographic Sciences (IOS) program to survey the United States Exclusive Economic Zone (EEZ). In this, the fourth year of the program, the survey has concentrated upon the U.S. East coast.

For this cruise, the area to be surveyed was in the region of the Blake Plateau off Florida and Georgia. Approximately 60 hours of survey were required to complete the survey planned for the previous leg (Farn 4/87) which was carried out before moving onto the Blake Plateau. The activities of this cruise hinged around the Gloria sidescan system and the production of a sonograph mosaic. Supplementary data were collected using 10kHz and 3.5kHz echo sounders, seismic reflection profiler (SRP), magnetometer and XBT.

### 4) Cruise narrative.

---NOTE: ALL TIMES ARE LOCAL (LOCAL = GMT-4 hrs)---

9 May 1987 (day 130) Saturday

Spares for the 3.5 kHz fish were delivered at Norfolk and before departure Chris Fleweller and Snake replaced a harness, tow cable, and bulkhead plug. While we were in port the megapulse Loran C receiver was redirected to receive the southern network of stations. The northstar receiver was left locked onto the northern network. We sailed at 1600 amidst a fanfare of people on the dockside. The weather was exceptionally good and we made 15 knots through the water (12 knots groundspeed).

We headed directly for our first launch point without collecting data in transit. The first launch point was planned for a short (60' hour) fill-in survey, to complete the area planned for the previous leg. We shall number the lines continuing from the previous leg, so that the first line will be line 12.

10 May 1987 (day 130) Sunday

The gear was launched in fine weather at 1440 after which we turned onto course 056 to start logging data. At 1540 we were steady on line and began logging data. At 1550 a compressor change was forced by a low pressure warning. The compressor had overheated but Snake had it fixed and once it cooled down it was ready for use again. We found a drawer full of drawers, was Nancy the donor?

The Gloria records showed the same "line dropout" artifact reported on the previous leg. In order to prevent confusion we shall call them minads (minus one side, added to the

other). As on the previous leg we suspect that they are caused by the yaw filter. They always take the form minus the port side added to the starboard side. Unfortunately we don't have Leg 4 Gloria LSR records so we can't confirm the previous claim that they have occurred with the yaw filter both on and off. Propagation is good and we are getting almost 10NM per side.

11 May 1987 (day 131) Monday

As the two Lorán C receivers were directed at different transmitters the discrepancy between them was considerable. The ship was being steered by Northstar, and owing to jumps in the system navigation was becoming increasingly difficult. At 2000 ship's navigation was switched to Megapulse, as, when we compared both systems to the transit satellites Megapulse appeared to be the most reliable. At 2110 Northstar was redirected onto the Southern chain so now the only navigational discrepancies we get will be from the different algorithms used by the systems rather than errors on the networks.

12 May 1987 (day 132) Tuesday

The first prints for the mosaic were produced this morning. Two problems seem to be affecting the Gloria records, biological interference and signal loss on the starboard side. We seem to be getting considerable biological interference at night. The end of line 12 and the whole of the tie line 12b were obliterated by biological interference. There is nothing we can do about this except thank our lucky stars that we are on the tie lines at night. The biological degradation of the records in mid track would spoil the survey.

The problem of signal loss on the starboard side was something that attracted a lot of attention. Steve Williams reported that they had had similar problems on leg 3 of this survey and to compensate they had raised the starboard attenuator on the Gloria consol to 18dB (from the 12dB on the port side). The seafloor we encountered on the first days of this leg accentuated the starboard signal loss as it appeared that backscattering was generally low (ie near threshold for the photographic process). Derek compared the signal levels from the six sections at the outputs of the TVG units and the beam steering unit mixers and port and starboard matched. The outputs of the summing amplifier in the beam steering units did not match however. The starboard output was 8dB down on the port side. It was decided to tackle the problem during the tie line 14B which we started at 2246. Derek removed the summing amplifier from the beam steering unit and changed some of the

resistors with startling result. We were then able to match the attenuators on the Gloria consol to 12dB each after which the port and starboard signals were well matched and the records once again balanced. Gloria was up and running again by 2307. At the end of line 14 (2346) ship's navigation was switched to Northstar.

13 May 1987 (day 133) Wednesday

Excellent weather and everything went well with no problems.

14 May 1987 (day 134) Thursday

Weather still excellent everything hunkydory.

15 May 1987 (day 135) Friday

At 0700 we were on tie line 18B and a routine gun change was carried out. The new gun was in the water by 0730 and immediately interference appeared on the starboard Gloria channel. The interference occurred as a short streak in phase with the gun firing. At this stage the recently recovered gun needed a full service so this was swiftly undertaken with the "rogue gun" still deployed. We hoped that while the service was in progress the rogue gun would quieten down, it didnt! At 1146 we tried shortening the towing bundle and increasing the line pressure, to no avail. So we brought the gun in at 1300 and replaced it with the gun that we had just serviced. The interference disappeared, however we could find nothing obviously wrong with the rogue gun. It has been serviced and we will try it again at the next routine change. Apart from the gun the day was problem free and survey going well in excellent weather.

16 May 1987 (day 136) Saturday

Today we were running along the Blake escarpment, a feature which caused the Gloria correlator to overload. To prevent this from happening we reduced the RX filter gain to 6dB on the port (escarpment) side at 0825. At the end of the line we returned the gain back to normal (at 1536). The weather is still superb and the survey going extremely well. At 2037 the yaw filter program latched onto 000deg and Derek had to reset the system (using run-P) to get the compass onto the correct heading.

17 May 1987 (day 137) Sunday

Whenever we switch the yaw filter on we still get the minad

dropouts. The problem seems to be worse on a heading of 000deg, could it be related to yesterdays program failure? Derek has relabelled the yaw filter switch so that on means on!

Now that we are up on the Blake Plateau our range has been cut to 4NM per side. We don't seem to be getting much bad water column interference so I suppose we have something to be thankful for!

18 May 1987 (day 138) Monday

Survey going well in fine weather. The range that we are achieving is now less than 4NM and we are considering hauling the airgun and hydrophone so that we can go faster. Bill Dillon already has extensive airgun coverage over this area so our own records are not vitally important.

19 May 1987 (day 139) Tuesday

At 1400 we reached the end of line 22 and at 1520 we hauled in the airgun and hydrophone and increased speed to 10.5 knots through the water. We are keeping a careful eye on the sea state and vehicle depth (which is steady at 42M at 10.5 knots) and will reduce speed if the sea picks up or vehicle comes above 40M. The weather is perfect and sea flat.

20 May 1987 (day 140) Wednesday

This really is "mowing the lawn" (Bill's expression) the range is down to 3NM in places and our tracks only 6NM apart. The weather is still fantastic and seas flat calm. The U.S. Navy have asked us to vacate the area on 25 May and work to the south. Bearing in mind the short range we are getting here I won't lose any sleep over being asked to move! We have decided to spend the last few survey days working at the southern end of the Blake escarpment.

21 May 1987 (day 141) Thursday

It rained today! There was a bit of a squall at lunchtime and the wind got up to 15 knots! The tracklines are still down to 6NM apart, though there appears to be a slight improvement and tomorrow we may be able to add another mile on.

The Yaw filter program crashed again at 1900 and had to be reset (using run-P).

The U.S. Navy happened by at about 2110 and caused interference on Gloria which consisted of pulses approximately 2sec long. Fortunately they went away before any image deterioration was caused.

22 May 1987 (day 142) Friday

The survey went well today with no problems. We decided that owing to the restrictions imposed upon us by the U.S. Navy, we shall continue surveying the Southern end of the Blake escarpment on the way into Nassau.

At this, the western end of the survey, we are experiencing some interesting Gulf Stream effects. From the bridge you can see areas of the sea surface that are choppy and confused. When the ship steams through them we have temporary steering problems as we give the ship a different set to counteract the current. On Gloria these patches seem to coincide with increased noise in the far ranges.

23 May 1987 (day 143) Saturday

Survey going well and still at 10 knots without airguns deployed. The seas have picked up a bit but not enough to affect the survey, the sun shone!

24 May 1987 (day 144) Sunday

Survey still going well. At 2000 we finished the westernmost line of the survey and headed east to pick up where we left the Blake escarpment. Tomorrow we must get south of 28 deg. North before deploying the airguns or Uncle Sam will get upset.

25 May 1987 (day 145) Monday

The weather has got slightly worse, but bronzing and surveying remain unaffected. At 2000 we reached 28 deg N and deployed the airguns ready to conduct the rest of the survey out of range of the U.S. Navy. There is considerable "military" noise on the airgun records but not enough to wreck them. The noise takes the form of streaks across the records consisting of dots and covering about 4 seconds of record at a time.

26 May 1987 (day 146) Tuesday

The Navy is a bit quieter today and the airgun records a lot clearer. The survey is still going well however the seas have built up a bit today, fortunately we are on rolling courses so there are no problems.

At 1142 and 1625 the yaw filter program had to be reset again, we didn't get many minad dropouts though.

At 1853 we had to recover the airgun because of an air leak in the hose. By 2100 the problem fixed and we were airgunning once again.

27 May 1987 (day 147) Wednesday

At 0046 the gain on the STBD Gloria RX filter had to be reduced to 6dB as the escarpment was overloading the correlator with signal. It was returned to 12dB at 0214. At 0717 the STBD gain was again reduced to 6dB and at 0744 it was reduced to 0dB the signals were so strong. At 0832 the STBD gain was increased to 6dB and at 0900 the PORT to 6dB, both filters were left at these settings until the end of the survey.

At 1600 we finished the surveying and Gloria and the rest of the gear were recovered by 1645. Derek had a minor heart attack during recovery because the solenoid operating the high/low ratio shift in hydraulic power got stuck and it took a couple of attempts before Gloria could be recovered. When the 3.5 kHz fish was recovered its cable was found to be wrecked (the armouring was torn right through) and so repairs were done in the evening, another new cable will be needed for the spares kit. Frantic packing commenced as we watched the Bahamas by night.

28 May 1987 (day 148) Thursday

We docked at 0730 and prepared for the now customary dignified invasion.

#### 5) Equipment Reports

GLORIA: Gloria was in the water for a total of 16 days 2 hours and 20 minutes, in that time 39925 sq.NM. of seafloor were insonified.

We had good propagation in the deep water areas with ranges of up to 12 NM, on the Blake plateau, however, the range was cut down to only 3 NM owing to water depth.

Apparently the ship's log underreads the water speed of the ship by 1 knot (though the computer corrects this for logging speed). In that case we towed the fish at between 9 and 10 knots for the survey. At 10 knots the fish was at about 42 metres water depth.

From day 138 (1520) until day 144 (2000) we ran without the SRP syteem deployed so that we could survey at 10 knots. This was only done in consideration of the fine weather and calm seas.

There were no "fatal" problems that could have caused lost data, however we did have some minor difficulties:

a) Yaw filter. The Yaw filter appeared to be responsible for a series of line 'dropouts' which cropped up occasionally. These dropouts (see days 130 and 136) appeared to be caused by data being stripped from the port side and added to the starboard, we gave them the name minads to distinguish them from total dropouts. We noticed

that the minads usually appeared on course 000deg, and on day 136, whilst we were on 000deg the yaw filter locked onto 000deg and the filter program had to be reset. As the weather was so good we tended to keep the yaw filter off in order to avoid the minad and 000deg lockout problems. We didn't learn the cause of this problem and it still needs to be fixed. Incidentally, Derek has rewired and relabelled the yaw filter switch so that "on" means that the yaw filter is on!

b) Starboard signal level. Towards the end of leg 4 and at the beginning of this leg the difference in gain between port and starboard became more apparent because of the poor backscattering properties. At some time in the past an attempt to compensate had been made by adjusting the gain on the RX filters so that port was at 12 and starboard 12dB. During tie line 14B Derek had a look at the signal levels coming up the cable from all six sections on each side and followed them into the lab. The starboard output from the beam steering unit was down by 8dB. By changing some resistors in the summing amplifier in the starboard beam steering unit he managed to balance port and starboard perfectly. We were then able to match the RX filter attenuators to 12dB each and the records were much improved.

c) Gantry hydraulics. On recovery the solenoid which switches the winch from high to low gear stuck in high gear. The temporary solution is to hit it with a hammer! a more sensible solution would be to drain the hydraulics and fix it, any takers?

3.5 kHz: The 3.5 khz worked well throughout and we got superb records. It came as a surprise therefore when we found a severely damaged cable on recovery at Nassau. This has been repaired (with the spare) and a new cable is needed.

Echo Sounder: This worked faultlessly throughout.

SRP: The SRP system was run with 160 cu. in. air gun and two channel flexatir hydrophone. We both recorded the data on the USGS MASSCOMP system and produced paper records on board. The paper records displayed data in two frequency bands; 15-160Hz and 75-150Hz. We had excellent records and only two short periods of down time (see days 135 and 146) caused by a noisy gun and leaking air hose.

Magnetometer: This worked without fail throughout though a shark had taken a liking to the bottle!

Navigation: Our navigation was obtained from a combination of six systems; dead reckoning, transit satellites, three Loran C receivers and radar fixes off the land. We relied

mostly on the Loran C systems only using the others when necessary. At the beginning of the cruise we were in two minds as to which transmitting network to use, on day 131 this was resolved and we only used the southern network (see day 131). On our run into the Bahamas the Loran network became so bad we asked the bridge to make radar fixes off the land for us.

XBT: 23 XBT drops were carried out. These were done to build a record of temperature profiles for the study of GLORIA sound propagation problems. The data were also sent to the NOAA for inclusion in their data bank.

## 6) Results

Approximately 39925 sq.km. of seafloor were surveyed covering three main areas; the Hatteras Canyon, the Blake escarpment, and the Blake Plateau.

### A. Hatteras Canyon

The Gloria mosaic shows three main sedimentary provinces in the Hatteras Canyon area; Submarine channels, Sediment waves, and debris flows.

Submarine channels: Our tracks crossed the point where the Hatteras, Pamlico, and Currituck channels form a single channel in the Hatteras Transverse Canyon and emerge onto the abyssal plain. In its upper reaches where it is still confined by the Transverse canyon, the channel has gullied walls and steep sides. Lower down, where it reaches the abyssal plain, the channel begins to splay out into a 45 KM wide delta like feature with arcuate transverse bars approximately 2 KM wide and up to 27 KM long. The transverse bars appear to have blocked the channel to a certain extent and forced the most recent sediments to flow down its eastern edge.

Sediment Waves: To the east of the main (Hatteras) channel delta there is a field of sediment waves, migrating from the delta, north along the foot of the Hatteras Ridge. They have a wavelength of 5400m and amplitude of up to 75m and appear to originate in the Hatteras delta from which they are migrating north to a distance of 170KM. There are two types of sediment waves. Those to the south (near source) do not show the classic dune bedding shown by those to the north, their crests are also more sinuous and diffuse. We propose that these differences were caused by post sediment wave sediment blanketing which has draped over the southern waves so partially obscuring their form.

Debris flows: To the west of the main (Hatteras) channel delta there are a number of bright patches on the Gloria

records that we have interpreted as debris flows. There appear to be at least three debris flows of different ages sweeping down onto the abyssal plain. The central, largest and most prominent, debris flow is possibly the youngest of the flows and it shows many of the internal flow patterns that are characteristic of debris flows.

#### B) Blake Escarpment

The Blake escarpment is a feature that in places towers 3500 m above the abyssal seafloor. Our Gloria images reveal the change in character of the escarpment from the Blake Spur in the north down to the Bahamas in the south.

The Blake spur is a promontory that extends 54 KM beyond the general escarpment trend. As a result it has deflected the western boundary undercurrent and formed an interesting pattern of lee-side deposits to the south of the spur. The escarpment in the lee of the spur shows extensive gullying, a feature which we believe is only preserved by the protecting influence of the spur from the undercurrent. Elsewhere along the escarpment the current appears to have eroded the slope and removed any evidence of downslope transport. The abyssal plain at the foot of the escarpment has also been eroded exposing long outcrops of flat-lying abyssal strata.

In places major slope failures have broken through the current dominated terrain and produced deposits that extend out onto the abyssal plain. To the north of the spur, current lineations in the seafloor can be seen bending east along the flank of the spur. In the extreme south the influence of the undercurrent finally ceases off the Bahamas.

At the top edge of the escarpment the Gloria records are dominated by signals returning from small outcrops of eroded strata. In many places the 3.5 kHz records cannot resolve the subtle changes that occur at the outcrops, and they may be confused with other features which, whilst they may appear significant on the echo sounders, are not revealed by Gloria.

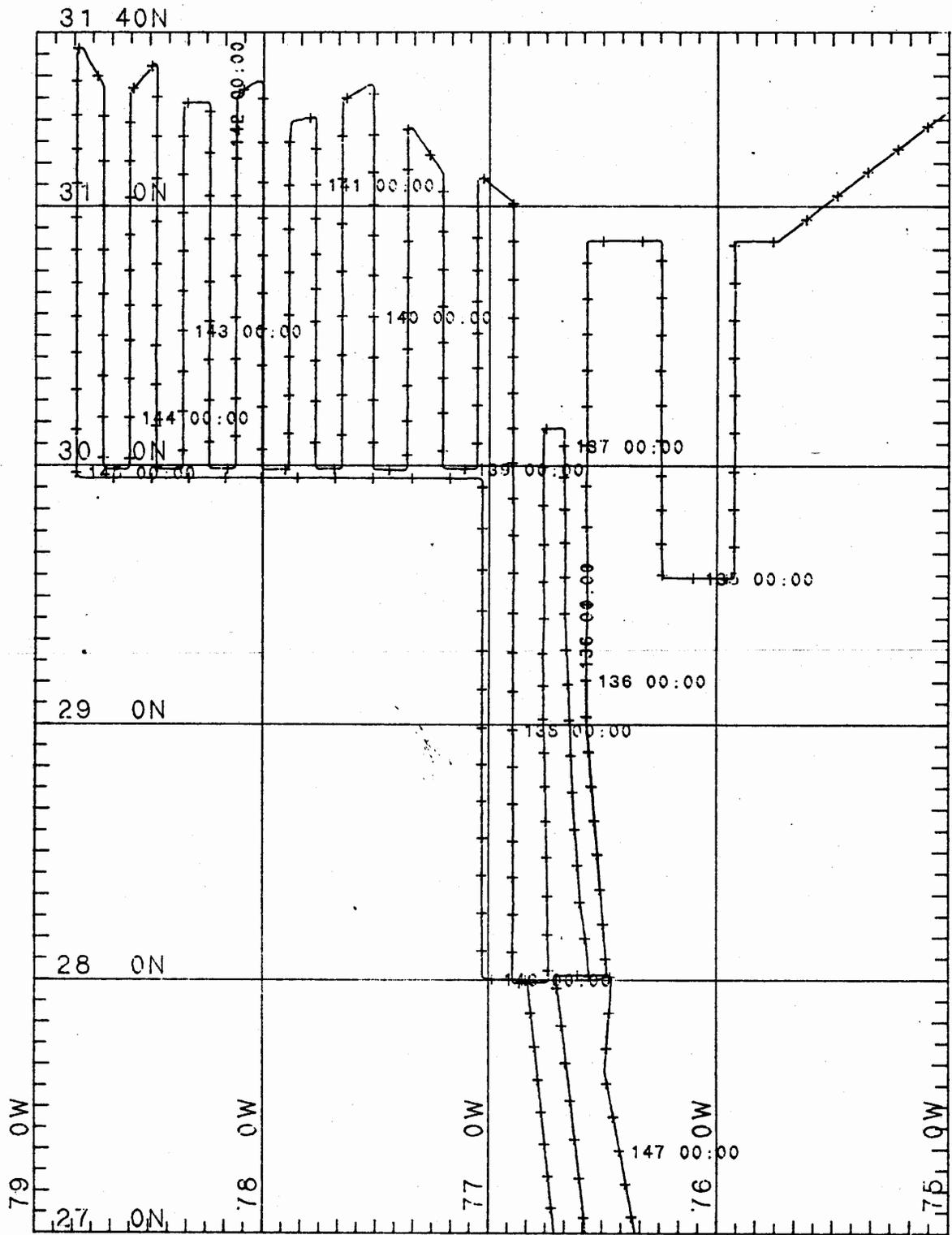
#### C) Blake Plateau

The plateau is dominated by erosional features. We found that it could be divided into two broad areas on the basis of both Gloria and 3.5 kHz records.

To the northwest is an area of highly reflective seafloor that is characteristically flat with incised channels and gullies that have oversteepened walls. On the Gloria records two channels could be traced running from west to east, perpendicular to the Gulf Stream. Bearing in mind the gentle northwards (up) slope of the area and the occurrence of the Charleston bump just to the north, we suggest that the eastward flowing channels reflect a possible eastward

forcing of the Gulf Stream at the bump (as in Stan Riggs work).

The area to the southeast is unremarkable! It is nowhere as reflective as the NW area and is also flat-lying, but with no deep incisions. It shows some evidence of minor erosion exposing strata and forming east west lineations.



MERCATOR PROJECTION

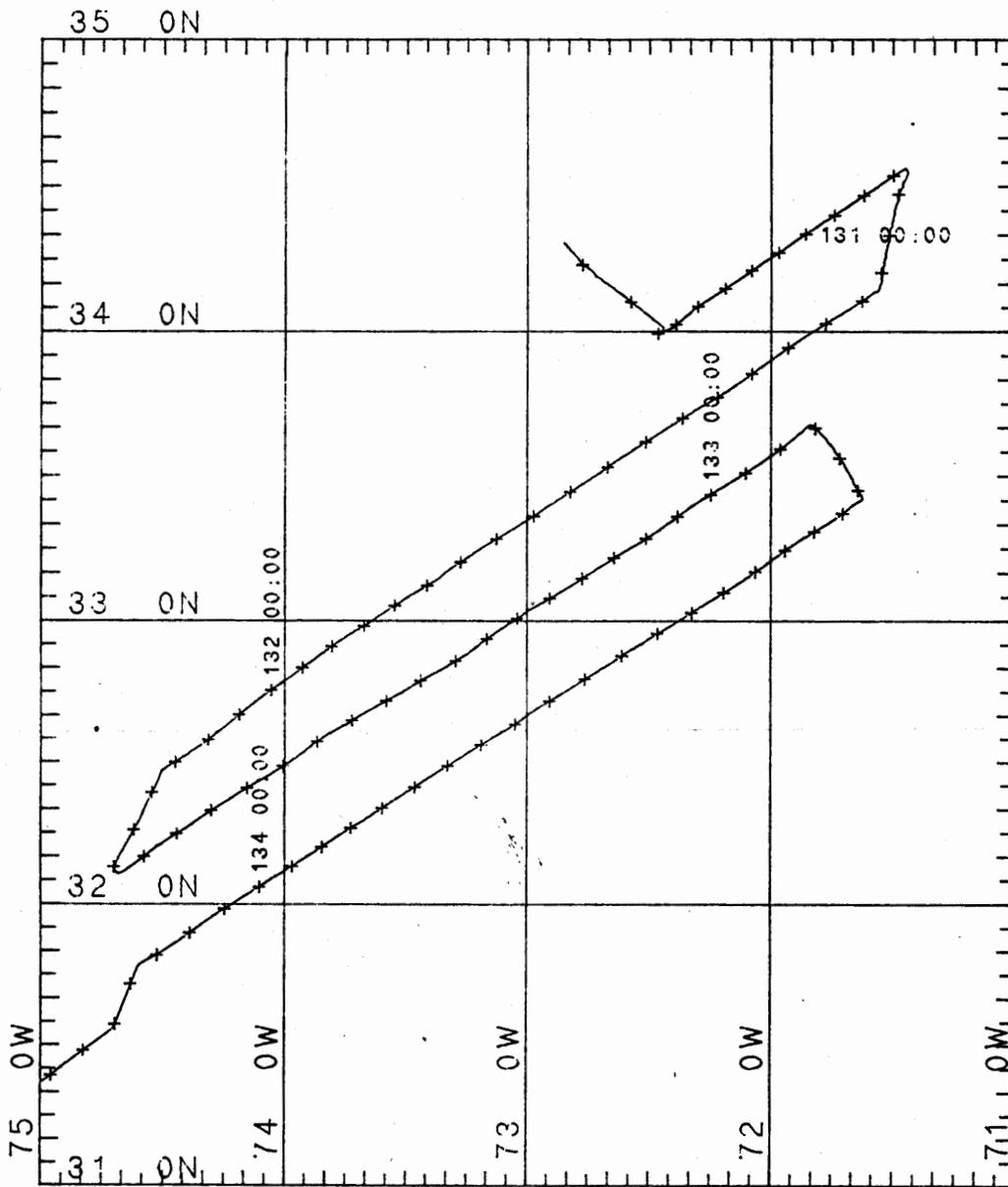
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GRID NO.  
TRACK NO.

Farnella 5/87 Norfolk - Nassau

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MERCATOR PROJECTION

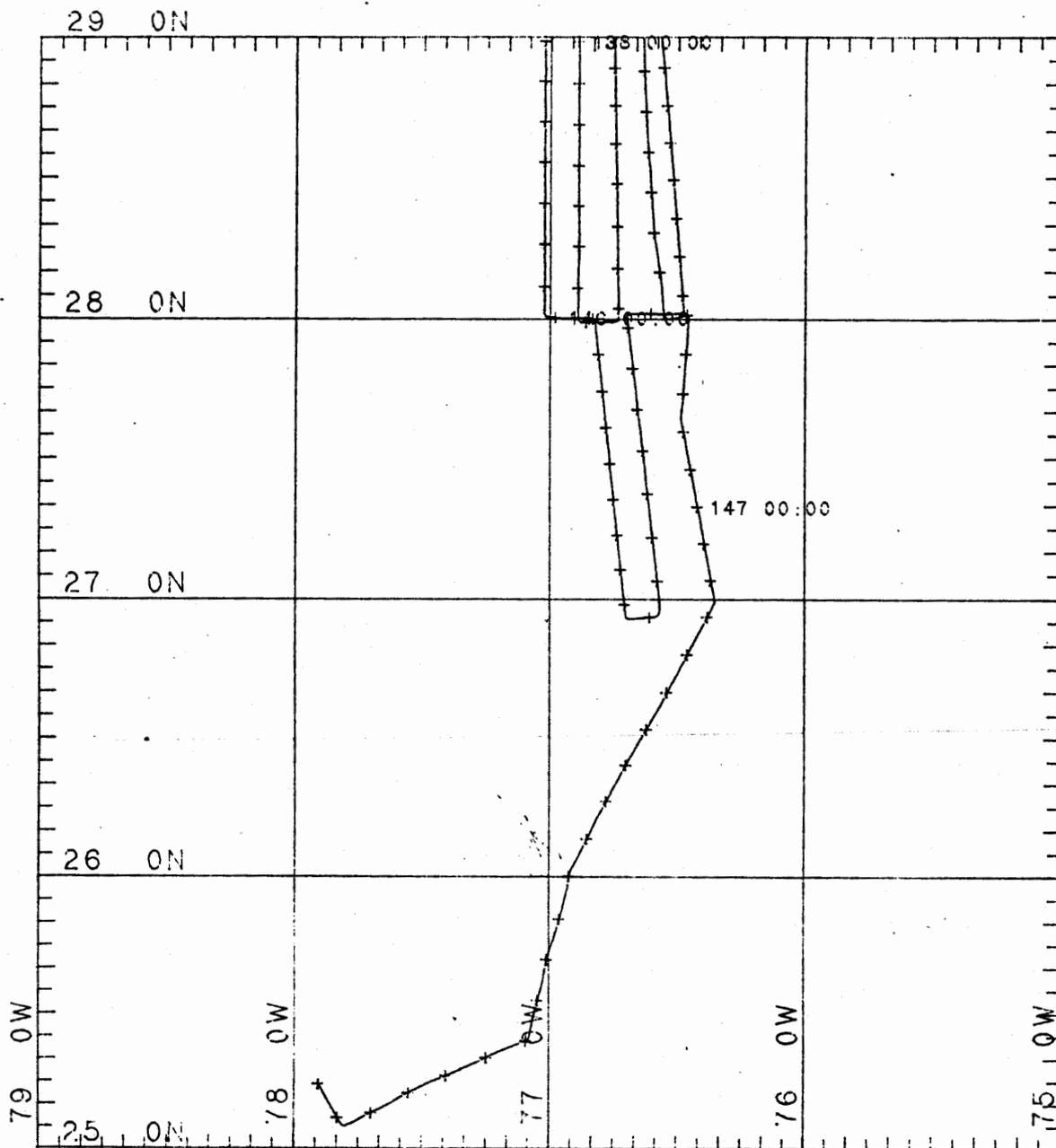
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FARNELLA 5/87

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# XBT DATA

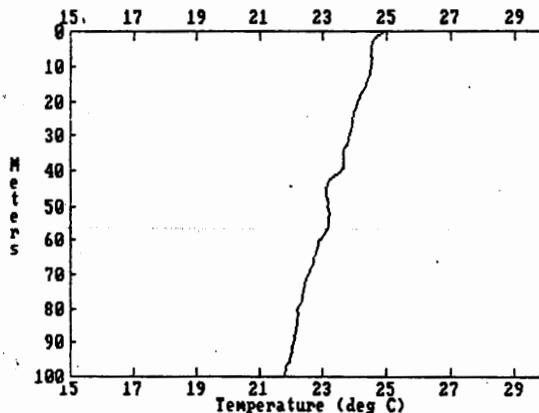
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009	T-07	87/05/12	21:27	33	14.9 N	72	35.3 W	07870512.009	Y
010	T-05	87/05/13	12:08	32	56.6 N	72	29.3 W	05870513.010	Y
011	T-05	87/05/13	21:49	32	12.7 N	73	49.8 W	05870513.011	Y
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016	T-07	87/05/17	13:51	28	21.3 N	76	44.5 W	07870517.016	Y
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018	T-05	87/05/18	14:09	31	01.6 N	76	54.5 W	05870518.018	Y
019	T-05	87/05/18	21:05	30	21.5 N	77	03.1 W	05870518.019	Y
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## NOAA

National  
Ocean  
Service

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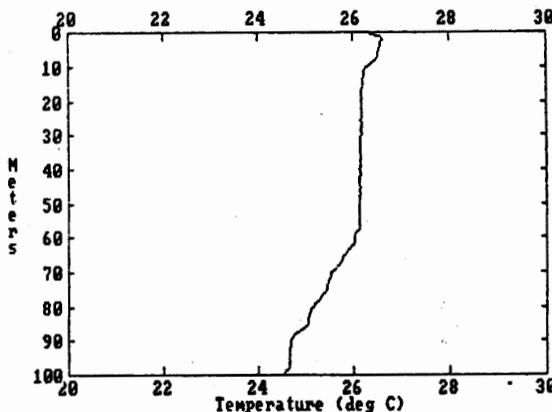


BLAKE  
SPUR

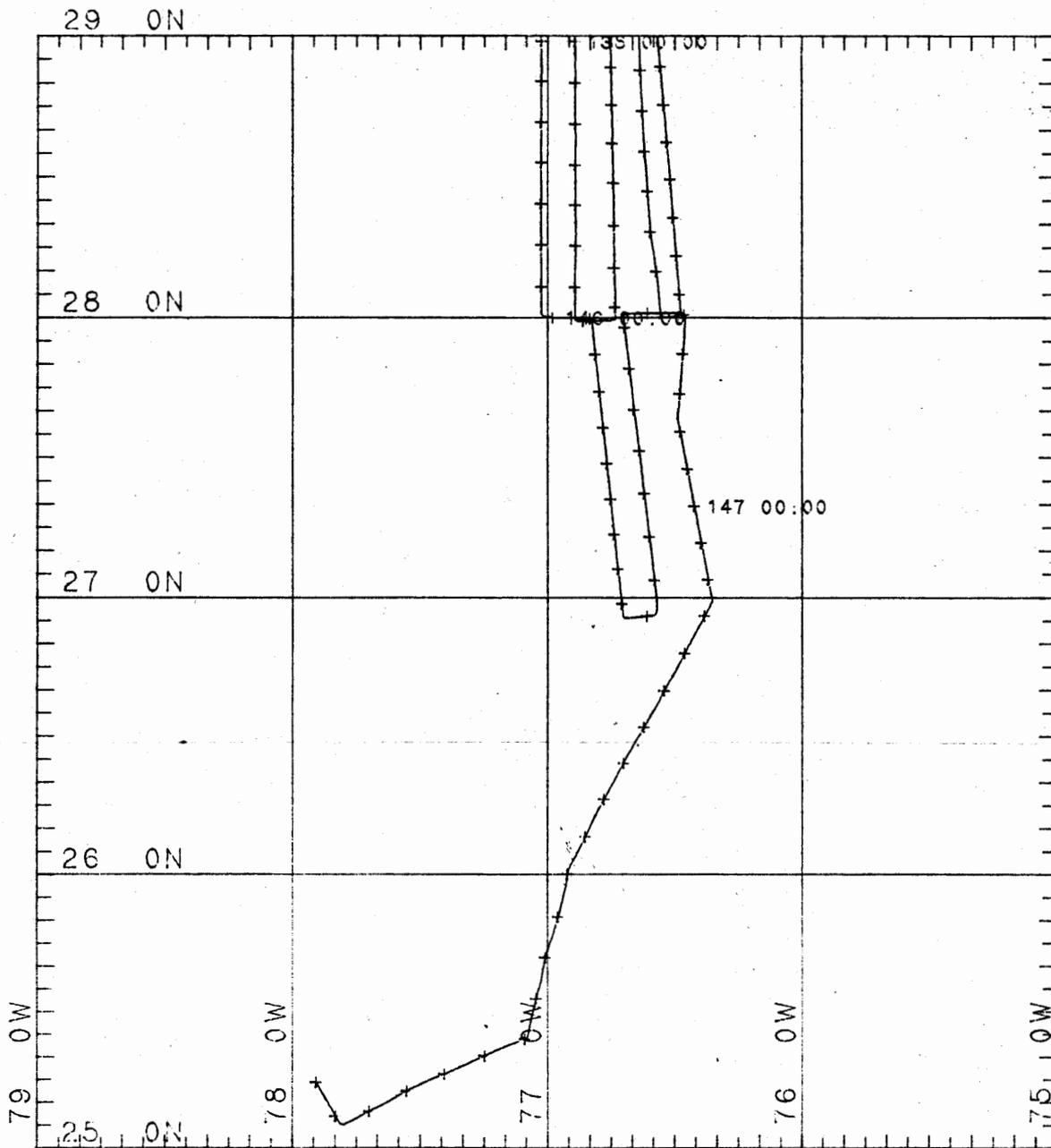
## NOAA

National  
Ocean  
Service

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Longitude: 78 21.0 W  
Probe T-07  
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Time 20:19 GMT  
Bottom depth: 765 m  
Cruise: F87-5



BLAKE  
PLATEAU



RS

MERCATOR PROJECTION

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INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

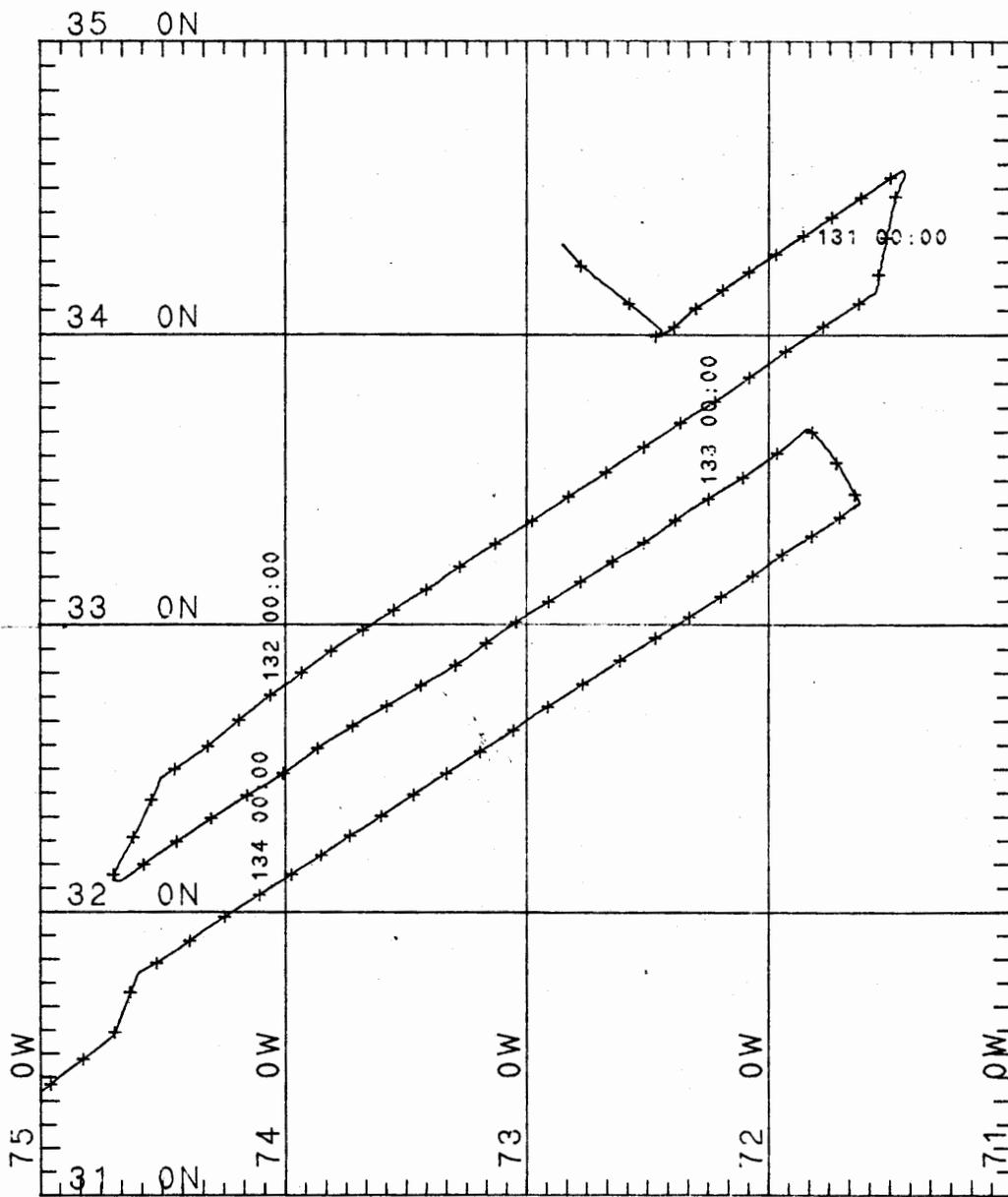
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Farnella 5/87 Norfolk - Nassau

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MERCATOR PROJECTION

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INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

FARNELLA 5/87

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