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CRUISE REPORT: RRS. CHALLENGER

CRUISE NO. 38/88

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Plymouth, PL4 8AA.

28 September 1989

CRUISE DATES: 27-31 October 1988.

INTRODUCTION.

This Cruise was the first of a series funded by a NERC AAPS Research Grant awarded to Prof. K.R.Dyer and Dr.C. Vincent to study Drag and Sediment Movement over Sand Waves in the Southern North Sea. Prof. David Huntley took over the running of the project in September 1987. The project is an integral part of the NERC North Sea programme. Cruise 38 was the October 'process' cruise for RRS Challenger.

Although most North Sea 'process' cruises were of two weeks duration, cruise 38 was originally planned to last only one week, to allow a one week refit to take place before the cruise. In the event, an unexpected problem with one of the ship's hot water boilers forced a further curtailment of the cruise, to 3 1/2 days with less than 3 days on site. Nevertheless it was decided that the cruise should go ahead, with a reduced set of objectives. This report therefore describes a 3 1/2 day cruise.

SCIENTIFIC PERSONNEL.

Prof. D.A. Huntley, Plymouth Polytechnic. Principal Scientist

Prof. K.R. Dyer, Plymouth Polytechnic.

Dr. R. Nicholls, Plymouth Polytechnic.

Dr. C.E. Vincent, University of East Anglia.

Mr. J. Van der Meene, University of Utrecht.

Mr. D. Teare, RVS.

Mr. R. Powell, RVS.

Ms. D. Jones, RVS.

Mr. J. Humphery, POL.

Mr. K. Taylor, POL.

Mr. D. Leighton, POL.

Mr. A. Harrison, POL.

Mr. S. Morris, POL.

AIMS.

The overall aims of our project are:

a) to measure the temporal and spatial variations in the flow field over sand waves, and compare measurements with numerical model predictions.

b) to measure the total drag which the current experiences due to the presence of the sand waves, and to study the partitioning of the total drag into skin friction and form drag components.

c) to quantify the rate of sediment transport across the top of the sand waves under a variety of wave and tidal current conditions and to compare these with the rates predicted by existing sand transport equations.

The specific aims for Cruise 38 were:

a) to survey a preselected area of sand waves, using sidescan sonar and echo-sounding, in order to assess the homogeneity of the sand wave field in the area, select a site for STABLE deployments, and provide bottom topography for planned numerical models.

b) to deploy two POL pressure sensors, separated by 10 km across the sand waves, to measure sea surface slopes. These were to be recovered one month later during cruise 40.

c) to deploy the bottom tripod STABLE, to measure turbulence and currents at the seabed, along with suspended sediment concentrations, pressure, and seabed topography by bottom photography. STABLE was to be recovered at the end of Cruise 38.

d) to run Acoustic Doppler Current Profiler (ADCP) surveys over as many tidal cycles as possible between the pressure sensors, to obtain mid-water current profiles.

e) to collect seabed surface samples using a Shipek Grab, to characterise the bed grain roughness at different locations over a sand wave profile.

An additional aim in the original cruise planning was to deploy two three-instrument current meter moorings close to STABLE for the duration of the cruise. However this was dropped about one week before the cruise departed, when the cruise time

was reduced due to overrun of the October refit.

GEOGRAPHICAL AREA.

Surveys and deployments all took place within the area bounded by

52 46'N	3 36'E
52 36'N	3 36'E
52 36'N	3 46'E
52 46'N	3 46'E

Cruise tracks within this area, for the period between day 302 0700 and day 303 1455, are indicated in figure 1. Cruise tracks for the remainder of time on site (303 1455 to 305 0515) are even more crowded due to repeated steaming over the same lines.

SEA AND WEATHER CONDITIONS.

Weather was moderate to good during the Cruise, with seas 2-2.5 m on 28 and 29 October, diminishing to 1.5-2 m on 30 and 31 October.

OUTLINE OF CRUISE SCHEDULE.

27 October (Day 301).

2300 hrs. Depart Great Yarmouth, after a day of loading, preparing equipment and replacing the Ship's hot water boiler.

28 October (Day 302)

0700 hrs. Arrive on site, 52 37'N 3 40'E.
Begin sidescan sonar and echo-sounder survey.
1520 hrs. Arrive at location selected for STABLE deployment
1602 hrs. Begin lowering STABLE.
1609 hrs. STABLE U-shaped mooring line parted due to excess tension.
STABLE probably on its side.
1639 hrs. Dahn buoy left to mark position of STABLE.
1800 hrs. Pressure sensor wire tests.
Overnight. Detailed sidescan and echo-sounder surveying in region.

29 October (Day 303)

0830 hrs. Recover Dahn buoy marking STABLE.
Begin dragging for STABLE with Giffard hooks.
0950 hrs. STABLE ground line snagged.
1012 hrs. STABLE on board.
1030 hrs. Begin further sidescan and echo-sounder surveys to select pressure sensor stations.
1620 hrs. Deploy northern pressure sensor at 52 42.5'N 3 43.1'E, in sand wave trough.

EPOL

1728 hrs. Deploy southern pressure sensor at 52 37.1'N 3 1.2 38.5'E,in sand wave trough.
1745 hrs. Begin steaming pattern of N/S lines between pressure sensors, with ADCP running.

30 October (Day 304)

0800 hrs. Begin detailed echo sounder survey midway between pressure sensors, to provide local bathymetry in region of future STABLE deployments.

0900 hrs. 3 anchored Dahn buoys deployed to assist in local position fixing.
1100 hrs. Dahn buoys recovered because they were dragging over the seabed and changing position.
1400 hrs. Grab sampling over sand waves in central region. 11 samples collected, from crests, troughs and both slopes from three consecutive sand waves.
1500 hrs. Begin ADCP and sidescan surveys at various speeds between pressure sensors.

31 October (Day 305)

0515 hrs. Leave sand waves region, heading for Great Yarmouth.
1300 hrs. Arrive at dockside, Great Yarmouth.

SUMMARY OF SUCCESSFUL DATA GATHERED.

1. Sidescan and echo-sounder data.

Approximately 80 n. miles of sidescan and echo-sounder data was collected within our sandwaves region, primarily over the 10 km distance between the pressure sensors, but including detailed suveys in the central region, the location chosen for future STABLE deployments. Figure 2 shows part of the echo sounding along the line between the pressure sensors, and confirms that our region is one of relatively uniform sand waves. These survey data are being used to construct a detailed topographic map of the area. The work is being carried out by final year hydrography students at Polytechnic South West.

2. Velocity profiles from the ADCP.

ADCP velocity profiles, averaged over 2 minutes and with 2 m depth resolution, were recorded over more than three complete tidal cycles. The raw data for depth averaged flows are shown in figure 3.

3. Pressure sensor data.

The pressure sensors deployed during Cruise 38 were

successfully recovered during Cruise 40. Approximately 27 days of high quality pressure and pressure difference data was obtained (figure 4). These measurements are being used, with the cruise 38 ADCP currents and the currents measured at the nearby Station F mooring (serviced during the North Sea survey cruises by RRS Challenger) to provide estimates of bottom friction coefficients over the sand waves.

4. Grab samples.

These provide a detailed picture of the variation of grain size distributions over the sand wave profiles. They will provide estimates of grain roughness for modelling purposes.

SUMMARY OF PROBLEMS ENCOUNTERED.

1. Failure of STABLE deployment

This was the major disappointment of the cruise. As a result, no data on turbulence, near-bed velocities, suspended sediment concentrations or small-scale bedforms were collected. The four electromagnetic flowmeters were irretrievably damaged, though other sensors seem, miraculously, to have survived.

The problem stemmed from the difficulty of deploying a delicate instrument like STABLE as part of a U-shaped mooring. The procedure chosen involved deploying STABLE first on its ground line, and then paying out the ground line over the ground, before attaching the ground line anchor and finally releasing a surface spar buoy. The delicate part of the procedure was paying out the ground line once STABLE was on the seafloor. Too little tension could result in a bight in the ground line catching around STABLE, with resulting disruption of the flow field around the sensors and potential sensor damage on recovery. Too much tension, as in Cruise 38, pulled STABLE over and resulted in damage to the sensors. In Cruise 38 the tension was so great that the line parted at the chain on the spar buoy side of the anchor.

In retrospect the failure of the STABLE deployment can be attributed to four inter-related causes, aggravated by relative inexperience of deployment of the tripod in shelf waters. These causes were:
1. attempting to deploy STABLE with a prescribed orientation. This required keeping way on the ship, which ultimately resulted in the ground line tension.
2. using a ground line which was shorter (100 m) than optimum, so that ship handling was critical.
3. using a chain which failed before its specified limit.
4. insufficient communications between the bridge and the afterdeck both before and during deployment, so that response to critical conditions was slow.

Much was learned from this incident, and subsequent

deployments of STABLE have proceeded without problems.

2. Other Problems.

a) The sidescan sonar fish (EG&G 272) provided signal only on the starboard side, despite attempts at repair.

b) The main computer, logging time, position and depth, went down at mid-afternoon on 29 october. Despite checking power supplies and changing circuit boards no repair was found possible.

CONCLUSIONS.

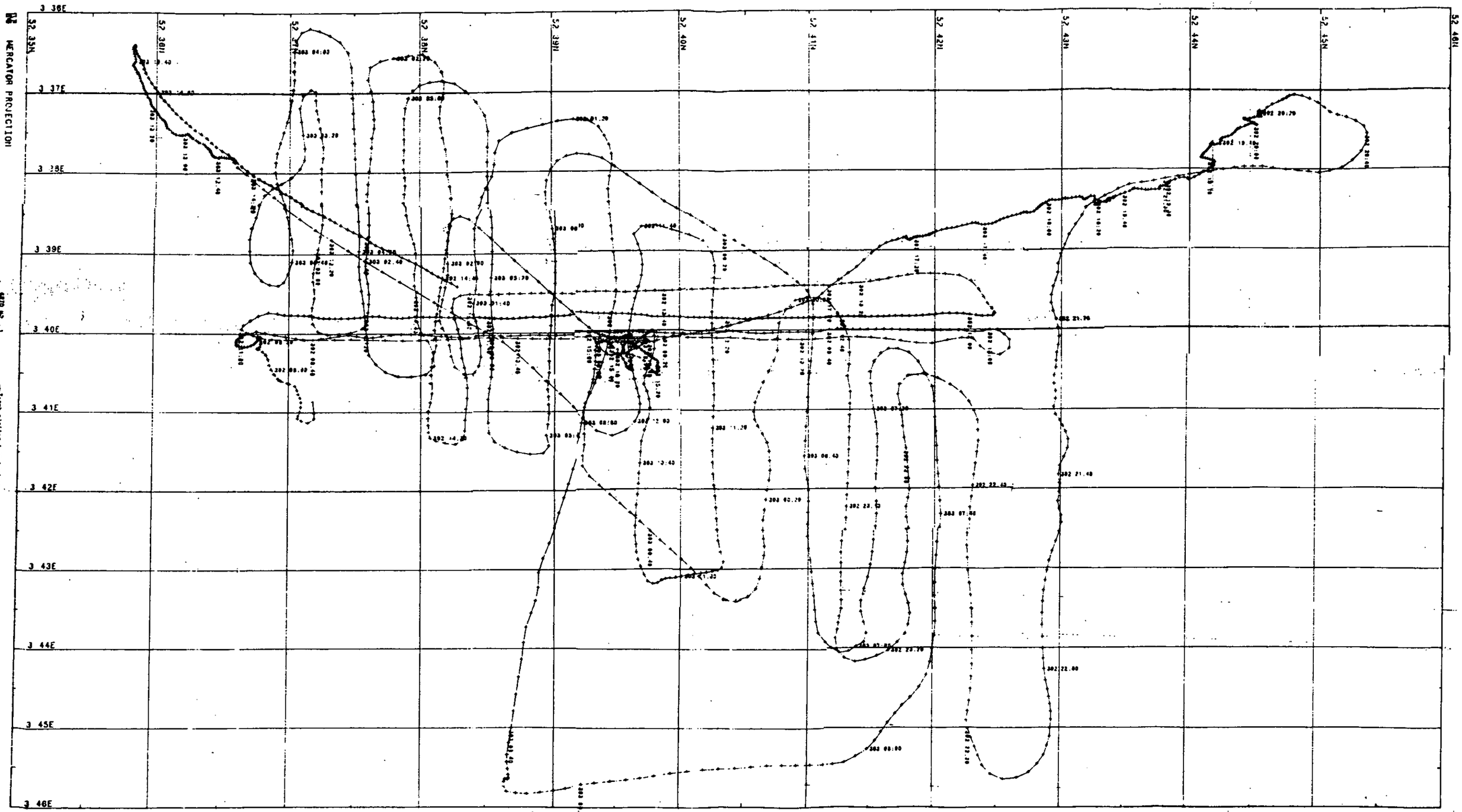
Despite a drastically shortened cruise 38, lasting only 3 1/2 days (less than three days on site), the cruise provided a very useful set of data. Four of the five reduced aims of the cruise were achieved. The sidescan and echo-sounder surveys confirmed that our preselected site was a region of relatively uniform sand waves, and established a carefully mapped region for subsequent deploymentys. Pressure sensor and ADCP data are proving valuable for estimating the bottom friction coefficients, a primary aim of the project. Bottom grab samples are being used to provide necessary information on seabed roughness.

The failure of the STABLE deployment has resulted in an improved deployment procedure. Our subsequent deployments and recoveries have proceeded without problems, though instrument failures have limited the data collected.

ACKNOWLEDGEMENTS.

A short cruise spanning a weekend cannot have been popular, yet officers and crew worked efficiently and in a helpful and friendly manner. The positive attitudes of all, officers, crew and scientific party were much appreciated and are acknowledged with thanks.

Figure 1. Cruise track plot at the sand waves site, for the period between day 302 0700 hrs. and day 303 1455 hrs.



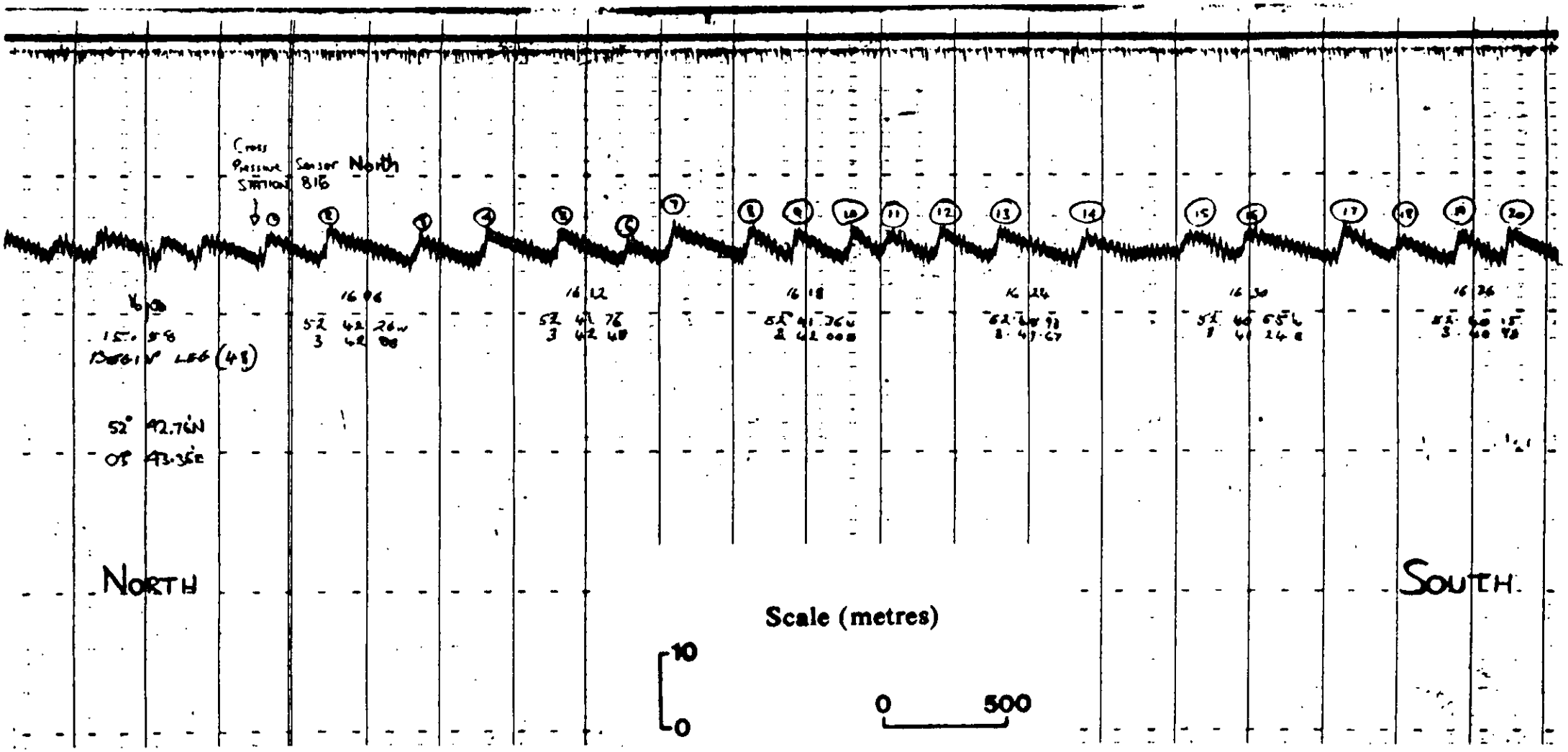


Figure 2. An echo-sounder trace across the sand wave field, running southwards from the northern pressure sensor location towards the southern pressure sensor location.

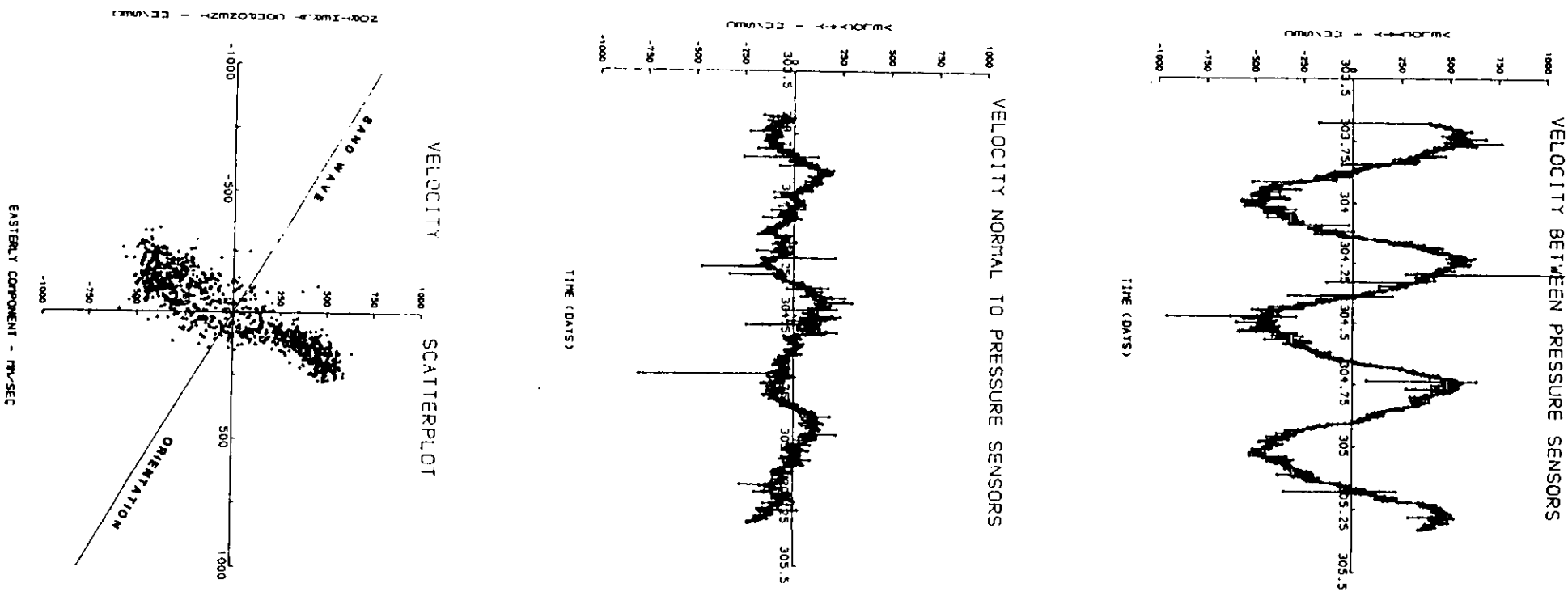


Figure 3. Depth-averaged currents measured with the Acoustic Doppler Profiler while at the sand waves site. Velocity is resolved into directions along the direction between the pressure sensors and normal to that direction. The scatter plot shows that the major axis of the tidal ellipse is at right angles to the sand wave crests, with the north-easterly flows the strongest, as expected from the asymmetry of the sand waves (figure 1).

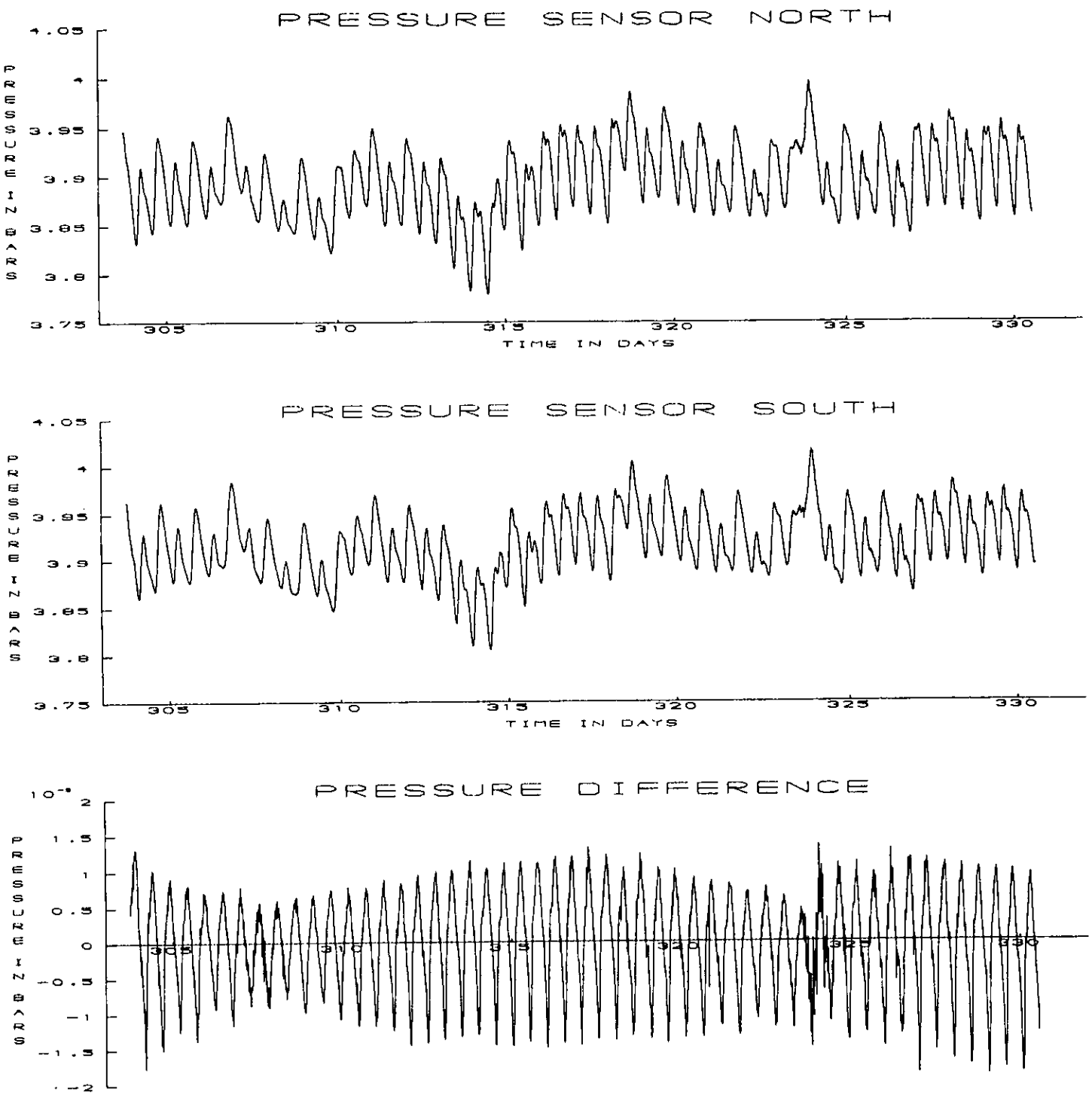


Figure 4. Data from the pressure sensors deployed during cruise 38 and recovered during cruise 40.

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Cruise Report of Proceedings

Ship RRS CHALLENGER Cruise No 38/88

Cruise Dates (Inclusive, port to port) 27 → 31 OCTOBER 1988

It is requested that the following aspects of the cruise may be covered in this report of proceedings for dispatch or delivery to the Director, Research Vessel Base, immediately on return to port.

a) Main objectives of the cruise.
b) Geographical area. Reference stations or points in latitude and longitude.
c) Sea and weather conditions encountered.
d) Conduct of cruise, main problems encountered and success or otherwise of the progra
e) Equipment performance.
f) Ship performance.
g) Any recommendations.
h) Signature and date.

Brief comments are preferred but if necessary please continue on another sheet.

Objectives: To study flow and sediment movement over sand waves in southern North Sea, using:-
(a) sidescan sonar and echo-sounder for bottom topography
(b) STABLE tripod for bottom currents, turbulence and sediment movement
(c) a pair of pressure tranducers to measure sea surface slope
(d) ADCP for mid-water velocity profiles
(e) Shipek grab for bottom samples.

Two current meter moorings, originally scheduled, were cancelled due to shortened duration of cruise.

Geographical area: Bounded by 52° 43N 3° 36E
52° 36.5N 3° 36E
52° 36.5N 3° 42E
52° 43N 3° 46E

Sea and weather conditions: Generally good weather. Seas 2-2½m # 28 & 29 Oct diminishing to 1½-2m on 30th & 31st.

Conduct of cruise:
(a) Approx 80 n.mi of sidescan and echo sounding survey.
(b) STABLE was deployed but was pulled over and dragged by excess ground line tension during deployment. Tension eventually caused ½" chain to part. Following mooring STABLE ground line was successfully snagged and STABLE recovered. Four EM sensors damaged beyond repair, other equipment apparently undamaged.
(c) Pressure sensors (POL) deployed 10 km apart at station 816 [52° 42.5 N 3° 43.1E] and station 817 [52° 37.12 N 3° 38.46E]. To be recovered during cruise 40.
(d) ADCP surveys run continuously between pressure sensors over two complete tidal cycles. During the second tidal cycle a short section (approx 400 m) was traversed at slow speed (0.5 kts over ground) whenever possible.
(e) 11 grab samples taken over two sand waves.

PLEASE SEE OVER

Equipment problems In addition to failed STABLE deployment :-

1. The sidescan sonar showed return only on starboard side, blank on port side.
2. The main computer, logging time, position and depth onto magnetic tape, went down at mid-afternoon of the 29th October. Despite checking power supplies and changing circuit boards no repair was possible.
3. ADCP fast pinging options could not be made to work.

The most pressing problem to follow up is redesigning the deployment procedure for STABLE.

Conclusion. Despite the short duration, the cruise produced a considerable body of data.

Relationships with officers and crew were excellent throughout, and their skill was much appreciated.

Duty mess

D A Huntley 31 October 1988.

PROF. DA HUNTLEY

(PLYMOUTH POLY)