PROUDMAN OCEANOGRAPHIC LABORATORY

CRUISE REPORT NO. 35

VEINS:
Inverted Echo Sounders in the Denmark Strait

As part of

FS METEOR CRUISE 45/4

AUGUST 13, 1999 – AUGUST 31, 1999

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VEINS: Inverted Echo Sounders in the Denmark Strait, as part of,
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ABSTRACT

The overflow of cold dense water from the Denmark Strait is one of the key elements of the north Atlantic thermohaline circulation and has important consequences for global climate change. It is important to measure the transport of this water and to understand its variability on seasonal and at longer time scales.

The European funded project "Variability of Exchanges in Northern Seas" (VEINS MAS3CT960070) is an attempt to measure variations in the Arctic circulation using modern oceanographic instrumentation.

A combined Inverted Echo Sounder and Bottom Pressure Recorder was successfully recovered and re-deployed in the Denmark Strait to measure the thickness of this cold dense water and thus determine transport.

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OVERVIEW

The overflow of cold dense water from the Denmark Strait is one of the key elements of the north Atlantic thermohaline circulation and has important consequences for global climate change. It is important to measure the transport of this water and to understand its variability on seasonal and at longer time scales.

The European funded project "Variability of Exchanges in Northern Seas" (Veins) is an attempt to measure the decadal variations in the Arctic circulation using modern oceanographic instrumentation. Part of this work involves the Denmark Strait where an array of current meters is in place to measure the strength of the Overflow Water (DSOW). CTD surveys provide knowledge of the physical properties.

To measure its thickness, and hence get a value for transport for the DSOW, an Inverted Echo Sounder was deployed in the core of the current with a view to detecting the echo from the interface between the cold bottom water and the overlying intermediate layer.

POL CRUISE OBJECTIVES

1) To recover two Inverted Echo Sounders in the Denmark Strait.
2) To re-deploy two Inverted Echo Sounders in the Denmark Strait.

IES/BPR DEPLOYMENTS

Ship Preparation

POL personnel joined FS Meteor at St Johns, Newfoundland on August 11, 1999. The equipment was loaded aboard the ship, unpacked and stowed safely.

ATTEMPTED RECOVERY OF IES/BPR (G1/IES) 19/8/1999

EVENTS

11.50 GMT	Arrive on station.
11.53 and 12.28 GMT	Release command transmitted.
14.00 GMT	Depart mooring site.

Total time on station: 2 hours 10 minutes.

IES/BPR (G1/IES) Attempted Recovery Summary

Acoustic conditions were very good since the ship can be made acoustically very quiet. Initially there was quite a bit of acoustic noise and this was misinterpreted as a response from the IES acoustic release system. A few range readings were obtained which corresponded to the correct deployment depth, although it was impossible to achieve consistent and reliable communication. Release commands were transmitted to activate the burnwire system. After half an hour, the commands were sent again since the unit showed no sign of having released. Range readings indicated it was still on the seabed. The ship's echo sounder, ADCP and propellers were deactivated, and the ship drifted with the wind. The ship was now acoustically very quiet and communication with the release units now proved to be impossible. A second acoustic deck unit was tried and the result was the same. The ship remained on station for ninety minutes after the last release command was transmitted, but the IES did not surface during that time.

RECOVERY OF IES/BPR (UK1/IES) 19/8/1999

EVENTS

16.12 GMT	Vessel on station.
16.13 and 16.55 GMT	Release command transmitted.
16.55 GMT	Released from the seabed.
17.32 GMT	On the surface.

Total time on station: 1 hour 25 minutes.

IES/BPR (UK1/IES) Recovery Summary

Acoustic conditions were very good since the ship shut down the echo sounder, the ADCP and the propellers as soon as it was on station. Communication with both acoustic releases was definite and immediate. The release signal was transmitted to the burnwire release system and the ship drifted whilst range readings were made to monitor for the moment of release. During ranging, it was clear that the burnwire release had activated since for every single acoustic ping from the ship, five replies were received. The first reply indicated the range whilst the following four pings verified release activation. After fifteen minutes, it was difficult to determine whether release separation had occurred, so the ship returned to the original position. The unit was interrogated and range readings showed that it had not released from the seabed, so a command was transmitted to the second release. The second release was fitted with a pyrotechnic device that fired instantly. The IES/BPR then indicated it had released and was rising to the surface.

DEPLOYMENT OF IES/BPR (UK1/IES) 22/8/1999

EVENTS

22.45 GMT	Vessel on station.
22.54 GMT	Release into the water.
23.31 GMT	On the seabed.

Total time on station: 46 minutes.

IES/BPR (UK1/IES) Deployment Information

The ship was acoustically very quiet, so it was possible to achieve excellent communication with both acoustic releases to the seabed.

CONCLUSIONS

With the failure to recover one of the IES/BPR frames, only half of the POL cruise objectives could be achieved. The excellent acoustic performance at the site of the recovered mooring, combined with the lack of response at the other site, indicates that the frame is unrecoverable.

APPENDIX 1 - BPR TECHNICAL INFORMATION

IES/BPR (G1/IES) ATTEMPTED RECOVERY INFORMATION

Location details	-	***Latitude***	***63°21.78' N***
		Longitude	***036°03.73' W***
		Depth	***2206m***
On station	-	11.50 GMT on 19/8/1999	
Release command transmitted	-	11.53 and 12.28 GMT	
Depart site	-	14.00 GMT	

There was no acoustic indication of this IES/BPR being at the deployed location upon arrival. Release commands were transmitted since there was initially some sea noise present that produced range readings of the appropriate value. When there was no sign of acoustic communication improving due to the frame having released, and the acoustic releases getting closer to the ship, the ship shut down all potential sources of sea noise. With the ship now acoustically very quiet there was still no communication with the acoustic releases. The ship maintained station until ninety minutes had elapsed after the last release transmission.

Equipment fitted to frame

Benthos XT6000 acoustic releases, 47166 and 58172
Logger SSDL 4 with sensors QT 119016, DQ 38173, DQ 46279
Inverted Echo Sounder with LDEO ADC board and 543Mb disk drive
Novatek Radio Beacon

IES/BPR (UK1/IES) RECOVERY INFORMATION

Location details	-	***Latitude***	***63°28.56' N***
		Longitude	***036°17.57' W***
		Depth	***2001m***
On station	-	16.12 GMT on 19/8/1999	
Release command transmitted	-	16.13 and 16.55 GMT	
Released from seabed	-	16.55 GMT	
On surface	-	17.32 GMT	

Acoustics fitted were 46457 (Rx 15.0 kHz, Tx 12.0 kHz, Release B, burnwire system) and 46428 (Rx 14.5 kHz, Tx 12.0 kHz, Release D, pyrolease system). The release command was initially transmitted only to the burnwire acoustic release. The pyrolease mechanism was going to be reused on the next deployment. After half an hour, there was no sign of the frame having

released from the seabed, even though the release signal had reached the burnwire acoustic and had activated the burning process. This was indicated by five pings from the acoustic every time a range reading was taken. The release command was then transmitted to the pyrolease acoustic and subsequent ranging indicated the frame had released and was ascending to the surface. Upon recovery of the frame onto the ship, it was discovered that the cathode lead of the burnwire mechanism had broken free from its mounting and was thus too far from the anode for the "burning" process to proceed.

Logger
Timebase

Expected Scan	Actual Scan
09.45.00 GMT on 20/8/1999	09.42.51 GMT on 20/8/1999

Timebase is 129 seconds slow.

Data were downloaded to UK1BPR9899.RAW

Data Arrangement
The raw data are made up of eight columns

Column	**Data**
1	Time
2	Date
3	Temperature (DQ 36573)
4	Pressure (DQ 36573)
5	Temperature (DQ 38175)
6	Pressure (DQ 38175)
7	Blank
8	Blank

Inverted Echo Sounder

The data were downloaded to UK1IES9899.IES.

No timing measurements of the IES were possible since the battery was fully drained upon recovery. The discharged battery was expected since when it was installed last year it had already been used previously, but should have had enough capacity for another year deployment. The battery fitted the previous year was also discharged upon recovery and that had been a new battery when installed. The reason for the discharged batteries had been identified as a hardware fault, however it was not located until after the deployments last year.

The hard disk drive was examined and found to contain 2090 samples. This corresponds to an operational life of 174 days.

IES/BPR (UK1/IES) DEPLOYMENT INFORMATION

Location details	-	***Latitude 63°28.58' N***
		Longitude 036°17.31' W
		Depth 2002m
On station	-	22.45 GMT on 22/8/1999
Released into the water		- 22.54 GMT
On seabed	-	23.31 GMT

Acoustic Servicing

S/N 46428

Old battery voltage	-	Red 11.23V
		Orange 11.22V
New battery voltage	-	Red 14.26V
		Orange 14.32V
Old pyrolease voltage	-	9.47V
New burnwire voltage		28.44V

Converted from a pyrolease mechanism to a burnwire mechanism. The burnwire circuit incorporates a 33Ω 50W resistor instead of a 15Ω 50W resistor which was not available.

S/N 46457

Old battery voltage	-	Red 12.60V
		Orange 12.57V
New battery voltage	-	Red 14.26V
		Orange 14.27V
Old burnwire voltage	-	28.00V
New burnwire voltage	-	28.72V

Acoustic Information	-	XT 6000 Acoustics, S/N 46428
		Rx 14.5 kHz, Tx 12.0 kHz, Release D
	-	XT6000 Acoustics, S/N 46457
		Rx 15.0 kHz, Tx 12.0 kHz, Release B

Both of the acoustic units are using a burnwire release mechanism.

Radio Beacon	-	Benthos 154.585 MHz
		Channel A
Logger	-	C1

Sensor	-	DQ 68486	

Timebase Channels

1	-	Temperature	
2	-	Pressure	
3	-	n/c	
4	-	n/c	

Sensor Frequencies

DQ 68486	-	Temperature	171.681 kHz
	-	Pressure	33.198 kHz

C1 timebase started at 19.00.00 GMT on 21/8/1999
First scan at 19.15.00 GMT on 21/8/1999

Battery Voltages

Logger	-	14.13V

<u>Inverted Echo Sounder Information</u>

IES	-	Chirp IES with POL ADC board Hard disk size is 1.4Gb

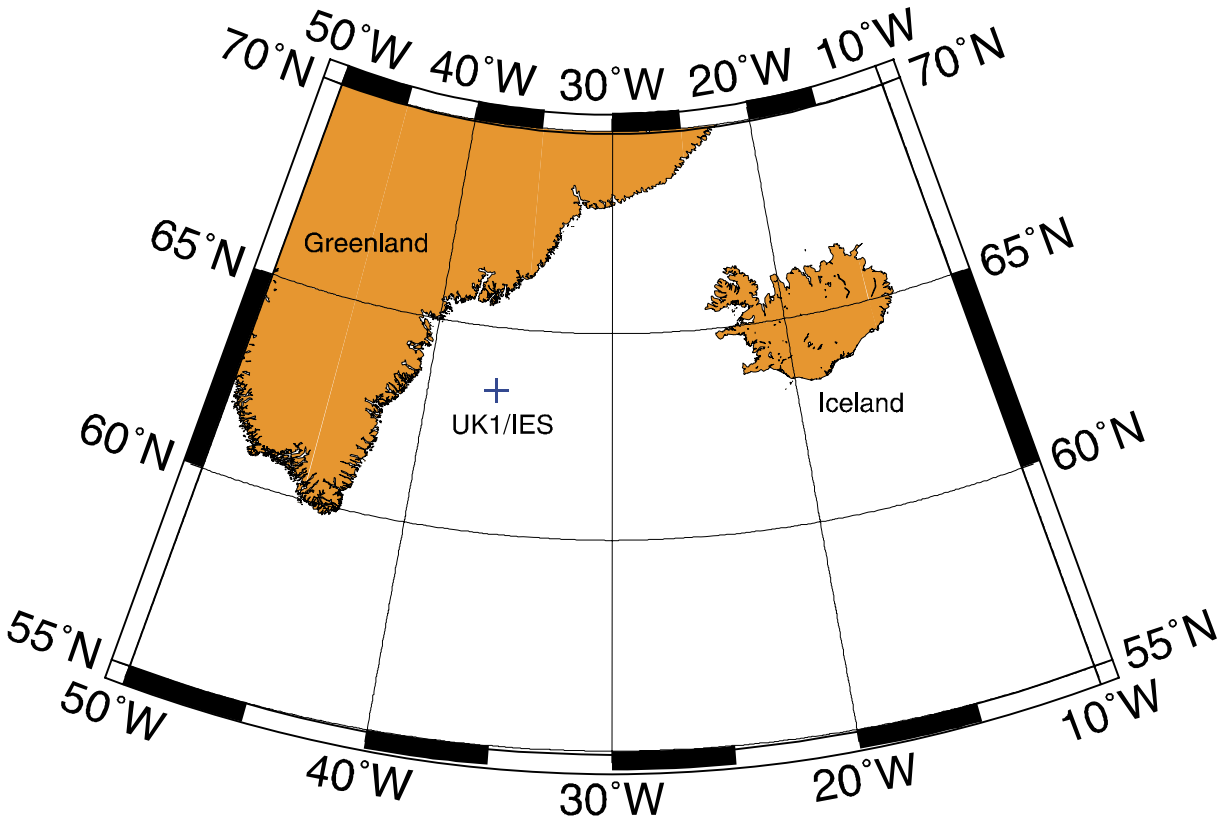
The IES was started at 15.59.42 GMT on 21/8/1999

IES parameters	-	Chirp Interval	120 minutes
		Samples per datafile	1
		Sampling Rate	fast
		Lockout time	0
		Start File	1
		Serial Number	5
		Deployment Number	5

These parameters give a deployment duration of 523 days.

First Chirp at 17.59.58 GMT on 21/8/1999

MAP OF IES/BPR DEPLOYMENT POSITION



GLOSSARY

ADC	-	Analogue to Digital Converter
BPR	-	Bottom Pressure Recorder
CEFAS	-	Centre for the Environment, Fisheries and Aquaculture Science
CTD	-	Conductivity, Temperature and Depth Profiler
DSOW	-	Denmark Strait Overflow Water
EPROM	-	Erasable Programmable Memory
FiMR	-	Finnish Institute of Marine Research
GMT	-	Greenwich Mean Time
IES	-	Inverted Echo Sounder
IfMH	-	Institut für Meereskunde, Hamburg University
LDEO	-	Lamont-Doherty Earth Observatory
POL	-	Proudman Oceanographic Laboratory
VEINS	-	Variability of Exchanges in Northern Seas