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Barra Fan Project
Geophysical Operations Report - Project 92/02

by

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Barra Fan, 57°N, 10°W

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1. INTRODUCTION

There is significant geochemical, geological and biological interest in the source and fate of methane in marine sediments. Where production rates are high in the near seabed sediments, or pathways through the sediment column allow the migration of deep biogenic or thermogenic gas, methane may escape into the bottom water where gas plumes may be detected by geophysical techniques. Such plumes were potentially identified on seismic records obtained by BGS at the foot of the Barra Fan, west of the Hebrides during surveys in 1985.

A multidisciplinary project has been established to examine geological, chemical and biological aspects of active gas seeps specifically in this Barra Fan area. The project is funded by the Natural Environment Research Council and involves scientists from British Geological Survey, Marine Biological Association and Dunstaffnage Marine Laboratory.

The geological objectives of the project include: searching for and mapping shallow gas and methane hydrate deposits and gas seepage areas on the continental slope east of the Rockall Trough and defining their geological and oceanographic setting; determination of the source of the gas and comparison of the physical and geotechnical properties of sediments at the seep sites with those from the surrounding areas.

Survey methodology comprised: an initial survey of the area with seismic and sonar equipment to locate seeps and gas charged sediments; sediment coring at identified control sites; photography of the seabed; CTD profiles and subsampling of the cored samples for geological, chemical, physical, microbiological and infaunal measurements.

The wide range of equipment and large numbers of scientists required to undertake the various components of this multidisciplinary project presented severe logistic and accommodation problems.

It was therefore decided that the most cost efficient way of meeting the objectives of the project was to undertake the geophysical component of the programme as a separate exercise. This was made possible by extending the charter of the vessel mv Kommandor Michael which was already on contract to BGS undertaking geophysical survey work in the Rockall Trough and Rockall Continental Margin areas. The vessel was already fully mobilised and operational and requiring minimal transit time to the project area.

A total of 17 lines were surveyed on 5 and 6 July 1992, representing a total of 201 line km. Bathymetry and pinger data were acquired on all lines and deep-tow boomer information was acquired concurrently on the first 11 lines. The weather throughout the survey period was excellent.

This summary operations report contains brief details of the survey including a daily log of events, details of the lines surveyed and a description of the equipment used.

The financial contribution from Statoil towards the cost of the geophysical survey is gratefully acknowledged.

2. SURVEY LOCATION

The survey area is located between 56°54'N and 57°02'N and 10°05'W and 09°45'W west of the Outer Hebrides at the foot of the Barra Fan. Water depths across the area vary between 1800 and 2100m.

3. EQUIPMENT OPERATED

1. Deep Tow Boomer

- a) Source: BGS developed deep towed fish based on a Hunttec boomer plate. Operating power 0.5kJ to a tow depth of 800m. Motion compensation applied.
- b) Hydrophone: Short 1m multi-element array towed behind the fish.
- c) Recording: Analogue single channel to a Kemo band pass filter, TSS 307 TVG amplifier, and display on a Waverley 3710 thermal recorder.

Digital - single channel recorded on BGS PC based system in SEG Y format on an Exabyte tape cartridge. Sampling rate was 0.1 msec and record length 600 msec. Recording delay applied for water column. Lines 8-11 only.

2. Pinger

Edo Western 3.5/7.0 kHz transducer in towed fish. Tow depth 5m. Power output 10KW using 515A-248 transceiver. Transducer operated in 7.0 kHz mode.

Recording on a Waverley 3710 thermal recorder, using TSS 307 TVG amplifier.

3. Bathymetry

Atlas Deso 20 with narrow beam deep water 33 kHz transducer rated to 2200m. Data also output digitally to Qubit Trac IV logging system.

4. Positioning System

VERIPOS differential GPS system based on Sercel NR 103 DGPS receiver. This fully integrated unit received both GPS data and differential correction data, carried out the

corrections processing and output a differentially corrected position to the Qubit Trac IV logging system. Correction data were received from shore stations at Wick, Brest and Barra. Two completely independent VERIPOS receivers were operated simultaneously giving 100% back up.

5. **Data Logging**

Qubit Trac IV navigation processor/logger. Using position information input from the VERIPOS system the logger produced navigation information, helmsman display, track plotting to AO drum plotter and fix outputs at 5 minute intervals to all survey recorders, whilst logging navigation and bathymetry survey data at half minute intervals to magnetic tape.

6. **Seismic Firing Control**

BGS seismic control unit to synchronise firing of pinger and deep tow boomer to allow concurrent operation. Firing interval of boomer was 2½ seconds with interleaved firing of pinger to allow 1 second shot interval. An inhibit pulse was provided to the echo sounder at pinger shot instant.

4. EQUIPMENT PERFORMANCE

1. Deep Tow Boomer

The fish was deployed on a cable length of 2,150m and the vessel's speed was adjusted so that it towed at a depth of between 600 and 650m to ensure operation on the same depth compensation range to reduce record scale changes. The equipment operated without problems until the vessel's total power failure between survey lines 11 and 12 on 6 July. Loss of supply of fuel oil to the main engines and generators resulted in a period of almost 1hr 20 minutes during which the vessel was without propulsion and it was impossible to operate the boomer winch. The water depth was less than 2,000m so the fish hit the seabed. When power was restored and the fish eventually recovered onboard it was found that damage was fortunately limited to a badly linked tow cable near the fish termination and failure of the depth compensation transducer. Owing to the nature of the damage and the limited survey time remaining no further use was made of the system.

The fish depth and length of cable deployed were recorded on the Qubit Trac IV. This allowed computation of an approximately layback position for the fish. The cable length deployed was not varied during the survey and a best estimate of 2,000m for the fish layback was used for the survey.

2. Pinger

In pre-survey tests it was found that very poor records were obtained when operating in the 3.5 kHz mode. However, adequate penetration was achieved operating at 7 kHz and this was used throughout the survey without problem. It was found that the outgoing pinger signal interfered with the echo sounder due to the close proximity of the tow sources. This was overcome by inhibiting the firing of the echo sounder at pinger fire time from the seismic

control unit. A second record from the pinger for lines 6-17 was displayed on an EPC recorder at an expanded scale to aid interpretation of the shallow section.

3. **Echo Sounder**

The echo sounder was operating near its depth limit and there were a number of mis-digitisations of the depth values. In these situation a null value was recorded. Pre-processing was carried out in the field to correct this by interpolation and reference to the analogue records.

5. SUMMARY DAILY LOG

4 July 1992

- 2300 Vessel completed survey work in Rockall Trough, with all outboard gear recovered.
- 2300-2400 - Pinger deployed and set up whilst vessel on passage to survey area.

5 July 1992

- 0000-0300 On passage to survey area.
- 0300-0450 Deep tow boomer deployed and towed at a depth of approximately 700m. Layback approximately 2000m.
- 0450 Line 1 commenced with echo sounder, pinger and deep two boomer.
- 0450-2400 Surveying lines 1 to 8.

6 July 1992

- 0000-1030 Surveying lines 8 to 11.
- 1048 Whilst on transit between survey lines the vessel experienced a total loss of power. Main engines stopped and all electrical power failed, therefore unable to operate electro-hydraulic deep two boomer winch to recovery deep tow boomer.
- 1205 Power restored to winch and deep tow boomer recovery commenced.
- 1315 Deep tow boomer on deck. Fish had contacted the seabed and the last 25m of tow cable was badly kinked - requiring retermination. The transducer providing depth compensation was found to have failed.
- 1415 Survey recommenced operating echosounder and pinger only.
- 1415-2245 Surveying lines 12 to 17. Survey terminated.
- 2245 Commenced recovery of pinger and raised the echo sounder transducer.
- 2300 Commenced passage to Leith to demobilise.

6. PROJECT PERSONNEL

A Dobinson)	Party Chief
J B Pheasant)	
C C Graham)	
D J Smith)	BGS Marine Operations
T Fitton)	
N C Campbell)	
A S Mould		BGS Regional Geophysics
D J Leachman		EMOOS Ltd
R Holmes		BGS Marine Geology

7. LINE SUMMARY SHEET - PROJECT 92/02

Serial No.	C1
Survey Area	Barra Fan Profiling
Project	92/02
Vessel	Kommandor Michael

Line No	Last Fix	Start Day	Time GMT	End Day	Time GMT	Differential GPS	Atlas	Deep Tow Boomer	Pinger	Line Length km
1	34	187	0450	187	0735	*	*	*	*	18.6
2	12	187	0810	187	0910	*	*	*	*	8.8
3	14	187	0950	187	1055	*	*	*	*	8.4
4	12	187	1145	187	1240	*	*	*	*	8.1
5	22	187	1330	187	1515	*	*	*	*	13.3
6	22	187	1630	187	1815	*	*	*	*	11.8
7	25	187	1905	187	2105	*	*	*	*	15.5
8	28	187	2155	188	0010	*	*	*	*	18.1
9	37	188	0135	188	0435	*	*	*	*	25.6
10	25	188	0530	188	0730	*	*	*	*	15.0
11	20	188	0855	188	1030	*	*	*	*	13.6
12	11	188	1415	188	1505	*	*		*	7.2
13	12	188	1540	188	1635	*	*		*	6.7
14	9	188	1715	188	1755	*	*		*	5.5
15	16	188	1845	188	2000	*	*		*	10.0
16	12	188	2040	188	2135	*	*		*	8.0
17	12	188	2150	188	2245	*	*		*	7.3