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Cruise Report 71 Charles Darwin

Barra Fan Project

by

J A Chesher

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British Geological Survey
Marine Operations
Murchison House
West Mains Road
Edinburgh
EH9 3LA

Tel: 031 667 1000
Fax: 031 668 4140
Tlx: 727343

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5 AUGUST - 21 AUGUST 1992

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BGS

J Chesher (Party Chief)

D Long

A Mould

N Campbell

S Alexander

G Tulloch

MBA

P Dando

S O'Hara

S Niven

L Taylor

I Bussman (Kiel University, Germany)

F Thiermann (Hamburg University)

P Guyo (Southampton)

DML

R Harvey

J Dibble

P Lamont

RVS

C Paulson

A Hill

Ships Master: Richard A Bourne

B) PURPOSE OF CRUISE

The purpose of this cruise was to locate and sample marine gas and oil seeps on the seafloor of the UK Continental Shelf in the region of the Hebridean Terrace west of the Outer Hebrides in the vicinity of the Barra Fan in water depths in the order of 2000m.

The cruise was undertaken jointly by the British Geological Survey (BGS), Marine Biological Association, Plymouth (MBA) and Dunstaffnage Marine Laboratory (DML) in order to integrate the geology with the biology and chemistry of these seeps in a truly interdisciplinary project.

There is great 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 coloumn 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. In the area under investigation in this cruise such plumes were identified by BGS in 1985 in the continental margin setting at the foot of the Barra Fan, where bottom conditions of temperature $3.5^{-4^{\circ}}$ and pressure 200 atmospheres are well within the temperature pressure stability zone where gas hydrates (clatherates) can occur. These hydrates are not only a source of potential hydrocabron energy but could effect sediment stability.

Associated with the gas seeps are frequently an enriched benthic biota which is often novel and exotic in composition with its biomass as spectacularly high compared to the surrounding sediment. Examples of this fauna are metre long vestimentiferan worms. Sediments in seep areas often have high sulphide concentrations as well as a high hydrocarbon content and can support bacterial-based food chains dependant on both methanotrophy and chemoautrophy.

C) SPECIFIC SCIENTIFIC OBJECTIVES

i) To search for and map shallow gas and methane hydrate deposits and gas seep areas on the continental slope east of the Rockall Trough and define their geological and oceanographic setting.

ii) To determine the source of the gas and study the geological conditions leading to its release.

iii) To compare the physical, geotechnical properties of the sediments at the seep sites with those from the surrounding areas.

iv) To determine the major energy sources available to chemoautolithotrophic and methylotrophic bacteria (eg methane, sulphides, ammonia) in the sediments within the seep area and compare these with concentrations found in sediments on the neighbouring slope.

v) To estimate, using stable isotope measurements the proportion of biomass in the benthos that is dependant on chemoautotrophic and methylotrophic bacteria.

vi) To determine the distribution of methanotrophic bacteria at different sediment levels in both seep and non-seep sites.

vii) To compate the composition, density and distribution of the benthic fauna at seep sites with that at nearby non-seep sites and to relate this to the sediment chemistry.

viii) To study the structural and ecological adaptations of animals living in the seep areas.

ix) To measure the sulphate reduction rates and methane oxidation rates in sediments from seep and non-seep sites.

x) To measure near-bottom current temperature and salinity in seep areas to estimate the dispersion and stability of the near-bed water mass.

D) LOCATION OF AREA

The survey area lies between latitudes 56°30'N - 57°30'N and longitudes 9°30'W - 10°15'W on the Hebridean Terrace west of the Outer Hebrides on the UK Continental Shelf. The geological setting of this area is commonly known as the Barra Fan.

E) SCIENTIFIC EQUIPMENT AND TECHNIQUES

i) The exact location of the seep areas and gas deposits was to be located using shallow seismic reflection techniques. This part of the cruise was undertaken in the previous month by a BGS survey ship already equipped for geophysics and working in the area. This was the most cost effective manner in which to proceed with this part of the work.

ii) Sediment samples were taken using a gravity corer with 5ft, 10ft or 20ft barrels to give in depth profiles.

iii) Surface samples to a depth of ½ metre were obtained using box corers from RVS and IOS. Location of the box corer relative to the ships position was made using a Navtrak navigation system, using a transponder attached to the box corer to give range and bearing and water depth.

iv) Agassiz trawl and an epibenthic sledge were used to take epifaunal seabed samples.

v) Near bottom water mass stability was examined by sections of CTD (conductivity; temperate; and depth) profiles in the area.

vi) Echo sounder traverses using the Simrad EA500 and the pinger were run continuously throughout the cruise.

vii) Sediment cores were cut into two halves and examined for sediment provenance, sedimentation rate (age) and reworking (by bioturbation, mass movement and gas migration). Standard soil mechanics measurements of the physical properties such as shear strength and compressive strength were made. Evidence for early diagenesis were looked for using standard petrographic methods.

viii) Infauna from the samples were examined by sieving the sediment samples through 1000 μm, 500 μm, and 50 μm sieves. Miofauna were processed and subsampled from the cores. The box cores were washed in side section to establish burrow structure and position of animals in the sediment and possible gas channels and sediment layers.

ix) Sediment samples for chemistry were taken at similar depth intervals. Measurements included Eh, pH of interstitial water ammonia, dissolved ferrous iron, dissolved sulphate (by ion chromatography), free sulphide and thiosulphide (by HPLC of the bromobimane derivatives), total reduced sulphur (chromous chloride reducable), element sulphut (by HPLC), methylamine and dimethylamine (by HPLC), hydrogen and methane (by GC of headspace samples of poisoned sediment).

x) Rates of sulphate reduction and methane oxidation in sediment cores were measured by injection of radioisotope-labelled substrates into sediment cores followed by incubation at seabed temperatures.

xi) Selected organisms were fixed for electron microscopy and taxonomic reference.

xii) Symbiotic bacteria were characterised by assaying for key bacterial enzymes, eg ribulosebisphospate carboxlase, hexalosephosphate synthetose, adenylylsulphate reductase.

xiii) Sediment samples from different depths were incubated in a methane-air atmosphere for later isolated of methanotrophic bacteria.

xiv) Samples of species in each box core were acidified to remove carbonates, washed and dried for later determination of $\sigma^{13}C$ and $\sigma^{34}S$.

xv) Navigation of the vessel was by a Veripos Differential GPS System giving an accuracy in the order of ±5 metres for the ships position. Sample station positions and geophysical traverse line were logged on a Trac IV computer system.

Sample locations and descriptions were written onto data sheets and transfered onto computer onboard vessel.

F) EQUIPMENT PERFORMANCE

i) The ship's performance was satisfactory for equipment deployment especially since the weather conditions were particularly favourable for the majority of the cruise. However it should be noted that when the weather reached in excess of force 5/6 deployment of the box corers and gravity corers was not feasible largely due to the inability of the vessel to maintain position.

The access to the wet laboratory, which was in constant use, via the heavy starboard side doors which needed to be kept closed for a significant proportion of the trip is potentially dangerous due to the possibility of trapping ones fingers when trying to open or close these heavy steel doors. An insert access door would be a vast improvement as regards safety and ease of access.

ii) DML, PML and RVS equipment worked well. However a secondary box corer inner would ideally have been required.

iii) The BGS gravity corer system was satisfactory but the requirement to increase line speed resulted in a few problems. The concept of increasing drum diameter by inserting an outer drum to achieve this objective was excellent but unfortunately the stresses on the drum proved excessive for the strength of design resulting in collapse of the outer drum.

Likewise the new aramid cable proved prone to abrasion through the gravity corer trough. The rope had to be continually taped to prevent wear through the outer sheath and exposure of the soft unprotected aramid core. Although an excellent rope its use in this mode is not recommended especially in water depths in excess of 1000m, where a vertical lead of the rope through the gravity corer trough is not practically feasible when holding the vessel on location.

Sample recovery from both the box corer and gravity corer were excellent with a consistent 0.3-0.4 metres recovered from the box corer. However much of the large macrofauna was below this depth as shown by burrows existing from the base of the core. This was in parallel to the evidence from the gravity cores which shows fresh burrows to 1/2 metres depth. 2 - 3 metres recovery was achieved from the gravity corer using a 10ft barrel. Use of a longer 20ft barrel was not generally practicable due to handling conditions in the prevailing seas, and

the samples obtained by the 10ft barrel were considered adequate by the scientific staff.

The Navtrak location system was used for the first time in an operational situation and worked well following prior in-house modifications. Any positional fluctuations were as a result of incorrect transducer depth due to the length of pole provided. This system would provide a satisfactory alternative, to the use of a ships Simrad HPR type system for location and tracking of seabottom equipment such as the BGS Rockdrill/Vibrocorer.

G) RESULTS

Samples taken during Cruise

Gravity corers	61 sites occupied with only one site having no recovery. Total length of core = 138.94m - which averages in excess of 2 metres core recovery per site
Box corers	14 sites occupied with only one equipment failure
CTD	9 successful sites
Agassiz Trawl	1 site
Epibenthic Sledge	2 sites

Geology

i) The box core sample of the top half metre of the seabed gave an excellent 3 dimensional contrast to the in depth sample obtained by the gravity corer. Most samples were taken on the Barra Fan debris although some control sites were taken away from the fan.

ii) A remarkable similarity was present in the cores. This consisted of a thin cover of pale brown sandy mud over normally consolidated soft olive grey silty clay with subhorizontal burrows over very soft unconsolidated sulphide streaked dark greyish brown mud with rare dropstones.

iii) The depth to the sulphide zone was extremely variable ranging from <1m to 72m, Excessive amounts of sulphide were not found.

iv) Sand layers in the lowermost horizons often showed fining upward sequences of less than 10cm, usually 2-5cm in thickness.

v) There was little apparent difference in lithology and geotechnical properties etc between sites of acoustic multi layering and dome sites, although sand layers were generally absent at multilayered sites whereas they were generally present at dome sites.

Areas of hummocky topography are due simply to a denser distribution of dome morphology.

vi) Samples from off the debris fan were less organis rich and less burrowed than on the fan with sands indicating coarsening upward sequence 1-2m thick.

7) The burrows are currently being worked and active to at least 1.5m below the seabed. The 3D nature of the burrow network was well illustrated in the box corers.

Chemistry

Eleven water bottle rosette casts were made for dissolved methane concentration measurements and CTD profiles were taken. Six large box-core samples were sampled for sediment chemistry profiles (pH, Eh, alkalinity, CH_4, NH_{4+}, PO_4^{2-}, SO_4^{2-}, $S_2O_3^{2-}$, HS-, FE^{2+}, total Fe, Mn, and NO_{2-}). Sulphate reduction rates and ammonia and methane oxidation rates were measured. Twenty-one gravity cores were sampled to measure methane profiles and one for sulphide concentrations.

Chemisynthesis

The major invertebrates with endosymbiotic chemisynthetic bacteria found in the box corer were pogonophores. One core was gently dissected from the side using water sprays to examine the tube distribution in the sediment and to relate the position of the animals to the sediment chemistry. Additional cores were partially dissected using hand implements. Animals were fixed for electron microscopy of the bacteria and for enzyme and stable isotope studies.

Pogonophores were consistently found in all the box corers and penetrated to between 17 and 22cm vertical depth before burrowing horizontally in the reducing sediment. This habit is being investigated with respect to the sulphure chemistry of the sediment.

Miofauna

Five box corers were samples for meiofauna species.

Macrofauna

The majority of the spade box corers were screened on a 0.25/0.42mm mesh after subcores had been removed for chemistry. The opportunity was taken to extract the more delicate members of the fauna,

normally fragmented by routine processing. This will provide reference data for quantification of earlier samples. The commonest faunal elements were foraminifera, polychaete worms, burrowing urchins, sipunculan and echiuran worms. Several worms measuring >100mm in length were retrieved from around 25cm deep in some cores. It is known that echiurans can burrow at least a metre deep in some sediments. Commensal bivalves were found in association with one echiuran and one priapulid, and more will probably be found when the samples were sorted. An agassiz trawl in 2000m provided a rich collection of invertebrates and a few fish for studies at Dunstaffnage and Southampton on reproduction and diet. Two epibenthic sled deployments were made in order to obtain large numbers of the smaller macrofauna for the above studies, and for a new initiative on the genetic basis of subspeciation in a bivalve mollusc. The second haul provided a valuable sample from DML northern permanent station which we were unable to visit in March '92 due to bad weather.

H) CONCLUSIONS

i) The initial geophysical survey prior to this cruise failed to locate the gas plumes so evident in the previous survey of this area in 1985.

ii) Analyses from the CTD's of the water column similarly showed no methane enrichment in this area.

iii) Sediment and in depth core samples likewise when analysed showed no increase in the methane profile with background valves in some cores even lower than in known gas free areas.

iv) Although traces of sulphides were present in the samples no specific enrichments were found.

v) No enriched benthic biota or exotic species were found which might have given evidence of gas seeps.

The above facts together raise the question as to whether the features recognised on the geophysics records of 1985 were indeed gas seeps although by comparison with geophysical records in other known seeps this would have seemed to be the case. There is no doubt that there is no evidence of gas at present in this area inspite of an extremely close grid of sampling and analyses.

It seems anomalous that if gas were present in 1985 there is no remaining traces in the sediment profiles. It is possible the gas release from seeps might be triggered by certain events such as earthquakes or seismic activity, but one would expect to see some residual evidence such as significant sulphide enrichment in the sediments or increased associated biota.

One is forced to conclude that the features seen on the earlier records must be due to an alternative explanation other than gas seepage.

I) ACKNOWLEDGEMENTS

Acknowledgements are due to the Master, officers and crew of the Charles Darwin for all their help and assistance given during the cruise both in the working and equally importantly in the social environment.

Thanks are also due to the scientific staff and the efforts of Paul Dando and Robin Harvey and Dave Long in making the survey truly interdisciplinary to try and achieve a common objective.

I must also thank Dr Nigel Fannin for initiation of this project and for proving the opportunity of undertaking such an interesting piece of scientific research.

J) SHIPS LOG

Wednesday 5 August

000 - 1030	Mobilisation Barry, South Wales
2200 - 2400	Departure from Barry and commenced steaming towards survey area

Thursday 6 August

0000 - 1030	Steaming towards survey area
1030 - 1130	Cruise brief, scientific staff, officers and crew
1130 - 1400	Steaming towards survey area
1400 - 1615	Trials of Navtrak system
1615 - 1630	Boat drill
1630 - 1700	Recovering transducer, pole and transponders. The 2 Simrad transducers satisfactory. the Edo western transponder questionable
1700 - 2400	Continued steaming to survey

Friday 7 August

0000 - 1900	Steaming towards survey area
1900 - 2400	Gravity coring (10ft barrel)

Saturday 8 August

0000 - 0800	Gravity coring
0800 - 1030	CTD deployment
1030 - 1150	Manoeuvring onto position for box corer deployment
1150 - 1400	Deploying box corer
1400 - 1700	Evaluation of box core sample and gravity coring at same location
1700 - 2000	Box coring
2000 - 2300	Gravity coring
2300 - 2400	Terminated gravity coring due to collapsed outer drum of winch. Commenced echo sounder and pinger traverses

Sunday 9 August

0000 - 0900 Echo sounder and pinger traverses

0900 - 1100 Box coring. Navtrak lost screen display. Problem diagnosed as faulty board

1100 - 1430 Commenced spooling cable off gravity corer winch onto ships trawl winch in order to effect repairs to gravity corer winch

1430 - 1800 Echo sounder and pinger traverses during winch repair time

2000 - 2400 Echo sounder and pinger traverses while effecting winch repairs

Monday 10 August

0000 - 0830 Echo sounder and pinger traverses

0830 - 1200 Spooling cable back onto gravity corer winch

1200 - 2030 Box coring with both IOS and RVS corers alternating. IOS did not trigger: lowering speed needed to be increased

2030 - 2400 Gravity coring and echo sounder and pinger traverses

Tuesday 11 August

0000 - 0800 Gravity coring

0800 - 1130 Box coring

1130 - 1300 Manoeuvering onto site for dredge

1300 - 1800 Agassiz trawl dredge

1800 - 2000 CTD deployment

2000 - 2400 Gravity coring

Wednesday 12 August

0000 - 0800 Gravity coring

0800 - 2000 CTD deployments

2000 - 2400 Gravity coring east of area to investigate seep potential on slope

Thursday 13 August

0000 - 0800 Gravity coring

0800 - 1830 Box coring in area where main gas plumes were recognised in 1985 by BGS

1830 - 2400 Gravity coring with 20ft barrel to assess if increased recovery achieved. Considerable abrasion on gravity corer rope

Friday 14 August

0000 - 0200 Gravity coring

0200 - 0800 Steaming to DML test control site

0800 - 0830 Preparing to deploy epibenthic sledge

0830 - 1400 Epibenthic sledge traverse

1400 - 1750 CTD deployment and sampling

1750 - 2400 Abandoned operations due to weather conditions and inability of ship to maintain station

Saturday 15 August

0000 - 0600 Hove due to weather

0600 - 0800 Gravity coring back in survey area

0800 - 1000 Steaming to most promising gas site in survey area

1000 - 1500 Deployments of CTD's

1500 - 2400 Gravity coring up the slope

Sunday 16 August

0000 - 0800 Gravity coring

0800 - 1210 Box coring

1210 - 1400 Traversing with pinger and echo sounder to locate valley at foot of slope

1400 - 1700 Box coring in valley

1700 - 1830 Slack turns on box corer winch rectifying situation

1830 - 2030 Deployment of box corer

2030 - 2300 Steaming west towards gravity corer sites

2300 - 2400 Gravity coring

Monday 17 August

0000 - 0800 Gravity coring

0800 - 1200 Deploying box corer

1200 - 1400 Steaming to trawl site

1400 - 1900 Epibenthic sledge trawl

1900 - 2300 Steaming to gravity core site

2330 - 2400 Gravity coring

Tuesday 18 August

0000 - 0800 Gravity coring

0800 - 1700 Box coring

1700 - 2100 Abandoned sampling due to weather

2100 - 2400 Gravity coring

Wednesday 19 August

0000 - 1000 Gravity coring

1000 - 2400 Steaming to Barry

Thursday 20 August

0000 - 2400 Steaming to Barry

Friday 21 August

0000 - 0900 Steaming to Barry

0900 - 2400 Demobilisation at Barry

DARWIN 71/92 August 1992
Internal cruise report for DR. J.D.Gage

Summary:

Biological samples obtained on the cruise consisted of twelve box cores, two epibenthic sled hauls and one Agassiz trawl. Most box cores were sub-sampled for chemical, meiofauna and bacteria samples before sieving onto 0.25 and 0.42 mm sieves. Some box cores were sampled for Pogonophores and obvious fauna only and were not sieved. The two epibenthic sled samples were examined as sieving progressed and fresh bivalve specimens were removed and placed in liquid nitrogen. The remainder of the sled samples were preserved in formalin. The Agassiz trawl was towed over ground expected to harbour methane gas seeps but the otherwise good haul of invertebrates did not seem unusual in any way.

Procedures:

Successful box core samples were sub-sampled for chemical analysis, meiofauna and bacteria. After sub-sampling, the remainder of the cores were elutriated in two fractions with the lower clay layer being kept separate from the softer upper mud which contained the majority of the fauna. Prior to removal of the core mud the surfaces were closely examined and as far as time permitted, surface fauna were exposed and removed by washing with a wash bottle and latterly with fine sprays made up from pressure tubing fed from the ship's non-toxic supply. Delicate Foraminiferans and other structures such as polychaete tubes were placed in seperate small jars to minimize further damage. Pogonophorans from a number of cores were removd and retained by PML (Dr. Dando). Processing box cores through final sieves of 0.25 mm proved lengthy and could take three to four people four to five hours. After treating a few cores using this time consuming procedure a compromise was reached where the top layer of softer mud was washed onto a 0.25 mm sieve whilst the lower, more solid layer, was washed onto a 0.42 mm sieve.

The water supply from the ship's fire hose system registered 23 degrees and it was considered undesireable to soak the sediment in the bins at this temperature. Sediment was therefore soaked and agitated by hand in buckets of sea-water from the non-toxic supply which was cooler.

Fauna:

Box cores

Altogether about seven specimens of Hemiaster were found in box cores 440, 444 and 435. One (30 mm long) in core 435 was photographed in situ at the bottom of the softer brown layer of mud. Several smaller specimens (c10 mm long) were found less than 20 mm from the surface in the same core. Burrows of 8 to 10 mm diameter were found at all depths in most cores. Similar burrows occurred as deep as 1.4 M from the surface in BGS gravity cores. These were probably made by echiuran, sipunculid or priapulid worms which were found singly in several cores including 434, 430, 444, 440. One echiuran (SBC 440) was found with commensal bivalve and in 438 a priapulid, also with commensal bivalve was found. Agglutinated and soft-bodied Foraminifera were common. Extensive, dichotomously branching mats of (?) Rhizammina algaeformis (Brady) commonly covered most of the cores just below the surface. Many partly buried soft-bodied Foraminifera were removed intact from the surface by gentle washing before the cores were sieved. Several specimens of Bathysiphon were extracted from 440 where they occurred in a vertical position buried just below the surface.

Sled samples

ES442 and ES439 differed in character. ES439 half filled the extension net (0.5 mm mesh) and was dominated by Zoroaster, corals and scaphopods among the megafauna. ES442 just overflowed the end pot and was dominated by Bathybiaster, Hymenaster, Zoroaster, Benthopecten, Ophiomusium and E. affinis among the megafauna. White, calcareous

spheres 3-4 mm diameter (Foraminifera) were common in the sample.

Agassiz

The Agassiz haul (AT436) included Echinus, O. lymani Brisinga, Bathybiaster, Plutinaster, Pseudarchaster, Benthopecten, one Asteromyx, one Umbellula and two Pennatula plus a few branches of Acanella. The few fish included Synaptobranchid, Antimora and Coryphenoides. No unusual, possible vent, fauna was observed.

Box core sample processing:

Previous procedures used for box cores were adhered to on this cruise. However there is an argument for reappraising these established procedures and introducing an alternative approach.

At present mud from the box is removed by hand and placed in the elutriation bins to be washed onto the sieve arrangement. This method works satisfactorily with the samples from epibenthic sleds for which it was originally intended. These samples are composed of mud from the top few centimetres of the benthos. This mud is softer than the lower layers sampled by the box corer. The soft, top mud layer suspends readily in the elutriating sea-water flow in the bins and delicate animals tend to be washed undamaged onto the sieves. In addition the action of the epibenthic sled and its long journey to the surface result in some pre-washing of the sediment. Sled samples tend thus to be relatively quickly processed on board when sieves of 0.4 mm are used.

The elutriation procedure in practice is neither suitable nor efficient with box core samples and sieves of 0.3 mm or finer.

A successful box core sample captures a portion of the sea bed with undisturbed bottom water overlying. Delicate animals on the surface or just below and those whose burrows extend below the surface for a few centimetres suffer and are damaged or fragmented when the mud is mechanically removed into the elutriating bins. Damage can even occur to more delicate form when the overlying water is drained off. Data on spatial arrangement of the fauna is lost unless, as on this cruise, fortuitously recorded when specimens were obvious or extra care and time was taken to examine the surface and flush clear any surface features or recognisable fauna.

Sieves of 0.42 to 0.45 mm pass the bulk of the matrix (Foraminifera shells) of the solid component of benthic oozes. When a finer sieve of 0.25 mm is used the bulk of the matrix is retained and the process of washing the sample on deck takes about three to four times as long. In addition, the more solid lower layer obtained by the box corer requires to be mechanically broken up and vigorously agitated to make a suspension suitable for sieving. Fauna in this layer seems to be scarce which is perhaps fortunate, since there seems to be no other way of passing it through a sieve in a reasonable time.

Design criteria for a new procedure should include;

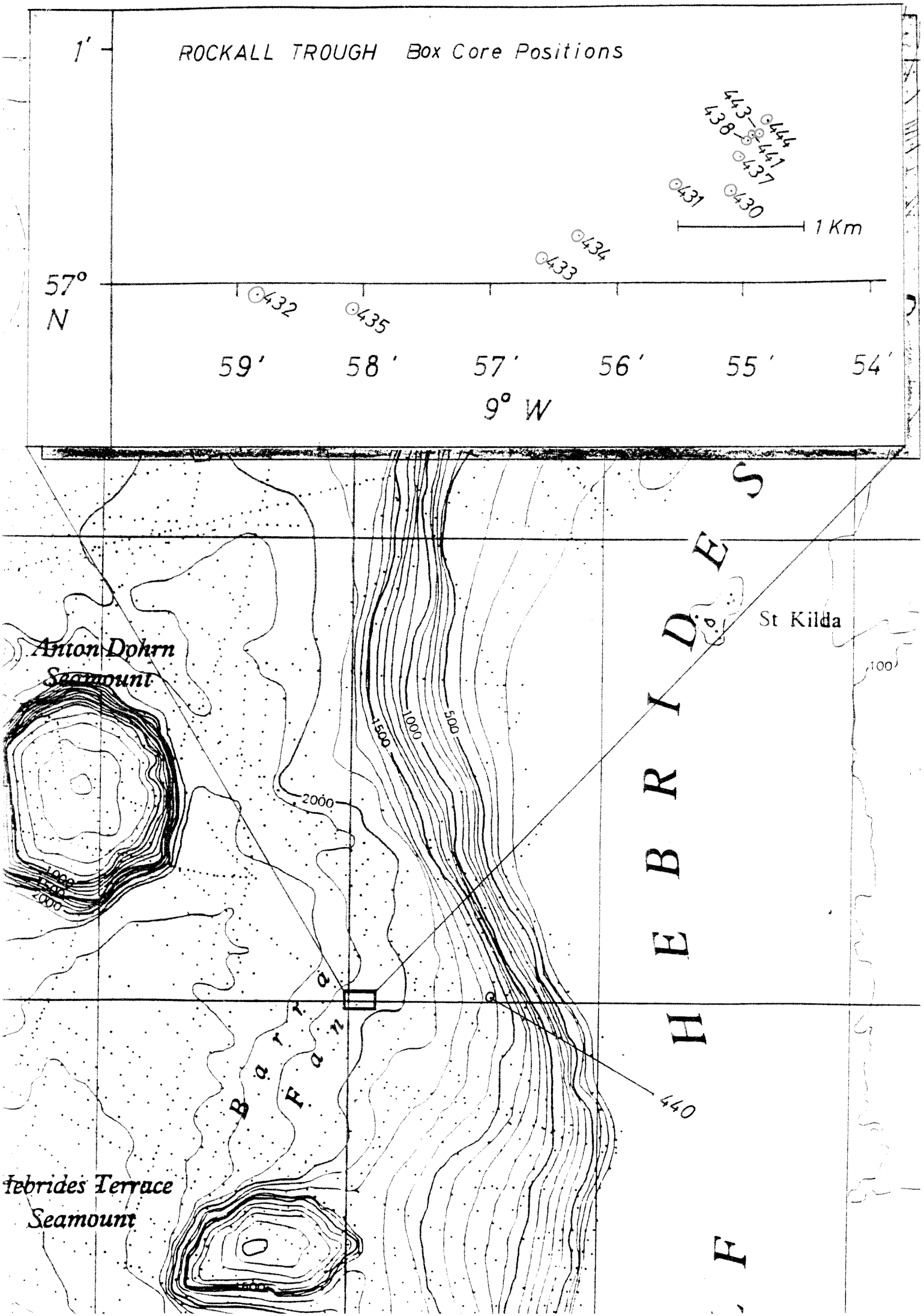
1. removal of delicate fauna undamaged
2. convenient recording of spatial arrangement of fauna
   (photographic, gridded paper)
3. minimum requirement for operator skill
4. precision control of filtered (cold) sea-water supply
   ie. running pressure,
   delivery volume,
   jet type (fine/coarse spray)

P.Lamont, R.Harvey, J.Dibble

DARWIN 71/92

Spade Box Cores; processing summary

CORE	sieves; 0·25 mm	0·42 mm	
SBC430	all		
43			
SBC431	top layer	-	lower layer picked
SBC432	all		
SBC433	all		
SBC434	top	lower	
SBC435	all		
SBC437	top layer	lower	
SBC438	top	lower	priapulid + bivalve
SBC440	top	lower	echiuran + bivalve
SBC441	- not sieved -		excavated with water jets
SBC443	- not sieved -		" " " "
SBC443	- not sieved -		Pogonophora removed (Sibloglinum eckmani)
SBC444	top	lower	


1'
ROCKALL TROUGH Box Core Positions
443
444
438
441
437
431
430
1 Km
434
433
57°
N
432
435
59'
58'
57'
56'
55'
54'
9° W
HEBRIDES
St Kilda
Anton Dohrn
Seamount
2000
1500
1000
500
100
Barra Fan
440
Hebrides Terrace
Seamount

Box Core Summary

SAMS	BGS Station	MBA	Date	Time GST	Depth	Latitude	Long.	Temperature Uncorrected	Temperature Corrected	Macrofauna	Meiofauna	Foraminifera	Depth	SO_4 Reduction	CH_4 Oxidation	NH_4 Oxidation	CH_4	H_2	pH	Eh	Alkalinity	NH_4	PO_4	NO_3	Fe ex	Mn	SO_4 S. spp.	Insol S spp.	
SBC																													
430	57	10153	CD1	9/8/92	1318	1000	57 [illegible] N	[illegible]	2·4	3·9	*	*			*	*	*			*		*			*		*		*
431	57	10155	CD2	9/8/92	1807	1989	57 00 41 N	9° 55 53 W			*	*	*	*	*				*										
432	57	10156	CD3	9/8/92	1817	1993	56 59 93 N	9° 56 83 W	2·3	3·8	*	*	*	*	*		*	*	*					3	x				
433	57	10158	CD4	10/8/92	1415	1982	57 00 10 2N	9° 56.574 W	2·1	3·7	*	*	*	*	*		*	*	*		*			*	*	x	x		
434	57	10160	CD5	10/8/92	1916	2026	57 00 21 N	9° 56 30 W	2·5	4·0	*	*	*				*	*	*										
435	57	10157	CD7	11/8/92	1040	2012	56 59 84 N	9° 58 081 W	2·3	3·6	*	*	*	*	*		*	*	*										
437	57	10180	CD17	15/8/92	1002	2025	57 00 [illegible] N	9° 55 03 W	2·1	3·[illegible]	*	*	*		*		*	*	*	*		*							
438	57	10183	CD13	15/8/92	1719	2026	57 00 61 N	9° 5498 W			*									*	*	*	*	*	*	x			
440	57	10193	CD3	17/8/92	1412	1624	57° 00 5[illegible] N	9° 25 64 W	2·9	4·4	*																		
441	57	10201	CD31	17/8/92	1016	2026	57° 00 6[illegible] N	9° 54 933 W					*										*	*	*	*			
444	57	10203	CD33	18/8/92	1457	2023	57 00 62 N	9° 5480 W			pickled core		*						*										
443	57	10202	CD34	18 8 92	1007	2025	57 00 618	9 5488 N			pickled core		*																

RVS SAILING INSTRUCTIONS ***RVS REF: P11/71/92***

RRS CHARLES DARWIN : CRUISE 71 /92 : 5 August - 22 August 1992

To: The Master

1. ***Ship's Programme:***

a) *RRS CHARLES DARWIN is to sail from Barry on Wednesday 5 August 1992 with members of Plymouth Marine Laboratory and Scottish Marine Biological Association on board to investigate the goeological and biological aspects of gas seeps off New Scotland.*

b) *The outline schedule is given below:*

Sunday 2 August	*:1900:*	*Arrival Barry* *Commence Demob Cr 70* *Mobilisation Cr 71.*
Monday 3 August	*: am :*	*Load bunkers* *Unload scientific equipment.* *Disembark scientific party.*
Tuesday 4 August	*: am :* *: pm :*	*Load bunkers* *Scientific party joins.*
Wednesday 5 August	*: am :*	*Sail Barry (HW 1227 BST)*
Saturday 22 August	*: pm :*	*Arrive Barry.(HW 1248 BST)*

2. ***Scientific requirements:***

a) *It is required to undertake investigations into GAS EMISSIONS in the region of 57 05'N 9 40'W. Sediment sampling will be undertaken.*

b) *Equipment to be utilised includes Gravity and Box corers.(Supplied by BGS)*

3. ***Scientific Party:***

a) *From BGS Edinburgh*

Dr John Chesher	*Principal Scientist*
Neil Campbell	
Dave Long	
Alan Mould	
Graham Tulloch	
Sheila Alexander	

From DML

Robin Harvey
Peter Lamont
Jane Dibble

	:	*Flag Officer Scotland and Northern Ireland*
Dunstaffnage Marine Laboratory, Oban	:	*Cruise participants (3)*
Plymouth Marine Laboratory	:	*Cruise participants (7)*

From PML

Dr Paul Dando
Sean O'Hara
Stewart Niven
Lesley Taylor
Ingeborg Bussman
Frank Thiermann
Phillipe Guyo

From RVS
Chris Paulson

b) The scientific party will embark on the afternoon of Tuesday 4 August in Barry and will disembark on 23 September in Barry.

4. **Agents:**

BARRY:

Research Vessel Services
No 1 Dock
Barry
South Glamorgan
CF6 6UZ

Tel: (0446) 737451
(24 hours)
Fax: (0446) 720562
Tlx: 497101 RVBASE G
E Mail: RVSOPS@ua.nrb.ac.uk

5. **Special Instructions:**

a) Scientific staff are reminded of their responsibility to provide their own personal safety working gear (vis. hard hat & safety boot/shoes).

P.E. Stone

pp. *Dr C W Fay*
Superintendent RVS

DISTRIBUTION:

Ship	:	*The Master RRS CHARLES DARWIN (10)*
Principal Scientist	:	*Dr J.A. Chesher B.G.S. Edinburgh (8)*
RVS	:	*Normal internal circulation & participants(24)*
NERC Headquarters	:	*Director Marine Sciences*
	:	*Director NSS*
	:	*Marine Planning Office*
Ministry of Defence	:	*Hydrographer Taunton*
	:	*Flag Officer Submarines (for CTF 311)*