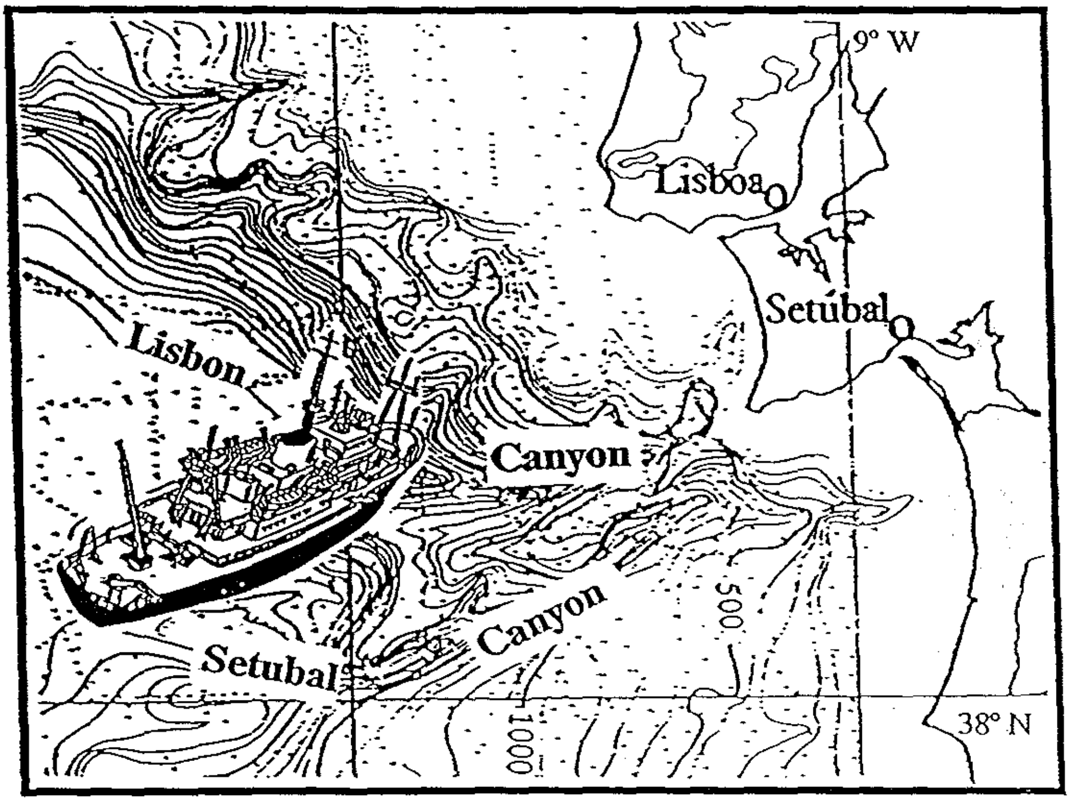
# DISCOVERY CRUISE
# 186




## LISBON AND SETUBAL CANYONS

21 Sept.- 16 Oct. 1989

**Part A Chronological Report of Cruise**

Introduction

Discovery Cruise 186 was planned to study benthic processes in submarine canyons, and on the continental slope and abyssal plains off the Iberian Peninsula.

The overall aim was to compare sedimentary environments from canyons and adjacent slope and abyssal plain areas off Western Portugal with respect to the structure of their biological communities and the relationship between these communities and the microbial, geotechnical and geochemical properties of the sediments.

The cruise itself was one of the most successful that the senior scientists have participated in. All of the gear worked well almost continuously and all the the seabed transponder arrays were extremely successful. We had good weather throughout the cruise, and the Master, ship's officers and crew provided an outstandingly efficient service.

The cruise was divided into two legs. Leg one was from Funchal, Madeira to Lisbon, Portugal, during which we sampled three abyssal plains, and leg two was from Lisbon to Lisbon during which we intensively sampled the canyons off Lisbon and the adjacent abyssal plain area.

The major pieces of equipment used during the cruise were the spade box corer (divided and undivided), the multicorer, the O.T.S.B. trawl, the Agassiz trawl, the seabed cameras, the seabed transponder array, the precision echo sounder and the 3.5 kHz profiler. There were no major problems with any of this equipment.

Cruise Participants

| | |
|---|---|
| Mr P.S. Meadows | Principal Scientist. Joint Cruise Coordinator, Glasgow University. |
| Dr P.A. Tyler | Joint Cruise Coordinator, Southampton University. |
| Dr J.D. Gage | Scottish Marine Biological Association, Oban. |
| Dr J.P. Robinson | Queen Mary College, London University. |
| Dr D.S.M. Billett | Institute of Oceanographic Sciences, Godalming (Leg 1 only). |
| Dr S.J. Wakefield | University College, Cardiff. |
| Miss A. Tufail | University of Glasgow. |
| Dr A.C. Reichelt | Marine Science Laboratories, Menai Bridge, Anglesey. |
| Mr R. Harvey | Scottish Marine Biological Association, Oban. |
| Mr B. Boorman | Institute of Oceanographic Sciences, Godalming (Leg 1 only). |
| Mr J.S. Waterworth | Queen Mary College, London University. |
| Mr C. Memon | National Institute of Oceanography, Karachi, Pakistan. |
| Mr M.S. Hariri | University of Glasgow (leg 2) |
| Mr I. Saleh | " " " " |
| Mr A. Demircan | " " " " |
| Mr S. A. Coates | " " " (leg 1) |
| Mr G.M. Tucknott | University of Glasgow (leg 1) |
| Miss L. de S. Campos | Southampton University |
| Miss L.A. Giles | " " |

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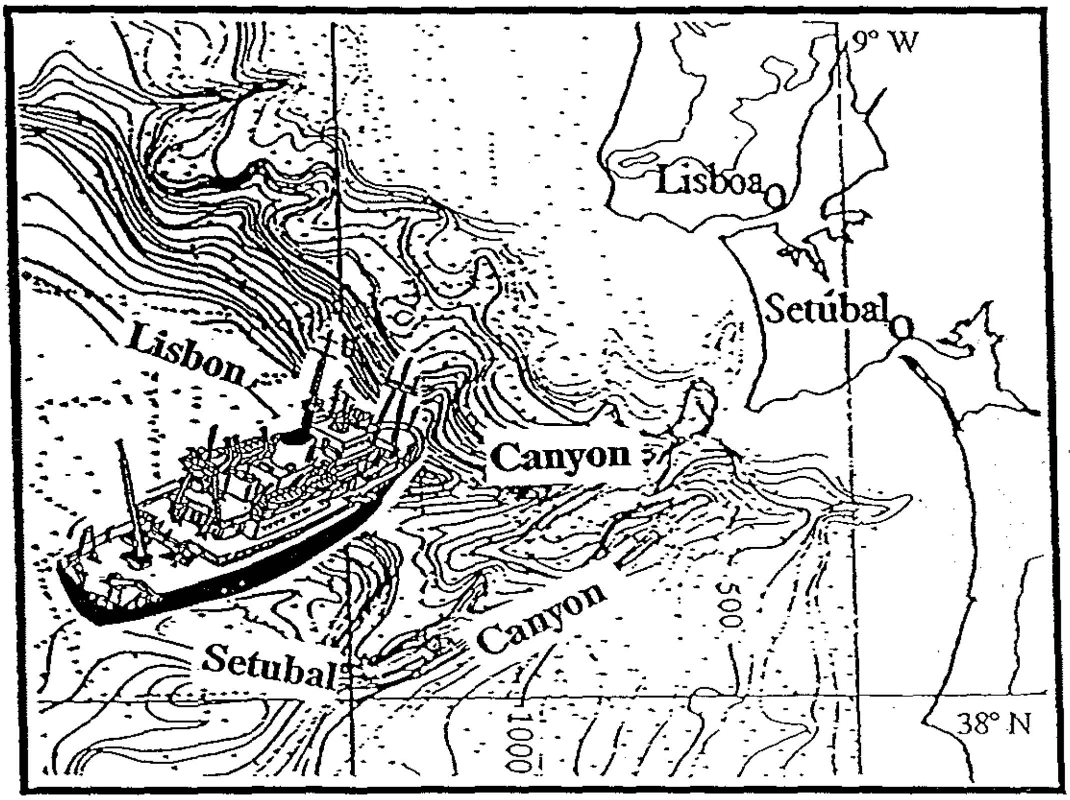



## LISBON AND SETUBAL CANYONS

21 Sept.- 16 Oct. 1989

| | | |
|---|---|---|
| Mr R.P. Griffiths | R.V.S. Barry. | |
| Mr R.A. Phipps | R.V.S. Barry. | |
| Mr C.H. Woodley | R.V.S. Barry. | |
| Mr D.G. Booth | R.V.S. Barry. | |
| Dr M.H. Costa | New University, Lisbon. | Portuguese observers |
| Mr J. Goncalves | Lisbon University. | |

Leg 1. Scientific Programme and Stations

Figure 1 shows the cruise track and Table 1 gives the station data. Discovery was delayed 24 hours in Funchal, Madeira because of non-arrival of baggage containing essential scientific equipment.

**Thursday 21st September**

07.00 hrs Discovery departed from Funchal, and steamed to the first station (Discovery station 11909).
17.30 hrs Discovery arrived at St. 11909 on the Seine Abyssal Plain (31°N, 16°W). The OTSB trawl was deployed in 4400 m (11909.1) and successfully retrieved.

**Friday 22nd September**

The multicorer was then deployed (11909.2) but failed to take sediment samples. Minor repairs to the brackets above the cores were then undertaken by RVS technicians. The multicorer was deployed again (11909.3) and successful sediment samples obtained.

We finished station 11909 at 17.00 hrs and then steamed to station 11910.

**Saturday 23rd September**

21.00 Discovery arrived at station 11910 (35° 23'N, 14° 30'W) and the OTSB trawl was successfully deployed and recovered in 4300 m water depth.

**Sunday 24th September**

Discovery left Station 11910 at 10.00 hrs to steam to Station 11911.

**Monday 25th September - Thursday 28th September**

Discovery arrived at station 11911 (38° 0'N, 11° 40'W) at 02.30 hrs. This was the major station on leg 1 of the cruise and was in 5040 m water depth. We firstly obtained a successful multicore sample (11911.1), and then proceeded to lay a network of four transponders on the sea bed. The sea-bed transponder array allowed extremely accurate positioning of the subsequent box cores that were obtained. 10 box core drops were undertaken (11911.2-6 and 8-12) of which 8 provided good sediment samples. The OTSB trawl was successfully deployed and retrieved as 11911.7.

The box coring at this station was completed at 15.40 hrs on 28.9.89. However because of shortage of time, we began retrieving the transponders from the sea bed at c. 14.00 hrs. All the transponders were retrieved before darkness, owing to the excellent seamanship by the Master, Officers and crew.

The transponders had to be retrieved during daylight because they have no lights on them. It is strongly recommended that in future lights be fitted to all transponders operated by RVS Barry, both as a matter of ship safety and of ship efficiency. This is a matter of considerable urgency and needs immediate attention. The cost is small compared to the cost of the ship's time that would be saved by being able to retrieve the transponders at night.

**Friday 29 September 1989**

Following the completion of station 11911 Discovery steamed to Lisbon at the end of leg 1. On the way (07.30-09.45 hrs on 29.9.89) we conducted a preliminary P.E.S. survey of the Lisbon Canyon complex that we would be studying on leg 2. This survey was done under very congested conditions of shipping and fishing buoys, and the Master decided that the near shore area should not be surveyed at night.

Discovery reached Lisbon at 12.00 hrs 29.9.89. On arrival, we found that two Portuguese observers had been allocated to the cruise by different Universities in Lisbon (Dr Helena Costa, New University and Mr Jose Goncalves, Lisbon University). After consultation by telephone with Mr C. Adams RVS Barry, we were able to accept both observers on Discovery following consultation with the Master. This brought the scientific personnel on the cruise to 21.

Four scientists left and four joined Discovery at Lisbon.

Figure 1. Leg 1: The cruise track of Discovery 186
Funchal (Madeira) to Lisbon (Portugal)
21/9/89 to 29/9/89.

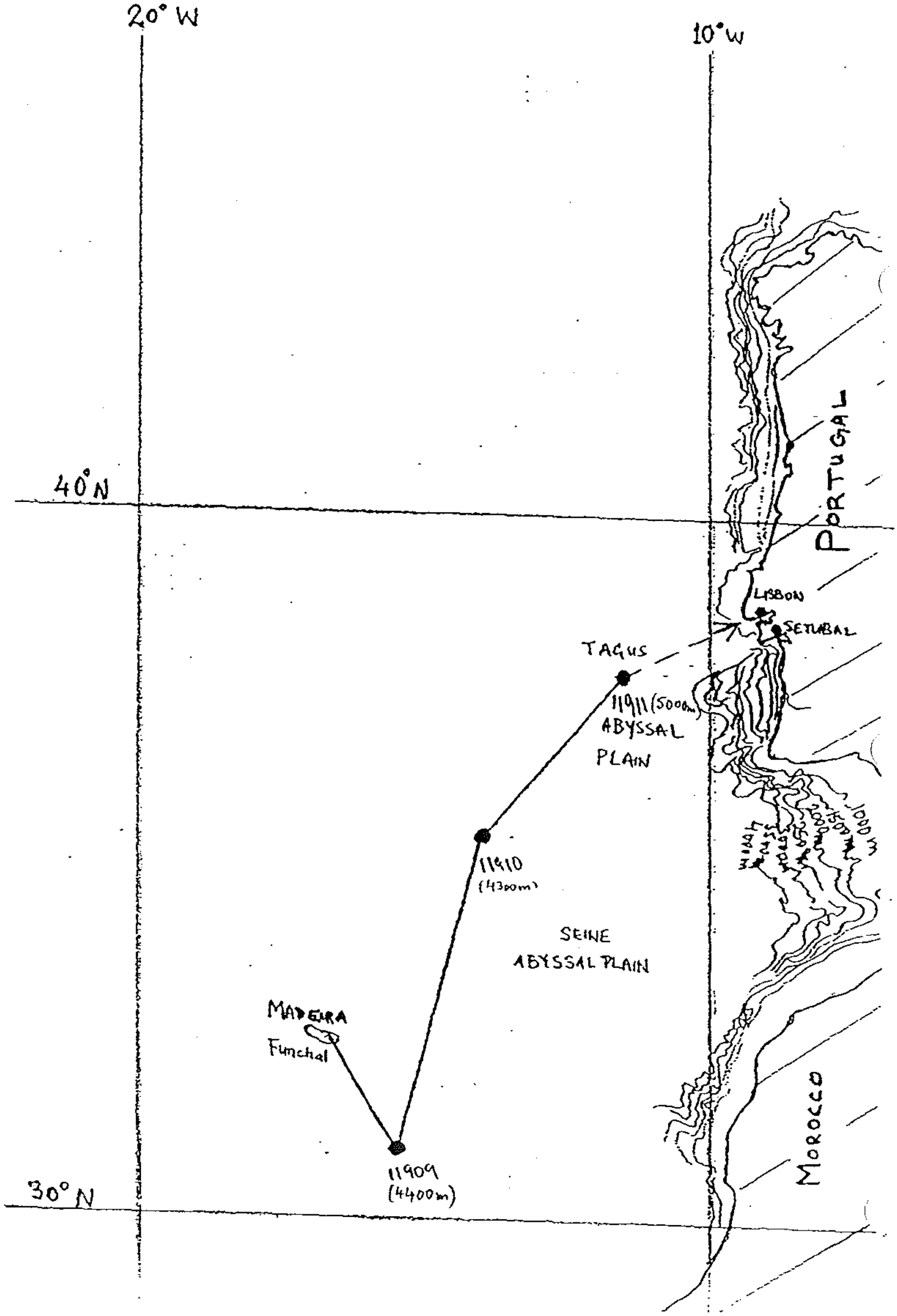


Table 1 STATION POSITIONS FOR DISCOVERY CRUISE 186 LEG 1

| Station | Date | Latitude(N) | Longitude(W) | Depth(m) |
|---|---|---|---|---|
| OTSB 11909.1 | 21/09/89 | 31° 03.335' | 16° 30.370' | 4400 |
| MC 11909.2 | 22/09/89 | 31° 24.994' | 16° 21.527 | 4405 |
| MC 11909.3 | 22/09/89 | 31° 27.22' | 16° 22.88' | 4405 |
| OTSB 11910.1 | 23/09/89 | 35° 48.1' | 14° 23.1' | 4300 |
| MC 11911.1 | 25/09/89 | 37° 59 202' | 11° 38.436' | 5040 |
| SBC 11911.2 | 25/09/89 | 37° 59 81' | 11° 40.12' | 5030 |
| SBC 11911.3 | 26/09/89 | 37° 59 838' | 11° 39.879' | 5035 |
| SBC 11911.4 | 26/09/89 | 37° 59 888' | 11° 40.478' | 5035 |
| SBC 11911.5 | 26/09/89 | 37° 59 975' | 11° 40.083' | 5035 |
| SBC 11911.6 | 26/09/89 | 37° 59.205' | 11° 40.118' | 5035 |
| OTSB 11911.7 | 26/09/89 | 38° 00.0' | 11° 32.7' | 5035 |
| SBC 11911.8 | 27/09/89 | 37° 59.915' | 11° 40.169' | 5035 |
| SBC 11911.9 | 27/09/89 | 37° 59.955' | 11° 40.26' | 5035 |
| SBC 11911.10 | 28/09/89 | 37° 59.784' | 11° 39.971' | 5250 |
| SBC 11911.11 | 28/09/89 | 37° 59.883' | 11° 40.113' | 5035 |
| SBC 11911.12 | 28/09/89 | 37° 59.979' | 11° 40.242' | 5035 |

Leg 2 Scientific Programme and Stations

Figure 2 shows the cruise track and Table 2 gives the station data.

Leg 2 was to be a near shore survey and benthic sampling programme of the canyon complex and slope off Lisbon and the adjacent abyssal plain. Box coring, and in the latter stages Agassiz trawling, were interspersed with 3.5 kHz and PES surveys over the whole area. The transponder array was laid once, at station 11912.

**Friday 29th September 1989**

Discovery left Lisbon at 18.00 hrs 29.9.89 and steamed S.W. looking for suitable ground in the area between 38° 23'N, 9° 20'W and 38° 19'N, 9° 16.5'W. After some PES searching approximately a flat bottom was found at 38° 18'N, 9° 17'W, which became station 11912, water depth 1430-1650 m. We conducted a successful Multicorer sample (11912.2) after one initial failure (11912.1) and then a successful spade box core sample (11912.3).

**Saturday 30th September 1989**

Discovery left station 11912 at 06.30 hrs and began a series of 3.5 kHz and PES transects in a grid pattern up the proximal Lisbon Canyon, which was completed at 19.00 hrs. During this survey the PES towed transponder was damaged by a fishing line, and took 24 hours to repair by RVS technical staff. In the meantime the PES hull transponder was used.

Station 11913 at the head of the proximal Lisbon Canyon in 65-75 m water depth (38° 34'N, 9° 16'W) was begun at 19.00 hrs, and consisted of an unsuccessful Multicorer sample (11913.1) two successful Multicorer samples (11913.2 and 3) and a successful camera drop (11913.4).

We then conducted an overnight 3.5 kHz and PES transect from 38° 25'N, 9° 38'W to 38° 12.5'N, 9° 19'W.

**Sunday 1st October 1989**

Discovery conducted 3.5 kHz and PES transects in a grid pattern up the proximal Setubal Canyon, from 06.00 hrs to 15.30 hrs, and then established station 11914 38° 19.5'N, 8° 50'W which was on the shelf in 60 to 66 m water depth. At this station a successful camera drop (11914.1) and spade box core sample (11914.2) were obtained. The spade box corer brought up coarse gravel/sand. This is an interesting result because it is in complete contrast to the sediment at the top of the proximal Lisbon Canyon - which was extremely fine fluid mud.

From 16.00 hrs to 20.00 hrs, PES surveys were conducted at the top of the proximal Setubal Canyon to define a suitable flat bottom at about 250 m. This was found at 38° 18'N, 8° 53'W in 240 m water, which became station 11915 Two spade box cores (11915.1 and 6) and two multicore cores (11915.2 and 3) were successfully obtained.

**Monday 2nd October 1989**

Discovery left station 11915 at 00.30 hrs and steamed SW to 38° 2'N, 9° 31'W, and then conducted a PES and 3.5 kHz transect on 346° to 38° 25'N, 9° 38'W across the distal ends of the distal Lisbon and distal Setubal Canyons.

We then steamed to 38° 28'N, 9° 24'W and conducted another PES and 3.5 kHz transect on 155° to 38° 18.6'N, 9° 18.5'W, continuing on 112° to 38° 13.3'N, 9° 1.4'W. The second part of this profile was chosen to transect across station 11912 conducted 2 days previously. We then steamed to 38° 19'N, 9° 35.5'W, which was station 11916 in 2600 m water, arriving there at 20.30 hrs. The station was in the middle of the distal part of the Lisbon canyon. A successful spadebox core(11916.1) and camera drop(11916.2) were undertaken. The spadebox core material was unusual, containing some unexpected reddy/brown sediment layered towards the bottom, and some rock fragments at the bottom of the core.

**Tuesday 3rd October**

We then steamed to station 11917 (38°05'N, 9°42'W) in 3400 m water depth at the lower end of the distal Setubal Canyon, and undertook a successful spadebox sample (11917.1).

Station 11917 was followed by a PES and 3.5 kHz profile on 340° to 350° from 38°00'N, 9°41'W to 38°27'N 9°46.7'W, experiencing some minor navigational alterations of course during the afternoon, including passing the Canberra, because we were on the seaward edge of a shipping lane. This profile was designed to include the positions of stations 11917 and 11918. The profile was completed late afternoon on 3.10.89 under almost flat calm conditions, which had been experienced during the whole of the cruise, and we then steamed to 38°19'N, 9°45'W, hoping to establish station 11918 there. However inspection of the PES and 3.5 kHz record for the upper distal Lisbon canyon showed that the seabed along the transect was very rugged and mountainous except where the transect crossed the telephone cable running SE-NW. No seabed activities are allowed 1 nm either side of this. We therefore transected at 5 kts from 38°21'N 9°46'W at 19.34 hrs to 38°15'N 9°55'W on 226° until 21.20 hrs, looking for a flat bottom on which to boxcore. No flat bottom was found except where a telephone cable transected the canyon. We could not spadebox core here for obvious reasons. A PES and 3.5 kHz survey was then conducted from 38°15'N 9°55'W on 168° to 38°N 9°51'W looking for the canyon base leading into the lower distal Setubal Canyon. It was found at c. 38°6.5'N 9°52'W to which we returned at the end of the transect to make this the position of station 11918.

**Wednesday 4th October**

Station 11918 was begun at 02.00 hrs at 38° 7'N, 9°53'W in 3840-4200 m. Two spadebox cores were successfully obtained at 11918 (11918.1 and 2).

At both 11917 and 11918 traces of sea grass were found in the sediment samples suggesting that the distal Setubal Canyon may be active in feeding material from the proximal Lisbon Canyon onto the Tagus Abyssal Plain. Station 11918 was completed at 11.45 hrs.

We then conducted a PES at 3.5 Khz transect across the mouth of the distal Setubal Canyon from station 11918 to 38°N, 9° 46'W and then to 38°10.4'N 9°46'W in order to identify the deep channel leading from the Canyon onto the abyssal plain. This transect was then continued NE along the hill between the distal arms of the Lisbon and Setubal Canyons to the hillock at 38°18'N 9°25'W, and then NW to the upper reaches of the proximal Lisbon Canyon. This transect proved that there was a well-defined ridge running between the hillock and the northwest side of the proximal Lisbon Canyon which almost certainly prevents any sediment from the proximal Lisbon Canyon reaching the distal Lisbon

Canyon. The sediment almost certainly discharges into the distal part of the Setubal Canyon. At the end of this transect, 38°28.47'N, 9°18.28'W, we conducted a series of short transects across the Canyon at a canyon bottom depth of c 700m, in order to establish a flat sediment in the V of the canyon in which to box core. This was found at 690 m, at the above latitude and longitude. Station 11919 was established here and careful positioning of the ship enabled two box cores (11919.1 and 2) and a camera drop (11919.3) to be conducted in 760 - 800m.

**Thursday 5th October**

Station 11919 was completed at 01.40 hrs. We then steamed to station 11920 38°5.5'N, 9°41'W, c 3400 m water depth, arriving there at 06.00 hours. Station 11920 was a major station at which a series of box cores were to be taken

A sound velocity profile was taken prior to laying the transponders. At this stage it was realised that the canyon was so narrow that more detailed PES and 3.5 kHz profiling was required in the immediate area of the station within a 5 nm x 2 nm area along the axis of the canyon. This was conducted until 09.30 hrs.

The four transponders were then deployed between 16.00 hrs to 21.15 hrs in a rectangular array along the axis of the canyon on an area chosen from the survey. The precise locations of the 4 transponders, which were established in a rectangle along the SW-NE axis of the canyon, and of the central target were:

| | | | | |
|---|---|---|---|---|
| Transponder | A | : | 38°6.0'N | 9°40.6'W |
| " | B | : | 38°5.4'N | 9°40.65'W |
| " | C | : | 38°5.1'N | 9°41.4'W |
| " | D | : | 38°5.75'N | 9°41.5'W |

Target : 38°5.65'N 9°41.0'W

Water depth within the rectangle 3250 to 3450 m.

**Friday 6th October**

The positioning and calibration of the transponders were completed at 02.00 hrs. Box coring was then begun, and continued through Saturday 7th October.

**Sunday 8th October**

The last of the 10 successful box cores at station 11920 was retrieved inboard at 00.58 hrs. A camera drop was then successfully done and the four seabed transponders retrieved by midday.

A 3.5 kHz and PES profile was then conducted up the centre of the distal Setubal Canyon and then transecting NW and SE across the flat area between the upper(proximal) and lower (distal) Lisbon and Setubal canyons.

We hove to transecting SE at 39°19.5'N 9°23'W to retrieve the PES and 3.5 kHz fish, and then steamed to station 11921, 38°31'N 9°16.5'W.

**Monday 9th October**

During a preliminary PES survey using the hull transducer, we snagged a fishing line at c. 01.00 hrs 9.10.89 39°31.5'N, 9°15.5'W.

The Master decided to steam to Cascais to have the snagged fishing line removed. Discovery arrived Cascais early afternoon, and the fishing line was successfully removed.

Discovery left Cascais at 16.55 to steam to 38°22.5'N, 9°23.5'W, arriving there at 19.00 hours.
The PES and 3.5 kHz fish were then deployed, and a 5 kt transect began on 206° to 38°13'N, 9°29'W.

**Tuesday 10th October**

Station 11921 was established at 38° 14'N, 9° 28'W, which was in the middle reaches of the Setubal Canyon in c. 2400 m of water. This proved to be a very interesting station, as there appeared to be two bottoms in a W formation across the canyon in a NW-SE direction. The more southerly of the two bottoms was sampled. Two excellent spade box cores were obtained (11921.2 and 3). These were followed by a successful camera drop (11921.4).

We then steamed south to conduct two Agassiz trawls at 500 m and 1000 m These were stations 11922 and 11923. Station 11922 was conducted in c 500 m from 37°50'N, 9°15'W at 12.10 hrs, to 37°56'N, 9°15'W at 21.55 hrs. We then steamed to the second Agassiz trawl station.

**Wednesday 11th October**

Station 11923 was conducted in c 1000 m from 37° 59,7'N, 9° 23'W at 00.25 hrs, to 37°51.3'N, 9°27.3'W at 05.00 hrs.
Both Agassiz trawl stations were successful, yielding excellent and varied catches of benthic fauna which were preserved for later use.

Discovery then steamed to the distal Setubal Canyon, conducting 4 PES and 3.5 kHz transects across its upper reaches, then north across the central plain between the proximal and distal canyons, to station 11924 which was established at 38°22.5'N, 9°20.5'W in 1660 m of water after some initial PES survey of the V shaped bottoms of the canyon at this point. Three excellent spade box cores (11924.1 to 3) and a camera drop (11924.4) were achieved at this station. The mud was very soft, overflowing the top of the box core on one occasion. Station 11924 was completed at 23.00 hrs, 11.10.89.

**Thursday 12th October**

Discovery steamed at SW full speed to the lower end of the distal Setubal Canyon to begin three PES and 3.5 kHz transects across the southwesterly (distal) end of the canyon, working progressively in a northeasterly direction. These transects completed our survey of the distal Setubal canyon.

Discovery then steamed to 38°16.5'N, 9°00'W half way up the proximal arm of the Setubal Canyon to establish station 11925 at c.700 m water depth. Three box cores (11925.1,2 and 4) were done at this staion, with a camera drop (11925.3). The sedimentary material in the box cores were not the same, indicating marked heterogeneity on the canyon slope.

Station 11926 was established about 5 nm west at the base of the proximal arm of the Setubal Canyon, at 38°16.4'N, 9°8.4'W, in 1200 m water depth, at which three spade box cores were obtained (11926.1 to 3). Station 11926 was completed at 22.00 hrs.

**Friday 13th October**

A series of approximately east-west transects were conducted across the central plateau of the canyon complex, to establish bottom topography and to further define the ridge running NE-SE which appears to separate the proximal arms of the Lisbon and Setubal Canyons and the distal arm of the Setubal Canyon, which seem to be one sedimentary environment, from the distal arm of the Lisbon Canyon which may be a relict canyon not at present fed by a large sedimentary input. This survey was completed mid-morning.

Discovery then steamed to the top of the proximal arm of the Lisbon Canyon to establish station 11927, 370 m, at 38°30.8'N, 9°16.2'W where two box cores were obtained (11927.1 and 2). This station was completed at 17.30 hrs.

Discovery then steamed to station 11928, arriving at 19.00 hrs at 38°20.6'N, 9°25.0'W, in 1300 m of water. This station was on the ridge referred to above. One box core was deployed (11928.1).

Discovery then steamed to Station 11929 to the west of the ridge in 1700 m of water at 38°22.3'N, 9°27.7'W, arriving there at 22.30 hrs. One box core was obtained (11929.1).

**Saturday 14th October**

Station 11929 was completed at 00.30 hrs, and Discovery then steamed to station 11930, 38°06'N, 10° 10'W on the Tagus abyssal plain west of the distal Setubal Canyon, to sample abyssal plain sediment in about 4500 m of water. The station was worked for 12 hours, and three box cores were obtained (11930.1 to 3). Discovery then left the station late p.m. and proceeded to the distal and then proximal parts of the canyon system. A PES and 3.5 kHz survey was then conducted in a predominantly N-S pattern, giving a detailed coverage of the area between the proximal and distal canyons, and of the distal Lisbon Canyon.

**Sunday 15th October**

The survey was continued.

**Monday 16th October**

The survey was completed at 01.30 hrs, and Discovery then steamed to Lisbon on completion of the cruise.

Figure 2. Leg 2: The cruise track of Discovery 186 Lisbon to Lisbon 29/9/89 to 16/10/89.

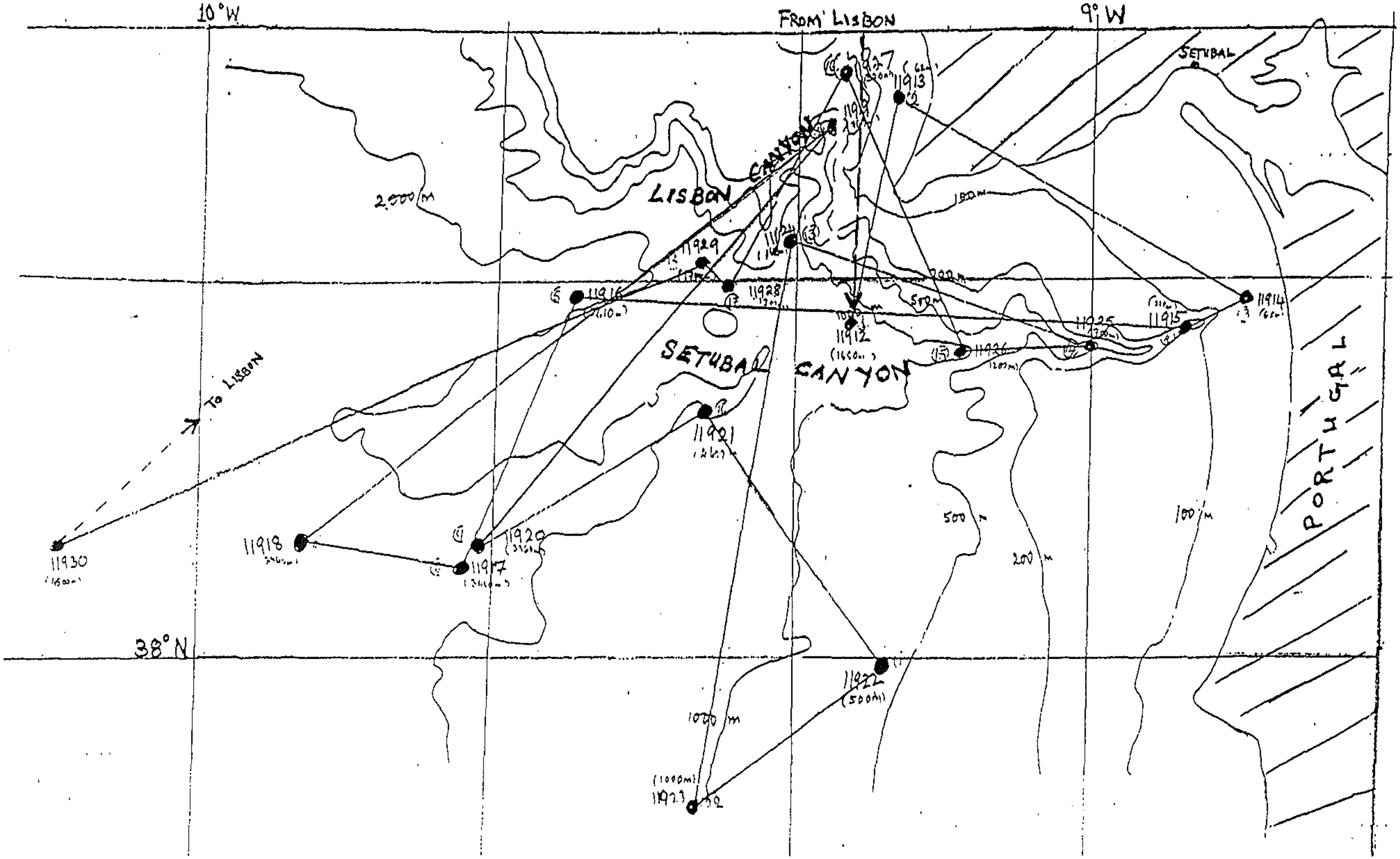


Table 2 STATION POSITIONS FOR DISCOVERY CRUISE 186 LEG 2

| Station | Date | Latitude(N) | Longitude(W) | Depth(m) |
|---|---|---|---|---|
| MC 11912.1 | 29/09/89 | 38° 17.493′ | 09° 17.511′ | 1550 |
| SBC 11912.2 | 30/09/89 | 38° 17.840′ | 09° 16.583′ | 1570 |
| SBC 11912.3 | 30/09/89 | 38° 18.084′ | 09° 16.011′ | 1427 |
| MC 11913.1 | 30/09/89 | 38° 34.101′ | 09° 14.720′ | 70 |
| MC 11913.2 | 30/09/89 | 38° 34.438′ | 09° 14.759′ | 65 |
| MC 11913.3 | 30/09/89 | 38° 35.183′ | 09° 13.434′ | 70 |
| CAM 11913.4 | 30/09/89 | 38° 34.150′ | 09° 15.319′ | 65 |
| CAM 11914.1 | 1/10/89 | 38° 19.303′ | 09° 51.263′ | 60 |
| SBC 11914.2 | 1/10/89 | 38° 19.687′ | 08° 50.366′ | 60 |
| SBC 11915.1 | 1/10/89 | 38° 18.079′ | 08° 52.716′ | 240 |
| MC 11915.2 | 1/10/89 | 38° 18.026′ | 08° 52.750′ | 240 |
| MC 11915.3 | 1/10/89 | 38° 17.915′ | 08° 52.602′ | 268 |
| SBC 11915.4 | 1/10/89 | 38° 17.972′ | 08° 52.913′ | 256 |
| SBC 11915.5 | 1/10/89 | 38° 18.110′ | 08° 52.986′ | 254 |
| SBC 11915.6 | 2/10/89 | 38° 18.046′ | 08° 53.065′ | 248 |
| SBC 11916.1 | 2/10/89 | 38° 18.474′ | 09° 35.503′ | 2600 |
| CAM 11916.2 | 2/10/89 | 38° 18.622′ | 09° 35.755′ | 2600 |
| SBC 11917.1 | 3/10/89 | 38° 05.035′ | 09° 41.377′ | 3400 |
| SBC 11918.1 | 4/10/89 | 38° 07.498′ | 09° 52.984′ | 4000 |
| SBC 11918.2 | 4/10/89 | 38° 06.336′ | 09° 53.339′ | 4200 |
| SBC 11919.1 | 4/10/89 | 38° 28.931′ | 09° 17.690′ | 700 |
| SBC 11919.2 | 4/10/89 | 38° 28.110′ | 09° 17.299′ | 700 |
| CAM 11919.3 | 4/10/89 | 38° 27.898′ | 09° 17.828′ | 760 |
| SBC 11920.1 | 6/10/89 | 38° 05.559′ | 09° 41.239′ | 3360 |
| SBC 11920.2 | 6/10/89 | 38° 05.785′ | 09° 40.982′ | 3450 |
| SBC 11920.3 | 6/10/89 | 38° 05.733′ | 09° 41.995′ | 3546 |
| SBC 11920.4 | 6/10/89 | 38° 05.628′ | 09° 41.218′ | 3435 |
| SBC 11920.5 | 6/10/89 | 38° 05.610′ | 09° 41.504′ | 3360 |
| SBC 11920.6 | 6/10/89 | 38° 05.588′ | 09° 41.136′ | 3365 |
| SBC 11920.7 | 7/10/89 | 38° 05.656′ | 09° 41.100′ | 3365 |
| SBC 11920.8 | 7/10/89 | 38° 05.655′ | 09° 41.214′ | 3540 |
| SBC 11920.9 | 7/10/89 | 38° 05.523′ | 09° 41.256′ | 3390 |
| SBC 11920.10 | 7/10/89 | 38° 05.730′ | 09° 41.086′ | 3380 |
| SBC 11920.11 | 7/10/89 | 38° 05.583′ | 09° 41.172′ | 3360 |
| SBC 11920.12 | 7/10/89 | 38° 05.739′ | 09° 41.132′ | 3440 |
| SBC 11920.13 | 7/10/89 | 38° 05.542′ | 09° 41.055′ | 3860 |
| CAM 11920.14 | 8/10/89 | 38° 05.607′ | 09° 41.148′ | 3380 |
| SBC 11921.1 | 10/10/89 | 38° 13.604′ | 09° 28.679′ | 2400 |
| SBC 11921.2 | 10/10/89 | 38° 13.746′ | 09° 27.699′ | 2533 |
| SBC 11921.3 | 10/10/89 | 38° 14.999′ | 09° 27.556′ | 2220 |
| CAM 11921.4 | 10/10/89 | 38° 14.002′ | 09° 26.751′ | 2335 |
| AT 11922 | 10/10/89 | 37° 53.934′ | 09° 15.763′ | 500 |
| AT 11923 | 11/10/89 | 37° 53.716′ | 09° 26.632′ | 1000 |
| SBC 11924.1 | 11/10/89 | 38° 23.218′ | 09° 21.304′ | 1600 |
| SBC 11924.2 | 11/10/89 | 38° 22.859′ | 09° 20.599′ | 1665 |
| SBC 11924.3 | 11/10/89 | 38° 22.506′ | 09° 20.615′ | 1660 |
| CAM 11924.4 | 11/10/89 | 38° 22.361′ | 09° 21.161′ | 1660 |
| SBC 11925.1 | 12/10/89 | 38° 16.799′ | 08° 59.343′ | 690 |
| SBC 11925.2 | 12/10/89 | 38° 16.905′ | 08° 58.892′ | 575 |
| CAM 11925.3 | 12/10/89 | 38° 16.864′ | 08° 00.033′ | 680 |
| SBC 11925.4 | 12/10/89 | 38° 17.005′ | 09° 00.172′ | 440 |
| SBC 11926.1 | 12/10/89 | 38° 16.967′ | 09° 08.053′ | 1150 |

Table 2 Cont'd STATION POSITIONS FOR DISCOVERY CRUISE 186 LEG 2

| Station | Date | Latitude(N) | Longitude(W) | Depth(m) |
|---|---|---|---|---|
| SBC 11926.2 | 12/10/89 | $38^{o}$ 16.464' | $09^{o}$ 08.517' | 1165 |
| SBC 11926.3 | 12/10/84 | $38^{o}$ 16.569' | $09^{o}$ 08.615' | 1220 |
| SBC 11927.1 | 13/10/89 | $38^{o}$ 30.947' | $09^{o}$ 17.224' | 385 |
| SBC 11927.2 | 13/10/89 | $38^{o}$ 30.574' | $09^{o}$ 16.446' | 385 |
| SBC 11928.1 | 13/10/89 | $38^{o}$ 20.506' | $09^{o}$ 26.037' | 1350 |
| SBC 11929.1 | 13/10/89 | $38^{o}$ 22.361' | $09^{o}$ 28.306' | 1720 |
| SBC 11930.1 | 14/10/89 | $38^{o}$ 07.193' | $10^{o}$ 11.997' | 4660 |
| SBC 11930.2 | 14/10/89 | $38^{o}$ 06.578' | $10^{o}$ 11.884' | 4660 |
| SBC 11930.3 | 14/10/89 | $38^{o}$ 06.924' | $10^{o}$ 13.113' | 4640 |

## Part B Reports by Senior Scientists on Cruise

Discovery 186 Leg 1

### OTTER TRAWL HAULS

D.S.M. Billett, Institute of Oceanographic Sciences, Godalming
B. Boorman, Institute of Oceanographic Sciences, Godalming
L. de S. Campos, Southampton University

Three otter trawl hauls were made at abyssal depths on the Madeira Abyssal Plain, the Horseshoe Abyssal Plain and the Tagus Abyssal Plain, for fish and large epibenthic invertebrates. In all cases the trawl worked well and large catches were obtained. On one haul the cod end line snapped on recovery and on the last occasion the catch was so large that the net holding the cod-end broke.

The trawl from the Madeira Abyssal Plain contained several large fish, including Nematonurus armatus, tripod fish and the rare species Bathymicrops regis. Apart from these the catch was notable for the holothurians Deima validum and Benthodytes typica, the asteroid Styracaster sp., ophiuroids, large natant decapod crustaceans, Plesiopeneus sp. and several other crustaceans (Polycheles sp., Glyphocrangon sp. and Munidopsis sp.). Many of these animals also occurred on the Horseshoe Abyssal Plain, but in this area the catch was more diverse. Many large fish were taken as well as the holothurians Pseudostichopus villosus, P.marenzelleri and Psychropotes semperiana, brachiopods, gastropods and bivalves, in addition to those species cited above. This haul also collected a large oil drum, a feature of the haul from the Tagus Abyssal Plain too, which sadly is grossly littered with anthropogenic debris. There were some similarities with the previous two catches, notably the ophiuroids, the holothurian Deima validum, the crab Munidopsis sp. and large natant decapod crustaceans, but a range of other fauna was also taken. This included the infaunal holothurian Molpodia blakei, the asteroid Dytaster sp., actiniarians, the pennatulid Umbellula, cirripedes and gastropods.

Samples were frozen at -70° C for genetic and biochemical studies. The holothurians were in too poor a condition for a study to be made of their feeding strategies.

Discovery 186 Leg 1

Mr D.G. Booth, RVS Barry

**ACOUSTIC NAVIGATION SYSTEM**

Prior to the deployment of the system the connectors on the tow cable were re-terminated. Several software modifications were carried out. These included increasing the number of targets from 5 to 15 and further enhancements to the plotter routines (some work on this had been carried out on the previous cruise on Eastella).

Before any rigs were deployed a sound velocity profile was carried out. See attached sheet for details. Deployment of the rigs took longer than expected. This was partly caused by having to wait for transit satellite fixes (normally GPS is used). A problem occurred with one transponder when tested in the water prior to being released from the ship. This was quickly rectified using the command system. No problems occurred during the relative calibration run (absolute calibration was not possible without GPS and anyway was not required).

The system performed satisfactorily during each of the spade box corer deployments (the transponder attached to the wire was placed 150 m above the corer). No plots or screen hard copy was made of station 11911.3 (the second box core), although the data were logged. This was later replayed onto a printer and a valid drop position was found. On the next station the hard copy of the screen showed invalid data and no data were logged,and therefore, it was impossible to give a position for the corer. However, a position for the ship is known as this was valid on the hard screen copy. All other spade box corer drops were both logged and a hard copy of the screen taken. Providing that there are enough people on watch in the plot the actual operation of the acoustic navigation system at the drop time can be performed by anyone appropriately instructed as long as the system has been set up just prior to the drop.

A non-conventional scheme of recovery was devised owing to the fact that only 4 hours of daylight were available after the last spade box core. The first transponder (Xpdr) was released and then recovered using the workboat while the box corer was still in the water column after bottoming. After the recovery of the corer the transponders were recovered by the workboat while the ship released the next one. The fourth transponder was recovered using the ship, conventionally. The fish was then recovered. The use of the workboat to recover the transponders was only possible because of the excellent weather conditions and the full co-operation of the ship's officers. Normally for this water depth 8 hours should be allowed for recovery of the transponder array.

**Precision Echo Sounder**

The PES worked completely satisfactorily during Leg 1. It was good to see that most watch keepers did remember about the need to change the blade every 4 hours of use, considering the fact that the PES was not used continuously.

Discovery 186 Leg 1

Sound Velocity Profile

| Depth (m) | Velocity (m/s) |
|---|---|
| 0 | 1525.40 |
| 20 | 1525.79 |
| 50 | 1512.30 |
| 225 | 1504.88 |
| 300 | 1503.57 |
| 475 | 1502.87 |
| 700 | 1508.84 |
| 1200 | 1513.95 |
| 1300 | 1513.35 |
| 1700 | 1503.70 |
| 2000 | 1501.74 |
| 2300 | 1503.11 |
| 2700 | 1506.87 |
| 3500 | 1518.22 |
| 5100 | 1546.00 |

Times taken (5100m water depth)

| | | |
|---|---|---|
| Sound Velocity Profile | 2.5 hours | |
| Deployment of transponders | 6 hours | |
| Relative Calibration | 3 hours | |
| Recovery | 5 hours | * SEE TEXT |
| TOTAL | 16.5 hours | |

Discovery 186 Leg 2

Mr D.G. Booth, RVS Barry

**ACOUSTIC NAVIGATION SYSTEM**

Difficulty was experienced in positioning the transponder array. A detailed bathymetric study was carried out. This showed that the canyon was narrow with steep sides. To gain a suitable distance between transponders it was felt that two transponders should be placed on the canyon floor while the other two should be placed on either side. It was also decided to increase the height of the transponders off the seabed (from 200 m to 400 m)

Although GPS was scheduled to come back on line before this station it did not happen and transit navigation was used. This, however, gave a 1 km shift between two fixes, which combined with poor bathymetric detail positioned one of the transponders on the wrong side of the intended target. After a very difficult Relative Calibration the true positions were calculated. This showed large errors in assumed positions (see transponder diagram) and also showed that the target area could still be accurately covered. It should be noted that the calibration solution error was 0.8 of a metre! The system behaved perfectly. It was however discovered that it CANNOT work while the 3.5 kHz profiler is in use. Thirteen box core stations (11 successful) and one camera station were carried out. All data were logged. Diagrams were plotted showing the station details (this was also performed for station 1).

PES and 3.5 kHz

No major problems occurred (one fish [3.5] tow cable was critically damaged during the first deployment - cause probably a fishing net).

Camera system

All OK.

Discovery 186 Leg 2

Sound Velocity Profile

(See copy of results)

Times taken

| | | |
|---|---|---|
| Sound velocity | 2 | hours |
| Deployment | 6 | hours |
| Rel. Cal. | 5.5 | hours |
| Recovery | 5 | hours |
| Total Time | 18.5 | hours |

Discovery Cruise 186 Leg 1

Dr. J.D. Gage
Scottish Marine Biological Association, Oban.

**REPLICATE BOX CORING**

The first part of this programme was undertaken on a position in the Tagus Abyssal Plain at 28°N 11°40′ W in soundings of 5035 m. Ten samples were required, using the vegematic subcores (each covering 10 x 10 cm), with each bottom position plotted within a transponder net laid for the duration of the station. Details of the transponder beacon deployment are provided by D. Booth (RVS).

The purpose of the exercise is to obtain data on spatial pattern of species in terms of their abundances and demographic composition. In conjunction with the data obtained on leg 2 from a similar sampling design in the adjacent Lisbon/Setubal Canyon, the results are hoped to yield important new data on small-scale pattern and its relationship to disturbance and the high species richness of the smaller macrobenthos in the deep sea.

The coring programme commenced at 21.50 hours on 25th September and continued until 22.15 hours on 26th September, yielding 5 excellent sets of cores from 5 consecutive depoyments. The sea state was verging on the marginal for box coring with a heavy northwesterly ground swell. The coring programme was broken off in order to undertake an OTSB trawl. This necessitated extra steaming out of the transponder area and the trawling operation overshot its time allocation. As a consequence inadequate time was available to finish the coring station. Coring resumed with the sixth deployment at 17.00 hours on 27th September and was terminated at 15.43 hours on 28th September. With the noteworthy efforts of the deck crew, RVS technicians and the scientific party, together with the co-operation of the Master in effecting time savings in recovery of the transponder system, five further deployments were accomplished. The last two were unsuccessful, and there was regrettably no opportunity to repeat them in order to complete the station before recovery of the transponders in the remaining few hours of daylight.

Each of the nine innermost subcores were removed and washed individually through 297 and 250 um sieves using the ship's fire hose supply filtered through a 60 um filter. Sieve residues were fixed and bagged separately for subsequent sorting in the laboratory after the cruise.

Discovery 186, Leg 2

Dr J.D. Gage, Scottish Marine Biological Association, Oban

**REPLICATE AND OTHER BOX CORING FOR MACROFAUNA**

Box coring on the second leg had the two aims: 1) obtaining a further set of vegematic box-core replicates from a slope/canyon position showing evidence of disturbance; 2) obtaining single box cores for analysis of macrofaunal community structure and standing crop at different locations within the Lisbon and Setubal canyons (referred to below as the Lisbon/Setubal Canyon System) in order to relate macrofaunal community structure, faunal distributions and standing crop to canyon topography and processes.

1. Replicate box coring

It was hoped that analysis of the spatial pattern and community structure of the macrobenthos in these cores, when compared with the cores from the Tagus Abyssal Plain obtained on leg 1, will provide new information on the role of disturbance in maintaining the high species richness associated with deep-sea sediments.

Initial samples from the lower Canyon System were examined on board in order to try and find a suitably disturbed bottom for the replicate box-coring. Because of the generally excellent weather and calm conditions, it was possible to sort samples on board with a binocular microscope using sediment 'rescued' from box cores after subcoring by other cruise participants for other purposes. Because of limitations of time and available taxonomic literature, only the bivalve molluscs could be completed. But it was possible from this data to make a preliminary assessment of community structure in order to detect a disturbed environment. Sediment from stations D11916 and D11917 was treated in this way; and although limited, the data indicated the latter station, located in approximately 3.5 km depth in the lower part of the canyon system, showed faunal characteristics typical of a disturbed community. These included relatively low species richness, and a greater degree of numerical dominance by a few abundant species, compared with comparable sites nearby (Figs. 3 and 4; Table 3). The choice of the location of station D11917 was also supported by evidence from seabed photographs taken at this position by Dr Tyler that showed rippled bedforms indicating, possibly intermittent, strong currents. Accordingly, this station was selected as the site for the suite of 10 box-core replicates from a 'disturbed' area of the Canyon System.

The four Oceano transponder beacons were laid in the narrow canyon area near the site of station D11917 on 5 October. This was accomplished without the aid of GPS navigation that had been promised to have been available by this date. As a result of difficulties with SatNav and the Oceano transponder equipment, the final positions of the beacons around the target area were not quite those originally thought. The programme of box-core replicates (stations D11920.1-13) using the 'vegematic' subcores was started at 03.00 hr on 6 October and completed at 00.56 hr on 8 October. Of the thirteen drops undertaken there were two failures (gear not tripped). The sediment surface of three of the samples displayed a fractured and broken surface, possibly caused by closure of the gear as the overlying water generally was clear. As with the replicate samples obtained during Leg 1, the innermost 9 cores were washed individually using a 300 um sieve. In addition, the outermost 16 cores were also sieved as pooled sample in order to provide a larger sample for study of overall community structure and biomass. Thanks to excellent navigation achieved by 'Discovery', and the skill of D. Booth (RVS) in managing the computer system, a maximum 73 m and minimum of 3 m range from the target was achieved with the successful drops.

2. Macrofaunal box coring

On completion of this work, a series of 6 successful macrofaunal box-cores (stations D11921.3 to D11930.3) were obtained at various positions within the Lisbon/Setubal Canyon System, from 10 to 14 October. The shallowest (D11927.2) was in 0.385 km near the head of the Lisbon arm of Canyon System, the deepest (D11930.3) was in 4.675 km depth at the base of the Lisbon/Setubal Canyon System. As previously, these samples were washed on deck through a 300 um sieve. The opportunity was taken at two of these (stations D11921 and D11924) also to sort sediment residues left after subcoring box-cores obtained for the other cruise participants. The preliminary results for the bivalve component of the sorted fauna from these cores are also summarised in Figs 1 and 2 and Table 1 for comparison with results for stations D11916 and D11917.

Although, too early to draw firm conclusions, the preliminary evidence obtained from observations of reducing conditions in the underlying sediment, of green sea grass fragments in washed samples, and indications of detrital material on the bottom in seabed photographs taken at box-core sites, suggest the canyon sites sampled are active conduits for organic material - probably derived from the nearby Tagus and Setubal estuaries.

I wish to express my sincere thanks to my colleagues on this cruise whose kind cooperation and fortitude in helping with the sampling, especially washing samples on deck, made this work possible. I am also most grateful to the RVS Technicians who helped us operate, cared for, and willingly repaired our vital sampling gear, and, of course, 'Discovery's captain, officers and crew who contributed so much to making this work a success.

Table 3 Shannon-Weaver and Expected Species statistics for the four samples shown in Figs 3 and 4.

| Station | No. Bivalve Individuals | No. Bivalve Species | H' | $H^{max}$ | J' | $E(S_{20})$ (See Fig. 3) |
|---|---|---|---|---|---|---|
| D11916 | 17 | 8 | 0.81 | 5.57 | 0.15 | 8.8 |
| D11917 | 30 | 7 | 0.63 | 18.96 | 0.03 | 5.5 |
| D11921 | 44 | 12 | 0.88 | 24.83 | 0.04 | 8.2 |
| D11924 | 90 | 12 | 0.84 | 78.76 | 0.01 | 7.2 |

Fig. 3 Rarefaction curves computed from bivalve species abundance data from the four samples sorted. The curves interpolate the numbers of species expected in progressively samller samples drawn at random, without replacement, from the total sample, using the algorithm of Hurlbert (1971), Ecology vol. 52, pp 577-86.

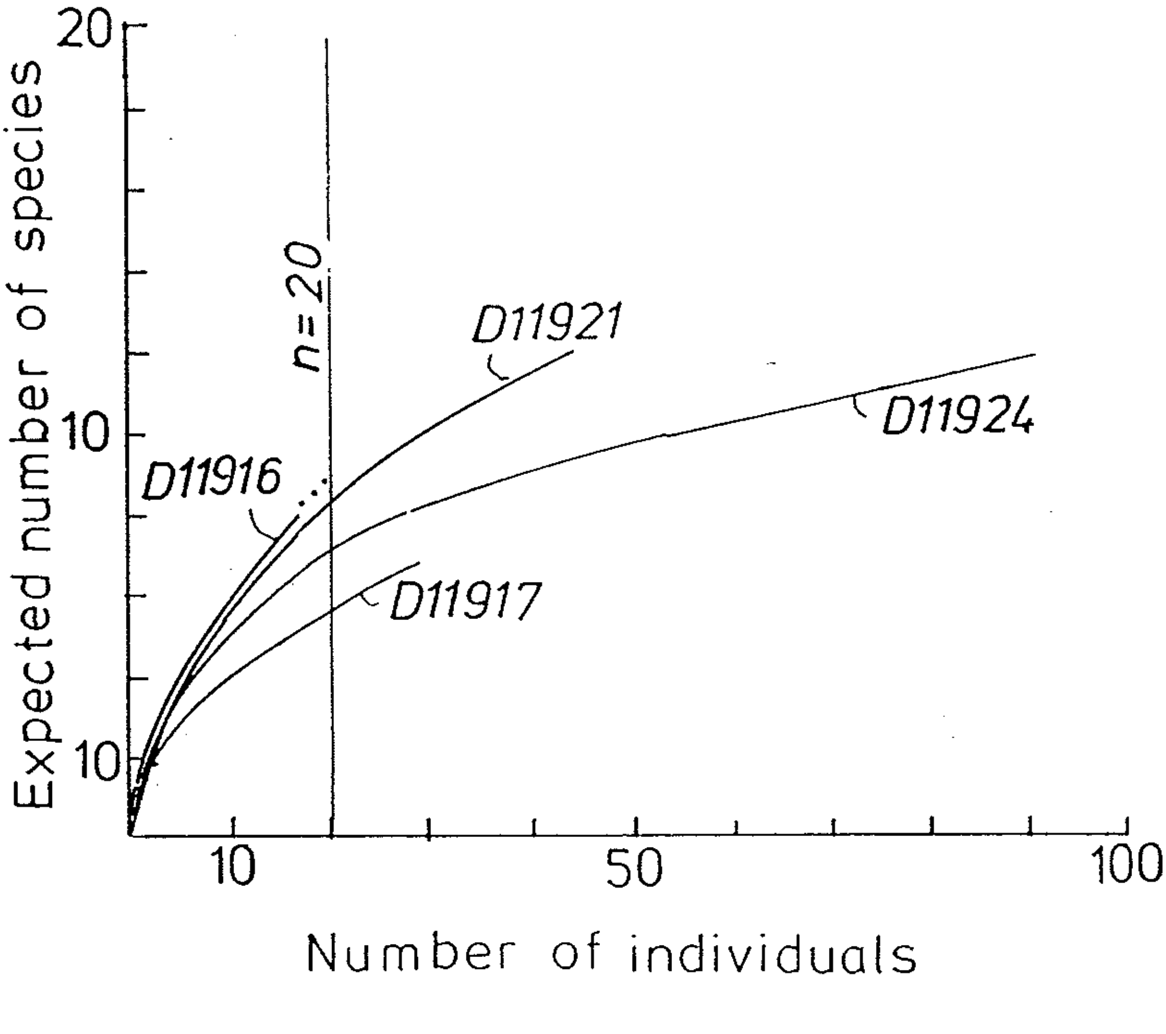
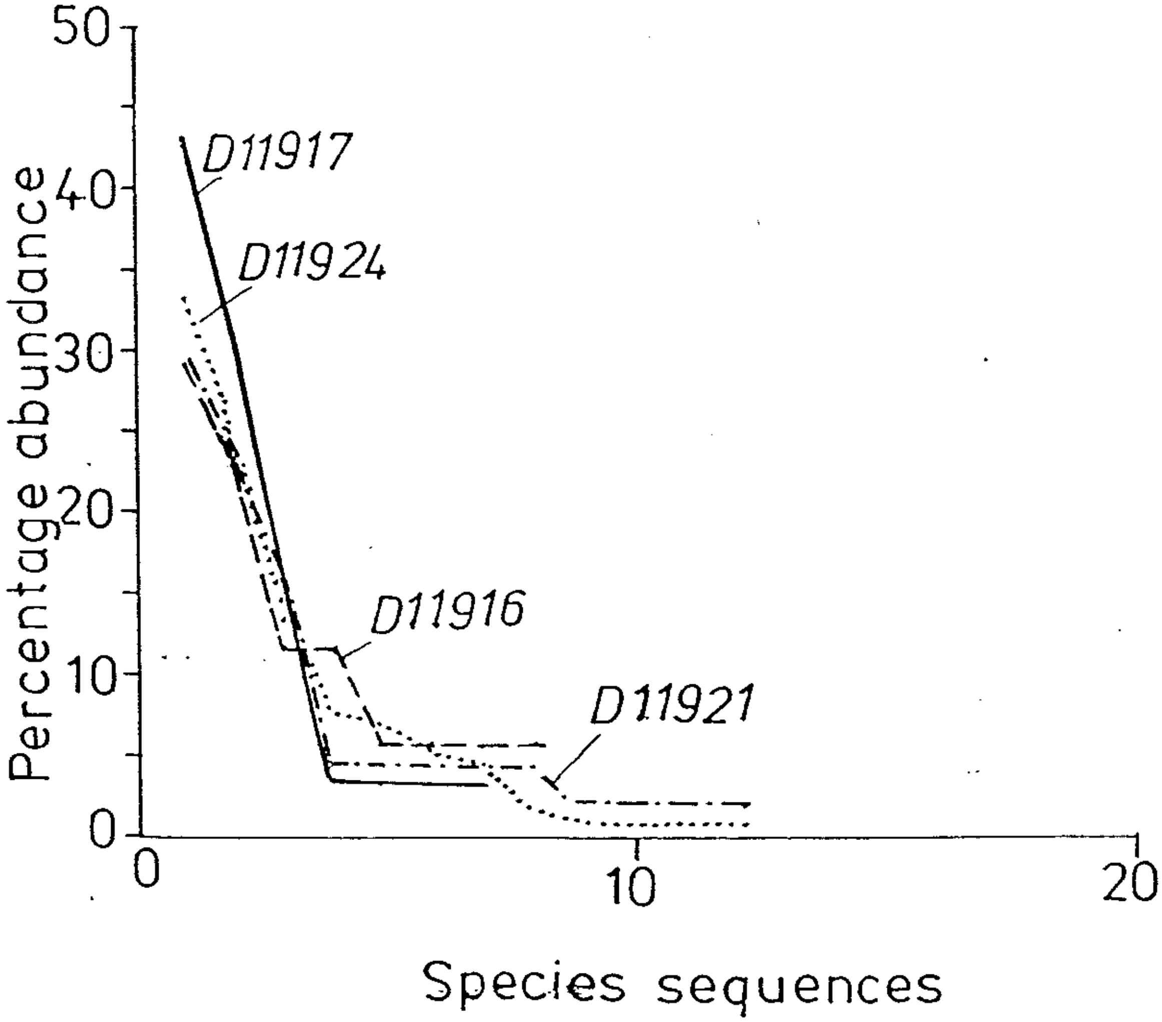


Fig. 4. Percentage abundance of bivalve species ranked from the most common to the least common (species sequences) in the four samples. The more sharply kinked the curve, the greater the sample is dominated in terms of numbers of individuals by a few common species.



Dr. A.C. Reichelt Marine Science Laboratories, Menai Bridge, Anglesey.

Leg 1 Progress Report.

Samples were collected from both of the successful multicore drops. These have been used for depth profiling of meiofaunal densities and feeding groups, micro-organism densities (by direct counting), organic carbon and size fractionation. These have all involved preservation of contiguous 1cm depth sections near the sediment-water interface and at intervals further down the cores. The micro-organism samples have been incubated with a $^{14}C$-labelled amino-acid/glucose/acetate mixture prior to fixation. These samples will also be examined for labelled meiofauna. Both the micro-organism and meiofauna samples will be subjected to selective staining to aid identification of the microbial groups present.

A whole multicore has also been collected and dried for whole-core autoradiographic analysis for bioturbation structures and sediment layering. This core will also be used for uranium series disequilibrium dating of sediment layers and $\gamma$-emitting fission produced nuclide analysis.

Inter-relationships between the biological, physical and chemical parameters will be examined on return to the UK.

Leg 2 Progress Report.

During leg 2 cores were collected from fourteen boxcore and multicore stations. Samples from thirteen of these stations have been incubated and preserved for assessment of meiofaunal and microbial parameters as per leg 1. A single core from each of the fourteen stations has been stored for whole core radiography and sediment dating.

The rapid changes in depth within the Lisbon-Setubal canyon system may well permit rapid movement of organic material from costal to abyssal water depths if the currents are present. The communities found within the canyons should therefore differ significantly from those found at equivalent depths away from canyons. The changes in inter-relationships between biological parameters with water depth in the canyons and also the difference between the abyssal depths near the canyon and those on the central plain (sampled in leg 1) will therefore be examined.

The whole-core radiography and sediment dating (uranium series disequilibrium) data from this twin canyon system should allow dating of rapid sediment transport (eg. by slumping) and also of sedimentation rates. Relationships between these data and the structure of the microbial and meiofaunal communities will also be examined.

Combination of the sediment age: depth profile and granulometric data will allow the route(s) of sediment transport down the canyons from the Lisbon and Setubal rivers to be determined.

Discovery Cruise 186    Leg 1 and Leg 2

Dr. J.P. Robinson, Queen Mary College, London University.

## EXPERIMENTS ON BENTHIC MICROBIOLOGY

The aim of these experiments is to attempt to detect methanogenesis and methane oxidation in a number of sediment, meiofaunal and fish gut samples collected on leg 1 of the cruise. The experiments are divided into four series:

- I Methane formation - sediment
- II Methane oxidation - sediment
- III Methane formation - animal gut
- IV Methane formation - meiofauna

Summary of experiments so far initiated:

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### EXP. SERIES I. METHANOGENESIS IN SEDIMENT SAMPLES

Samples of sediment have been mixed with anoxic, sterile seawater, containing final concs. of .0003g/l $Na_2S$ and .0003g/l cysteine (as reducing agents) and dispensed into stoppered tubes under nitrogen. Substrates (nutrients) used by methanogenic bacteria have been added to the "sediment slurries" and the tubes incubated without shaking at 4°C.

| | | Final conc. | |
|---|---|---|---|
| Substrates added:- | Acetate | (10mM) | ± 10mM molybdate |
| | Formate | (10mM) | ± " " |
| | Methylamine | (10mM) | ± " " |
| | Hydrogen | (2ml/20ml) | ± " " |
| | Conhol | ($N_2$ alone) | ± " " |

Two stations have been sampled and different depths of sediment have been used to prepare slurries.

| Exp.No. | Station No. | Depth (cm) |
|---|---|---|
| Ia | 11910.3 | 0-1, 15-16cm |
| Ib | 11911.1 | 0-1, 4-5, 20-21cm |

Appearance of methane is measured by gas chromatography.

This experiment will continue until the ship arrives in Barry.

**RESULTS** No methane formation detected after 5 days incubation at 4°C.

**EXP. SERIES II** METHANE OXIDATION

Samples of sediment have been mixed with seawater and gassed with air. The tubes or bottles have been sealed and 2ml of pure methane added to the tubes. The tubes are incubated at 4°C.

Disappearance of methane is measured by gas chromatography.

**RESULTS** No sign of methane utilization in water or surface sediment samples.
4 days at 4°C.

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**EXP. SERIES III** METHANE FORMATION IN ANIMAL GUTS

Samples of gut contents have been taken aseptically from a fish:- (Nematonurus armatus) and a holothurian:- (Pseudostichopus villosus). These have been placed under $N_2$ in stoppered tubes with methanogenic nutrient substrates:-

formate ) Nematonurus
methylamine)

formate ) Pseudostichopus
methylamine)
acetate )

These are being incubated at 4°C and will continue until the ship arrives in Barry.

**RESULTS** No methane after 3 days incubation.

Samples of Nematonurus gut contents from a specimen collected 11911.7 have been frozen at -70°C under $N_2$ for return to the U.K.

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**EXP. SERIES IV** **METHANE FORMATION AND OXIDATION BY BACTERIA ASSOCIATED WITH BENTHIC MEIOFAUNA**

Samples of meiofauna are being separated by sieving the 500 to 63 um fraction from the 0 to about 3cm (or 8) of box cored sediments from the samples obtained on station 11911 (Tagus Abyssal Plain). These will be concentrated and used in experiments to measure the formation of methane from $^{14}C$ substrates including glucose, formate, acetate and methylamine. So far about 80 9.5cm square x 3cm deep sediment samples have been collected and concentrated. There are no results but microscopic examination has revealed copepods and nematodes in the concentrated sample.

A. Tufail, S. Coates and G. Tucknott
Zoology Department, Glasgow University.

Leg 1: Funchal to Lisbon 21st - 29th Sept. 1989

Our aim in the first leg of the cruise was firstly to compare some sediment properties and patterns of bioturbation between the Seine and Tagus Abyssal Plains. Secondly, the observations on the two Abyssal Plains would enable us later to compare them with canyon(s) (Lisbon canyon) which forms the second leg of the cruise.

So far we have covered two stations using the multicorer:

Station 1 Discovery Station No. 11909.3

Station 3 Discovery Station No. 11911.1

At each station vertical profiles of surface shear strength, Eh-redox potential, and pH were taken on a core from the multicorer. In addition sediment samples were preserved for scanning electron microscopy for later analysis. A separate core was visually examined for bioturbation and drawings made. All the above measurements were taken at depth intervals of 0,1,2,3,4,5,7.5,10,15,20 & 25 cm. along the core.

The results show in general that the shear strength increased with depth until 10cm. but decreased below. Eh decreased with depth for Station 1 but fluctuated in the top 4cm. and then increased with depth for Station 3. pH values were fairly constant for both the Stations. There was very little bioturbation, although few intact Y-shaped burrows were removed from the top layers and preserved in 2.5% Glutaraldehyde for SEM in the laboratory in the UK.

A. Tufail, M. Hariri, I. Saleh, A. Demircan
Zoology Dept., Glasgow University.

Leg 2: 29th Sept. - 15th Oct. 1989

The aim of this work was to examine the differences if any in the sediment parameters of the Lisbon and Setubal canyons off Portugal. We are also interested in finding out how the two riverine inputs vary in feeding these canyons.

Subcores were taken from the Spade Box Corer at 14 stations and measurements made on board ship of surface shear strength, Eh, pH and temperature. The same profile strategy was followed as in leg 1 of this cruise.

There was a distinct contrast between the two stations at the mouth of each of the canyons, St.11913 (Lisbon Canyon) and St.11914 (Setubal Canyon). The sediment at the mouth of the Lisbon Canyon consisted of a soft mud while the one at the Setubal Canyon was very coarse sand combined with shell gravel. Rinses taken from the latter were examined and a lot of diatoms (Naviculoid), foraminiferans and tiny sea urchins were found.

The next deeper stations, St. 11927 (Lisbon Canyon) and St.11915 (Setubal Canyon) gave shear strength readings lower on the surface which increased sharply with depth after 1cm. in the Lisbon Canyon. In contrast, the shear strength below 1 cm was fairly constant in the Setubal Canyon sample.

In the Lisbon Canyon surface Eh was high but decreased dramatically with increasing depth, while in the Setubal Canyon it was low at the surface and decreased gradually with depth. This may suggest that there is more mixing in the top layer of the sediment in the Lisbon than the Setubal Canyon. This pattern is repeated in St.11919 (Lisbon Canyon) and St.11925 (Setubal Canyon) which are further away from the mouth of the canyons. Again, in St.11924 (Lisbon Canyon) and St.11926 (Setubal Canyon) situated at the distal ends of the canyons the Eh values follow the same trend.

St.11921 seems to be influenced by the Lisbon-River Tagus System, because of the high aerobic environment in surface layers (ie. high Eh values). But St.11912 appears to be controlled by the Setubal-River Sado system, because of the low Eh values. One can hypothesise that the Lisbon Canyon is a more mixed evironment than the Setubal Canyon.

The two most remote stations sampled, St.11918 and St.11930 both have aerobic sediment up to 5cm in depth.

There were no significant differences in values of pH for the two canyons.

Bioturbation records were made in the same way as described in leg 1. There were in general quite a number of burrows - both vertical and lateral. These ranged from 3 x 0.5cm to 5 x 3cm in dimension.

The Stations (samples) near the Lisbon Canyon had burrowing animals such as polychaetes, nemertines and sipunculids, while samples from and near the Setubal Canyon had very few burrowing species.

Another interesting feature was the amazing numbers of faecal pellets in the Stations near the Lisbon Canyon. This is apparently directly related to the numbers of animals in these sediments. The Stations at the distal end of the Lisbon Canyon showed interesting 'Y' shaped burrow patterns filled with black (sulphide reduced) faecal pellets. Samples have been preserved in 10% formalin for examination later.

Apart from this study an interesting observation by Mr. P.S. Meadows (P.S.O.), was the drifting algae and sea grass in surface waters at 37° 52'N 9° 13'W at a water depth of c 500m.

Dr.J. Robinson and Dr. P. Tyler devised a means of collecting the floating algal fronds. These were collected in patches of 15-25 cm. A specimen of the gren alga Codium tomentosum ?? (species to be confirmed) and both green and decaying strands of the eel grass Zostera spp.together with a thriving community of numerous Isopods and a few Amphipods were found. These samples have been preserved in formalin for laboratory identification. The same night at St.11922 Zostera was collected in the Agassiz trawl at 500m depth. Dr. P. Tyler has provided a sample preserved in formalin from this collection. Dr. J. Robinson has taken samples of the eel grass to examine the attached microbial communities in the laboratory. The input of drifting sea grass and algae indicates that the River Sado and its shores have beds of Zostera which are washed out into the open waters. An exciting study would be to monitor the transport and rate of degradation of the sea grass in this area and estimate the amount of organic input this can provide into the sediment.

Discovery Cruise 186    Leg 1 and Leg 2

P.A. Tyler, L.S. Campos and L.A. Giles
Dept. of Oceanography, University of Southampton

1. Whole animal biology.

During Leg 1 three trawls were taken by D.S.M. Billett (IOS) (see leg 1 report). Material from these trawls was used for analyses of reproductive biology and analyses of gut contents.

Sperm and eggs from Deima and Pseudostichopus were preserved in glutaraldehyde for EM study. Other gonadal material was preserved in seawater formalin. Material from the gut has been frozen for later sedimentological and organic matter analysis. The ATP content of the gut was determined by extracting the ATP in boiling McIlvaines buffer and subsequently freezing the extract.

Samples of a variety of benthic invertebrates, collected by OTSB, were frozen at -70°C for subsequent genetic analysis.

On the second leg Agassiz trawls at 500m and 1000m were taken. Both yielded good samples, the 500m trawl dominated by crustaceans and the 1000m trawl dominated by Phormosoma. These, and specimens of Echinus were dissected and frozen at -70° C for later analyses of their gut content.

2. Core Analysis.

18 box cores were subcored with three cores. One core was frozen and one stored at 4° C for analysis of sedimentary parameters, organic carbon and total carbonate on return to the laboratory.

The third core at each station was sectioned and material fixed for bacterial and meiofaunal counts. The ATP content at the different levels was determined also by the extractive method outlined above.

Discovery Cruise 186 Leg 1 and Leg 2

Dr. S.J. Wakefield, University College, Swansea/Cardiff.

## OBJECTIVES OF PORE WATER WORK

To obtain pore water samples from box cores and to analyse them subsequently for nutrients and trace metals eg. Mn and Fe. This information then to be used to characterise the redox state of the top half metre or so of the sediment pile and to examine the chemical processes involved in the breakdown of organic matter and early burial diagenesis.

Leg 1

Specifically on Leg 1 samples were required to complement the data set obtained on Discovery 184 BOFS 3 by sampling the Tagus Abyssal Plain - a deep sea environment well south of the BOFS 3 transect (47 - 60° N).

Leg 2

Specifically on Leg 2 a comprehensive data set on the Lisbon/Setubal Canyon System was required to examine diagenesis in a canyon complex under the influence of a major terrigenous sediment supply and organic matter input.

## METHODS

The methods employed were basically those used by the IOSDL and Swansea (now Cardiff) Geochemistry groups over the past few years i.e. sectioning the cores in nitrogen filled glove bags at in situ temperatures and extracting the pore waters by refrigerated centrifugation. Cores were obtained by subsampling box cores with 10cm i.d. polycarbonate core liner. All subsequent manipulations of these sub-cores and pore waters were undertaken within the IOSDL cold container with the centrifuge located within the gravimeter room. The time taken to process a core limited the number of pore water samples that could be taken from any one core to a maximum of 24. These were usually 1cm thick sections taken contiguously over the top 8cm and then spaced according to stratigraphy to the bottom of the core. Intermediate (non-pore water) sections were stored in plastic bags. Following centrifugation of the sample (at 3000 rpm, 4° C, 30 min) the supernatant pore water was removed and filtered through an in-line Nuclepore 0.45 um filter into two sample bottles. One of these was pickled with 15 ul of $HgCl_2$/5ml of sample (for nutrients) and one to 1% v/v with 6M Aristar HCl (for metals) and stored cool. The residual solids from the centrifugation were placed in plastic bags and, along with the 'intermediate' sections, stored frozen. Each core had been completely processed within 12 hours of arriving on deck apart from those from 11926 and 11927 where turn round time was 20 and 16 hours respectively.

In addition, from each box core that was sampled for pore waters two 7.5cm i.d. sub-cores were usually taken for shore-based sedimentological and iorganic geochemical analysis. One of these was stored frozen and one cool.

**SUMMARY OF ACTIVITIES**

| Stn No. | Pore Water Core No. | Length (cm) | Pore Water Sections | Sediment Sections | Other Cores |
|---|---|---|---|---|---|
| D11911.6 | | | | | 1 |
| D11911.8 | 6/1 | 22 | 14 | 6 | 2 |
| D11912.2 | 6/2 | 52 | 24 | 17 | 0 |
| D11912.3 | | | | | 2 |
| D11915.1 | 6/3 | 40 | 24 | 13 | 3 |
| D11916.1 | 6/4 | 30 | 16 | 12 | 4 |
| D11917.1 | 6/5 | 39 | 14 | 12 | 2 |
| D11918.1 | | | | | 2 |
| D11918.2 | 6/6 | 20 | 11 | 6 | 0 |
| D11919.1 | 6/7 | 45 | 22 | 15 | 2 |
| D11920.3 | | | | | 1 |
| D11920.6 | | | | | 1 |
| D11920.13 | | | | | 1 |
| D11921.2 | 6/8 | 41 | 22 | 11 | 2 |
| D11924.2 | 6/9 | 49 | 24 | 16 | 2 |
| D11925.1 | 6/10 | 26 | 12 | 6 | 3 |
| D11926.3 | 6/11 | 34 | 15 | 10 | 3 |
| D11927.1 | 6/12 | 35 | 14 | 11 | 3 |
| D11928.1 | | | | | 3 |
| D11929.1 | | | | | 3 |
| D11930.1 | | | | | 2 |
| D11930.2 | 6/13 | 16 | 14 | 0 | 4 |

Hence a total of 4.49m of sub-core was processed into 226 pore water and 135 non pore water sections.

**DISCUSSION**

The sampling programme was very successful with the RVS box corer working exceptionally well in obtaining good quality interface materials. However, owing to the nature of the sediment only 98/226 pore water samples had volumes in excess of 10 ml. Ideally analysis should have been carried out on board to check on the validity of the sampling and handling techniques but this was not possible from a personnel point of view. Also in carbonate rich sediments _in situ_ measurements are necessary to fully characterise the carbonate system (pH, alkalinity) since pressure changes can modify pore water composition. Consequently shore based analysis will be restricted to NO3, PO4, Si, Mn, Fe in the first instance. Solid phase bulk chacterisation and elemental partitioning will also be carried out with particular reference to the formation of sulphides in the deeper sections of the Lisbon canyon sediments.

I am extremely grateful to the Director of IOSDL for allowing me access to the Institute's cold container, on board Discovery for Cruise 187. Also Sarah Colley of IOSDL is warmly thanked for all her earlier assistance in the transfer of pore water extraction skills modus operandi IOS.

Discovery Cruise 186 Leg 1

James Waterworth
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The purpose of this work is to isolate anaerobic bacteria from benthic samples capable of degrading certain polysaccharide polymers ($\alpha$ and $\beta$ chitin and/or peptidoglycan (PG) from bacterial cell walls). Sample sources to date have been:

Station 1 (11909.3) Multicore sediment from 0-1cm range.

Station 2 (11910.1) Otter Trawl: Gut content of benthic fish (*Namatomurus armatus*) and holothurian (*Pseudostichopus villosus*).

(Station 3 sample abandoned owing to equipment difficulties).

All these samples are being incubated at 4° C in anaerobic roll tubes containing mineral salts medium + appropriate substrate (chitin or PG).

No evidence of growth of colonies to date but long incubation periods are required (at least 2 weeks).

## Acknowledgements

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