CRUISE REPORT:CH7/84

DATES:September 19th-October 5th

AREA:WHITTARD CANYON AND SUBMARINE FAN(SOUTH WESTERN CELTIC SEA)

47.00N-48.20N

9.00W-10.30W

Introduction

The data base built up by the Bristol University Submarine Geology-Marine Sedimentation Research Group, refers to the sediment transport patterns on the Continental Shelf of the South Western Approaches area.Work on the Celtic Sea shelf edge and in the Whittard submarine canyon area has indicated that shelf sediment is being transported into the catchment of the Whittard Submarine Canyon system.This sediment moves down through the canyon, contributing to the development of a submarine fan measuring approximately 60nm by 60nm.

The purpose of cruise CH7.84 was to make a reconnaisance survey of the fan area and determine its importance as a potential sediment transport 'sink' for shelf sediments.The Whittard Sea Fan is the major depositional site towards the end of the Celtic Sea sediment transport path. In order to evaluate the sediment transport processes occuring over the fan area the cruise programme was designed to;

1)Measure the bottom currents over the fan

2)Map the distribution and morphology of the sediments

3)Examine the nature of the sediment surface

4)Determinre the shallow sequence of sediments in the fan.

Associated with the work over the fan, but further up the transport path, an attempt was also made to record the nature and mobility of the seafloor at the canyon head using the Bristol University Velocity Gradient Unit frame

CURRENT METERING

The original cruise programme required the laying of 12 retrievable freefall current meters to monitor bottom currents during maximum spring tides.Two of these were ultrasonic current meters (UCM2s) which were to be laid high up in the branches of the canyons. The intention was to measure the differences in current speed and direction resulting from the contrasting orientations to the tidal wave of the two branches.The remaining 10 current meters were to be Aanderaa RCM5s, recording current speeds 1m above the seabed .The first of these was to be placed at the top of the fan (ie;canyon exit) and the remaining 9 spaced out in a 3x3 station grid across the fan.

On arrival in Falmouth it was found that only 11 current meters were available and that two of these (the UCM2s) had a 2000m depth limit,it was neccesary to make changes in the planned current meter station deployments.The two UCM2s were not deployed in the deeper water of the canyons ,but were replaced by two RCM5s.The UCM2s were deployed later in shallower shelf waters ,1 mile either side of station CM10,the VGU mooring. The remaining 7 RCM5s were deployed,one at the canyon exit and 6 in a 2x3 station grid across the fan.The 3 stations originally planned near the fan margin were not occupied. All 11 current meter stations were succesfully deployed and retrieved with no major problems.Records were obtained which varied in length from around 211hrs to 106hrs.The details of position and period of deployment of all current meter stations can be found in Appendix III.

SEDIMENT SAMPLING

Originally it was intended that there should be a programme of sediment coring using recoverable freefall or boomerang corers.However the 10 to 20 corers required were not available,RVS Barry being able to provide only 3.As these corers alone would clearly not provide adequate coverage, 2 additional sampling methods were employed.In order to compensate for the limited coring capability of only 3 corers RVS provided a Reineck Box Corer. In addition to this, sediment grabs were used as a means of gathering more extensive areal coverage, despite the disadvantages of using wireline sampling methods in water depths of up to 4500m.

FREEFALL CORERS

The first of these was deployed on 24.9.84 under fair sea conditions. The descent and return time should have been between 1 to 1.\hrs, but after this time had elapsed there was no sign of the core arriving back at the surface.A search was made and 3hrs after the initial deployment the search was called off, with the assumption that the core was lost.This may have been a result of a failure to spot the surfaced core with its beacon and floats, but this seems unlikely under the favourable light and sea conditions prevailing.Such a failure to find the surfaced corer may have been associated with navigational error (see section on Position Fixing) The more likely explanation may be that the core never left the seabed, either due to the failure of the lead sleeve release mechanism or because the whole corer became too deeply embedded in what appeared to be a very fine muddy sediment.

The second freefall corer was deployed on 28.9.84. and was succesful. It had a return travel time of 1.25hrs in 3875m water depth and produced a 66cm core. The core was left upright overnight to allow the water contained in the core tube above the sediment core to settle.When clear water was drained off and the core tube shortened with a hacksaw and the remaining sediment core was frozen.

The 3rd corer was not deployed due to adverse weather conditions later in the cruise.

REINECK BOX CORER

This was the first occasion the Bristol Group had had the use of a Reineck Corer. It has been widely and succesfully used in Contiental Shelf waters but its use in deeper waters is less well documented.

The first deployment was made in 4130m of water. After a return trip of 3.5hrs the corer was brought back onboard but was clearly damaged. The rectangular base frame had parted from the main corer body and was hanging from one bolt. Closer inspection revealed that the other 3 bolts had not been sheared but had worked loose, presumably as a result of vibrations being transmitted down the 4000m plus wire.When after a hazardous operation the box corer came to rest on the deck, the rotating spade which closes off the base of the sample box was moved and a base plate was slid in. As this was being done large amounts of clear water poured out of the box indicating it to be empty. When the box was completely removed it proved to contain only a minute smear of sediment. Though this sample was toosmall to have any statistical validity, it was suffiently large for microscopic examination.

The Reineck Corer was subsequently bolted back together with locking nuts and hammered bolt ends to prevent a repetition of the frame loosening. However on the second attempt at deployment the box corer fell off its supporting blocks injuring one of the crew. As a result of this it was decided not to deploy the box corer until adequate and stable mounting blocks had been constructed. Secure mounts were made up in the ship's workshop but were not used as the breakdown of the ship's hydraulic crane prevented the box corer from being moved from its storage position to the aft deck.

SEDIMENT GRABS

For sampling in the deep waters over the fan, a Leeds or Elderfield grab was used as it was considered more suitable than the smaller Shipek grab. Though widely used in shelf waters, the Shipek is known to suffer from leakage of fines due to the washing action of hauling the grab back to the surface. The Leeds grab with its protective covers is believed to be less prone to this problem.

Four deployments were made with the Leeds grab, only one of which was unsuccesful. This failure was due only to the failure of the hydrographic winch which occured when wire became entangled in the spooling gear. On this occasion the grab never reached the seafloor.

In the cases of two of the succesful grabs it was possible to retrieve vertical blocks of undisturbed sediment, which provided useful infomation on vertical structure. These undisturbed sections were removed by hand and placed on wooden boards and quickly frozen. The wooden boards providing firm bases and also a secondary value in helping absorb excess moisture from the samples.

Though for reasons explained above the Shipek grab was not used in deeper water it proved its value when sampling in shallower waters near the shelf margin. Here it was used for nine stations though many of these required several deployments in order to produce an acceptable sized sample.The variable sample recovery rate was partly a reflection of the properties of the substrate being sampled, but was largely a result of the adverse weather conditions during sampling. Heavy seas may prevent the grab from hitting the seabed at the appropriate angle, ie with the wire close to 90' to the bottom, which causes it to fire before it has settled properly on the bottom, producing only a scraping of sediment from the surface.

A Day grab was supplied by RVS but it was not required as the Leeds grab proved adequate for deep water sampling and the Shipek grab was succesful in shallower water.

SEABED PHOTOGRAPHY

As a means of direct examination of the nature of the seafloor, over the fan and on the shelf edge, a series of photographic stations were occupied.

Five succesful deployments were made using a UMEL 35mm stereo camera system loaded with 20 exposure FP4 black + white film. A pinger was fitted above the camera rig with which it was possible to judge the height of the rig above the seafloor.Shutter release was controlled by a release of tension of a weighted line suspended below the rig.As the weight touches the bottom, the tension is reduced and the shutter fires.Each of the stations provided a pair of films and one of these pairs contained one frame of particular interest. Which showed the steep edge of a channel cut in laminated fine sand.Though largely a matter of luck that the shutter release at the right moment,it is also a reflection of the method of deploying the camera rig which increases the likelihood of interesting features being revealed by proceeding across the seabed by a series of hops thereby giving photocoverage over a relatively larger area.

CONTINUOUS SEISMIC PROFILING

To provide the additional information required concerning the subsurface structure of the fan an 8KJ sparker array was deployed for a total of 66hrs.The sparker used was a nine multielectrode array giving 8000J for a 2 second sweep. Recorders were set with a 155-300Hz pass band and a 210-600Hz pass band. Two dry paper recorders were used, firstly to provide a backup facility should one recorder fail but also to allow settings to be varied on one recorder whilst maintaining constant coverage on the second. In practice this was not always the case. Generally the recorders produced one consistently fair record and one consistently poor record. The quality of the records deteriorated particularly badly during bad weather. This problem and the general lack of clear records with good resolution stemmed from working in deep water, of upto 4500m, using what may be considered a shallow water, high resolution seismic tool. What is really required for this kind of work is a deep tow boomer facility.

The losses which occur in sending the signal through great depths are considerable but are particularly magnified in rough seas.At such times, turbulence in the upper water column causes the sparker array and hydrophones to move around, preventing a direct source bed subsurface bed reciever signal being transmitted. Unfortunately this problem resulted in some survey periods of several hours producing very poor records.

A new development for this cruise was the use of the BBC microcomputer for storing navigational data. A program 'Navigat' had been written especially for the cruise and was used during CSF to log the ships position from the data supplied by the ships SATNAV navigation system. Time, longitude, and latitude postitions and depths are recorded at 10 minute intervals. As this was the first use of the program some problems were encountered. However these were generally such that the inclusion of further error traps in the program would prevent the 'crashes' of the BBC which occured.

Generally the program proved very useful and further development may allow 'Navigat' to be used without the backup of a duplicating Decca log book.

VELOCITY GRADIENT UNIT

The Bristol Group's Velocity Gradient Unit has been described in detail elsewhere. On cruise CH7/84 it was intended to deploy the VGU in approximately 200m water depth at the shelf edge. The purpose of this deployment was to measure the actual sediment transport occuring on the seafloor at the head of the Whittard Canyon.

Initially the VGU was to be deployed for one 13 hour tidal cycle, but the premature completion of the sampling in deep water due to bad weather allowed early deployment of the frame. This would have been for a period of 39 hrs but further deterioration in the weather resulted in curtailment of the deployment after only 25hrs. Normally the frame holds a spine fitted with 5 Braystoke Impellors but with the failure of the logger unit required for the spine, a single Aanderaa RCM4 set to record at 1m above the seabed, had to be substituted. Though adequate for making measurements of U100, the use of the Aanderaa RCM4 caused other problems. Even with a shortened fin fitted to the Aanderaa, it still protruded beyond the frame, interfering with the flash units of the two camera systems aimed at the sediment traps and shadow frames. Since the positions of the cameras, flash units and shadow frames are normally set with a constant geometry, moving the flash units to accomodate the Aanderaa fin meant that the method of analysis normally used on the films could not be used. The conventional geometry is such that light is cast normally onto the shadow frame and then onto the seabed at an angle related to the angle of the shadow frame to the seabed. It was thus neccesary to measure the altered angles of the flash pillars to the VGU frame uprights before deployments. It was not however possible to measure the angles of the actual flash units to the mounting pillars before the VGU frame was put into the water. On retrieval of the frame it was possible to accurately measure the position of only one flash unit as the second had been accidently pushed out of its deployment position when bringing the frame onboard.

The sediment traps fitted to the frame may have been succesful in collecting any bedload material if sediment transport was occuring. However it was observed that on retrieval, due to poor sea conditions, the traps were washed out as the frame was raised and lowered through the water by the heavy pitching of the stern.

POSITION FIXING

A problem throughout the cruise was the level of navigational accuracy with which the ships position and therefore the position of the stations were estimated. Working out on the shelf edge means that the ship is beyond the beacon systems of the conventional coastal water position fixing systems of Decca and Loran C, so satelitte navigation had to be used. This does not give an instantaneous position fix as the beacon systems do. It gives constant Dead Reckoning update of position based on the ships heading, speed and last known position from a good satellite pass or fix. Unfortunately 'Satnav' does not give consistently accurate position fixes. When satellite passes are frequent (about every hour) or when the ship is underway on a constant course the accuracy is good However on those occasions when passes are less frequent (upto 5 or 6 hours between passes) or when the ship is attempting to maintain its position over a station for several hours, the accuracy is often very poor.

Unfortunately because of the nature of the work undertaken during the cruise and the water depths in which operations were carried out, often several hours were spent over each station. This meant that 'Satnav' dead reckoning on several of the stations was very poor. Generally the position given for any station is actually an estimate with an accuracy seldom better than 1 nautical mile. However considering the distances involved this is generally quite acceptable.

APPENDIX I

SCIENTIFIC PARTY.

Principal scientist	.	Dr D.Hamilton	- Bristol University
Scientist	.	G.S.Reid	- Bristol University
MIAS Observer	.	Dr R.Lowry	- IOS Bidston
Scientist	:	P.Bold	- University College London
Scientist	:	N.Chidlaw	- Cheltenham
Scientist	:	L.Nash	- Swansea University
Scientist	:	S.Stone	- Swansea University
RVS Technical Officer	:	W.Miller	- Barry
RVS Technical Officer	:	R.Powell	- Barry
Research Technician	:	M.E.Overs	- Bristol University
Research Technician	:	I.Avent	- Bristol University

APPENDIX II

Timetable

Monday 17th Sept' : Party from Bristol travelled down to Falmouth by minibus with equipment.

Tuesday 18th Sept' . Bristol University and RVS Barry equipment loaded and fitted aboard RRS Challenger.All scientific crew onboard.

Wednesday 19th Sept': Sailed from Falmouth 10.30am.Sea condtions poor.Proceeded out to sampling area.

Thursday 20th Sept' : Watches for scientific party begun. Acoustics for CM1 and CM2 wire tested to 3000m.

Friday 21st Sept' : CM1 deployed 10.06hrs.CM2 deployed 14.00hrs. Acoustics for CM3 and CM4 tested to 3207m.CM3 deployed 19.22hrs.

Saturday 22nd Sept' . CM4 deployed 08.38hrs.CM5 and CM6 acoustics wire tested.CM5 deployed 14.30hrs.Seals on CM6 proved faulty,deployment postponed.Leeds grab attempted at 18.00hrs,but wire on hyrographic winch caught in spooling gear.Leeds grab station aborted. Grab recovered succesfully.

Sunday 23rd Sept' . CM6 deployed 06.51hrs after problems with CM6 acoustics resolved.Acoustics for CM7,CM8 and CM9 tested to 3579m.On recovery the O rings had burst and the two modified tie bars had failed. CM7 deployed 14.01hrs. CM8 deployed 18.51hrs. Attempt made to land mooring in a submarine channel. CM9 deployed at 21.21hrs.

Monday 24th Sept' . 07.50hrs Leeds grab (B3606) in water. Succesfullyretrieved at 11.47hrs. 12.00-13.00hrs Sparker and hydrophones deployed for testing. 16.22hrs sparker retrieved. Freefall corer(B3607) deployed at 17.05hrs, not retrieved.Camera rig(B3608) deployed 20.38hrs.Sparker prepared for overnight deployment.

Tuesday 25th Sept' . 01.13hrs Sparker deployed. Navigat' computer logging begun.BBC crashed several times during the day.Seismic profiling contiued throughout the day.

Wednesday 26th Sept'. Seismic profiling continued until 12.00hrs. Reineck box corer (B3609) deployed 13.30hrs.Box corer retrieved but frame damaged and only a minute smear of sediment recovered.Camera station (B3610) deployed 19.00hrs.Began seismic profiling at 21.59hrs.

Thursday 27th Sept' : Seismic profiling continued through night until 08.15hrs. Record quality poor because of bad weather. Prepared Reineck corer for deployment but accident on deck prevented this. Leeds grab (B3611) deployed in place of box corer at 09.36hrs. Second Leeds grab station (B3612) occupied at 15.38hrs. Camera station (B3613) deployed at 19.30hrs. Seismic profiling begun at 22.50hrs.

Friday 28th Sept' . Seismic profiling until 05.07hrs. CM9 traced and released 07.40hrs. CM8 traced and released 08.38hrs. CM7 traced and released 12.29hrs. CM6 traced and released 15.43hrs. Freefall corer (B3614) deployed 18.12hrs. Retrieved successfully with 0.66m sediment core.

Saturday 29th Sept' : CM4 traced and released 06.32hrs. CM5 traced and released 10.36hrs. CM3 traced and released 12.48hrs. Around 12.00hrs the aft deck hydraulic crane broke down. CM2 traced and released 16.48hrs. Rough seas prevented Sparker deployment.

Sunday 30th Sept' . CM1 traced and released 06.34hrs. Wire tested VGU camera package. VGU frame deployed 18.30hrs. CM11 deployed 20.34hrs. CM12 deployed 21.33hrs.

Monday 1st Oct' . Shipek grab (B3618) deployed 08.15hrs. Shipek grab (B3619) deployed 09.20hrs. Shipek grab (B3620) deployed 10.05hrs. Camera station (B3621) deployed 11.38hrs. Camera station (B3622) deployed 13.00hrs. Also on this station shipek grab (B3623). Shipek grab (B3624) deployed 14.50hrs. Shipek grab (B3625) deployed 16.36hrs took several attempts to produce large enough sample. Camera and grab deployment programme abandoned because of bad weather, in order to pick up VGU frame. Frame retrieved 20.00hrs.

Tuesday 2nd Oct' : CM12 traced and released 13.05hrs. CM11 traced and released 14.30hrs. Shipek grab (B3626) deployed 3 attempts. Shipek grab (B3627) deployed 4/5? attempts. Shipek grab (B3628) deployed, unsuccessful after 8/9? attempts.

Wednesday 3rd Oct' . Seismic profiling overnight. At 06.32hrs cruise programme abandoned due to bad weather. Ship heads for Falmouth.

Thursday 4th Oct' : Arrived in Falmouth AM. Moored by noon.

Friday 5th Oct' . Unloaded Bristol University equipment and returned to Bristol.

APPENDIX III

STATION POSITIONS

1)Current Meter Positions

No	Long N	Lat W	Depth M	Date of Deploy/Retrieve		Length of useful deployment
(B3596) CM1	48,10.320	10,14.280	3575	21.9.84	30.9.84	211hrs.33mins
(B3597) CM2	48,06.740	10,29.298	3725	21.9.84	29.9.84	193hrs.50mins
(B3598) CM3	47,49.599	10,08.726	4100	21.9.84	29.9.84	184hrs.33mins
(B3599) CM4	47,38.693	10,27.814	4040	22.9.84	29.9.84	165hrs.03mins
(B3600) CM5	47,42.673	10,07.150	4100	22.9.84	29.9.84	162hrs.58mins
(B3601) CM6	47,42.121	9,49.749	4100	23.9.84	28.9.84	127hrs.49mins
(B3603) CM7	47,30.108	9,50.117	4250	23.9.84	28.9.84	118hrs.35mins
(B3604) CM8	47,25.399	10,09.068	4275	23.9.84	28.9.84	103hrs.51mins
(B3605) CM9	47,25.153	10,16.674	4370?	23.9.84	28.9.84	104hrs.04mins?
(B3615:VCU) CM10	48,48.762	10,04.096	193	30.9.84	1.10.84	24hrs.34mins
(B3616) CM11	48,49.046	10,05.048	200	30.9.84	2.10.84	41hrs.53mins
(B3617) CM12	48,49.139	10,01.715	193	30.9.84	2.10.84	39hrs.29mins

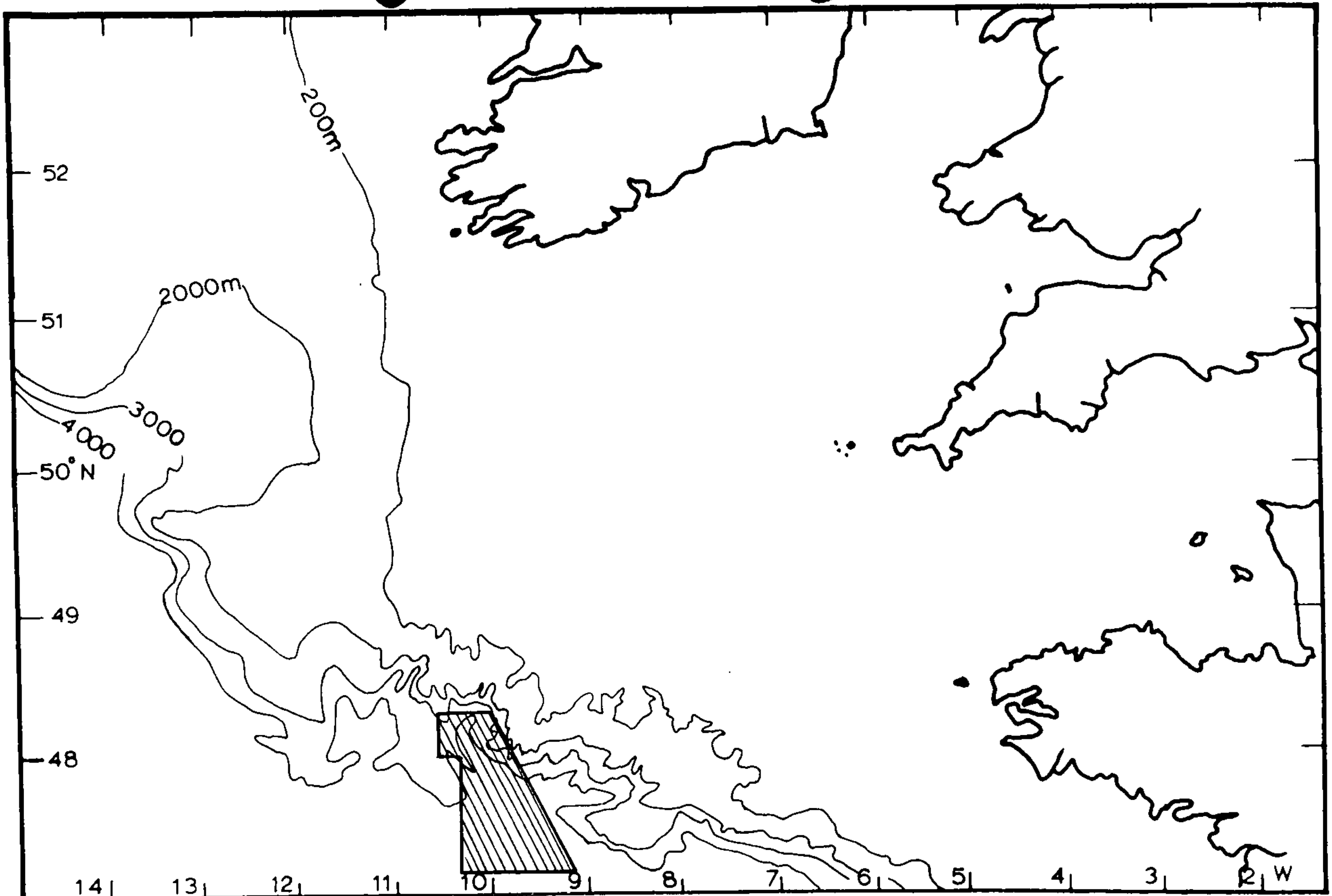
2)SEDIMENT STATIONS

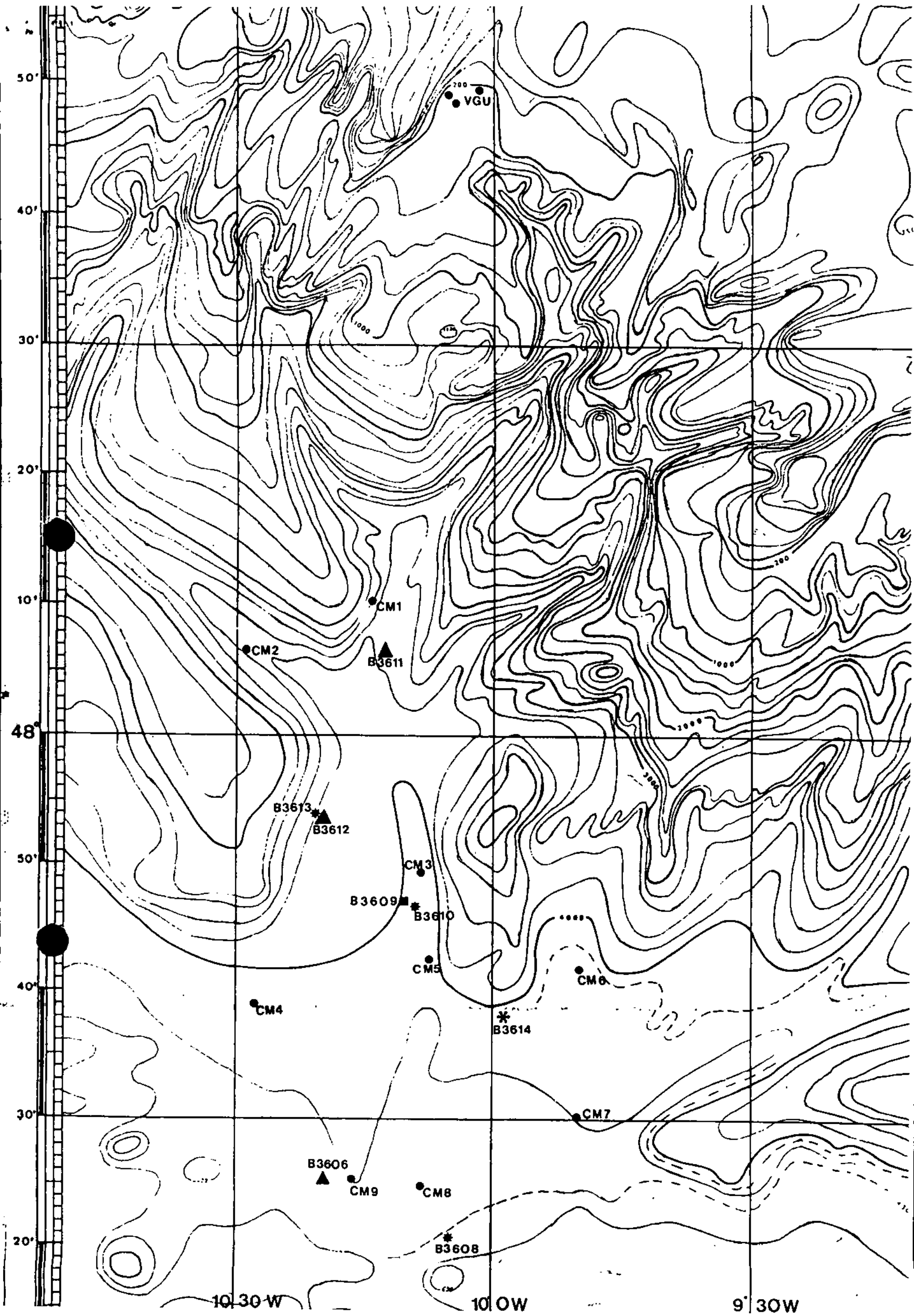
No	Date	Method	Lat(N)	Long(W)	Depth(m)
B3602	22.9.84	Leeds.G		(FAILED)	
B3606	24.9.84	Leeds.G	47,25.005	10,19.938	4200
B3607	24.9.84	Freefall.C		(FAILED)	
B3609	26.9.84	Reineck.C	47,47.413	10,10.568	4130
B3611	27.9.84	Leeds.G	48,06.427	10,12.886	3685
B3612	27.9.84	Leeds.G	47,53.383	10,20.192	3765
B3614	28.9.84	Freefall.C	47,38.458	09,59.544	3875
B3618	1.10.84	Shipek.G	48,47.350	10,03.982	218
B3619	1.10.84	Shipek.G	48,46.772	10,02.596	227
B3620	1.10.84	Shipek.G	48,46.728	09,59.682	193
B3623	1.10.84	Shipek.G	48,42.985	10,02.133	395
B3624	1.10.84	Shipek.G	48,42.961	10,05.079	900
B3625	1.10.84	Shipek.G	48,43.001	10,09.723	255
B3626	2.10.84	Shipek.G	48,48.337	10,03.835	200
B3627	2.10.84	Shipek.G	48,48.971	10,04.799	200
B3628	2.10.84	Shipek.G	48,48.650	10,01.180	195

CAMERA STATIONS (UMEL STEREO)

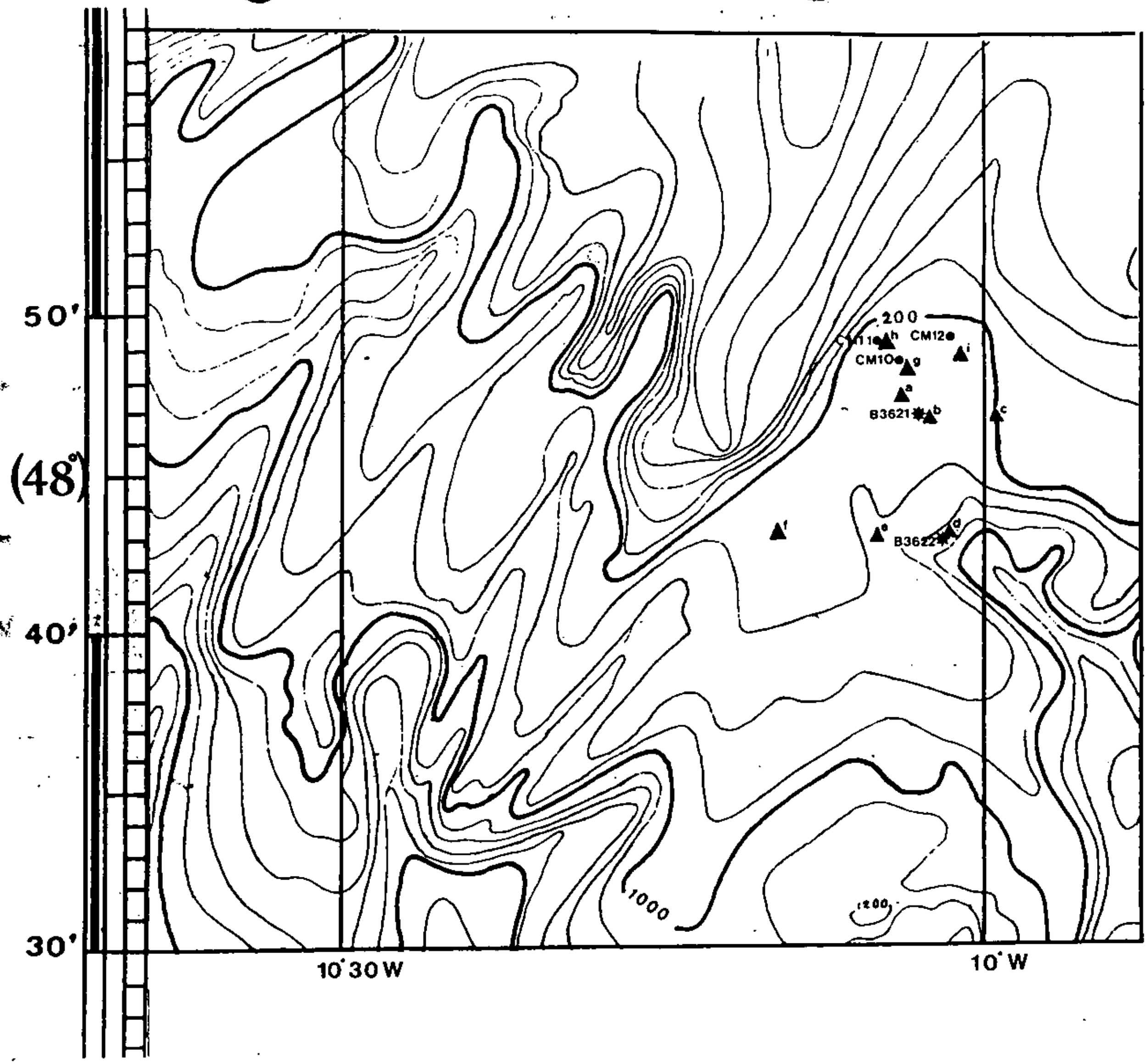
No	Date	Lat(N)	Long(W)	Depth(m)
B3608	24.9.84	47,20.410	10,06.938	4460
B3610	26.9.84	47,46.582	10,09.442	4155
B3613	27.9.84	47,53.947	10,20.965	3700?
B3621	1.10.84	48,46.928	10,03.107	240
B3622	1.10.84	48,42.908	10,02.042	305?325

CRUISE CH7-84 LOCATION MAP





● CURRENT METER
▲ LEEDS GRAB
* FREEFALL CORER
✱ UMEL CAMERA



V.G.U. and U.C.M.2 Site.

- CM10 : V.G.U.
- CM11 +12 : U.C.M.2

▲ Shipek Grab Samples

a. B 3618
b. B 3619
c. B 3620
d. B 3623
e. B 3624
f. B 3625
g. B 3626
h. B 3627
i. B 3628

✱ Camera Stations