INSTITUTE OF GEOLOGICAL SCIENCES
CONTINENTAL SHELF NORTHERN UNIT
Internal Report No. 80/4

CRUISE REPORT

WHITETHORN

Cruise 80 WH 04

Leg 2.

19.6.80 - 2.7.80

by

R. Owens

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1. INTRODUCTION

The object of leg 2 of cruise 80WH04 was to complete sampling on the Peterhead (57^{o}-58^{o}N; 2^{o}W-0^{o}) and Marr Bank (56^{o}-57^{o}N; 2^{o}W-0^{o}) 1:250,000 maps, the priority areas being the Peterhead SE, Marr Bank NE and Marr Bank SE 1:100,000 sheets. Poor weather during the second week of the leg caused diversion of effort to the Marr Bank SW, Marr Bank NW and the Tay-Forth stand-by work areas with the result that the Marr Bank SE 1:100,000 sheet area was not sampled. A total of 149 sites were occupied, 66 with the vibrocorer. The survey log is contained in Appendix I.

2. PERSONNEL

R. Owens	IGS (CSNU)	Senior Scientist
M. Thatcher	IGS (CSNU)	Surveyor
I. Moore	IGS (EGU)	Day Lab/Engineering Geology
R. Nicholson	IGS (A & C)	Day Lab/Geochemistry
W. Lonie	IGS (CSNU)	Technician
P. Wiggins	IGS (CSNU)	Technician
S. Brown	IGS (CSNU)	Night Lab/Geologist
G. Tulloch	IGS (CSNU)	Night Deck
S. Crutchley	Keele University	Other

3. EQUIPMENT

a) <u>Ship's</u>

i) 4 x 16t diesel-hydraulic anchoring winches

ii) 4 x Bruce anchors.

iii) 30t winch and "A" frame for vibrocorer handling.

iv) Atlas-Deso echosounder.

b) <u>IGS</u>

i) 6m vibrocorer with retraction and "penetrometer" systems.

ii) gravity coring system, complete with Lebus winch and braided nylon line.

iii) Shipek grabbing system, complete with Lebus winch.

4. PERFORMANCE

a) Ship

i) Anchoring - time required was considerably reduced by the limited scope allowed by the Bruce anchors. In calm weather, scope of as little as 1.25 times water depth was sufficient. Slippage of the winches was occasionally experienced, although this did not cause problems. The only equipment generated "down" time during this leg was caused by failure of the spooling gear on the starboard forward winch. This was due to bearing failure and caused a delay of 1½ hours.

ii) "A" frame and winch - despite attention in Aberdeen at the start of leg 2 this equipment functioned more slowly than required in the contract. Midway through the leg the rate of hauling (final layer) was measured at 20 metres/min. By the end of the leg the rate had slowed to 16 metres/min.

iii) General - the overall performance of the ship was excellent. Again, she has proved capable of safe working in fairly extreme weather conditions. The competence and quality of the ship's officers and crew are a large factor in this measure of success.

b) IGS Equipment

i) Vibrocorer - the "new style" vibrocorer performed extremely well. No problems of any kind were encountered with the retraction system. A single occurrence of an earth leakage was traced to a "blown" connector in the penetrometer power supply and was probably caused by contact of the main lifting warp with the connector whilst the equipment was on the seabed.

The "penetrometer" performed well. However, it is not yet completely satisfactory for two reasons. Calibration by "free" running in mid-water gives chart results differing by approximately 6% from those when a full sediment barrel is obtained. Random "noise" and surges picked up from the AC power supply to the vibrocorer are both seen in the record and seriously diminished its usefulness. This could be eliminated by shielding the signal cables and/or filtering the signal to the chart recorder pen.

The chart recorder itself has several problems. A check on the paper feed rate showed it to vary from the set 50mm/min., on occasions to as low as 41mm/min. This, and the problems experienced on leg 1 with the overheating time/event pens, suggests the source of trouble to be a fluctuating mains fupply. The separate constant voltage supply unit appeared to malfunction and made no difference to results. However, the problem may lie not only in voltage variation. It is possible that the frequency of the supply may vary from the normal 50Hz. This would effect the electric motor driving the chart if the frequency varied beyond its rated tolerance. As a temporary expedient, the time of starting and finishing were marked on the chart to allow the route to be calculated (leg 3 will be able to use a timing clock to calculate elapsed time more precisely).

One possible benefit of the barrel retraction system is enhanced core recovery. Core catchers were not being everted with the frequency previously experienced. However, it is clear that some core is still being lost during recovery (see below).

Use of the retraction system also allows considerable latitude in station keeping during vibrocoring. Bent core barrels (caused by lateral movement during extraction from the seabed) occurred on only two occasions during the leg, both in extreme conditions when the ship surged on the anchor wires during recovery.

Limited penetration at numerous stations where fine sands were cored was accompanied by apparent overconsolidation of the sand in the core cutter. This suggests that the action of vibrocoring in these sediments eventually repacks the sand ahead of the cutting shoe to such an extent that penetration is impossible. Penetration and recovery in such cases could be improved if water-flush was used. Alternatively, if a semi-rotary motion were imparted to cutting shoes fitted with "wings" similar to those on rotary coring bits, then the consequent cutting action should help to improve penetration.

ii) Gravity corer - the combination of the braided nylon warp and the new Lebus vibrocorer/gravity corer winch resulted in a very significant improvement in performance when compared to the experience of previous years. In particular, the ability to meter out the line (after allowance for a stretch factor) allowed the corer to be deployed more systematically and consistently than in previous years.

The nylon warp gave a clear indication of the moment that the seabed was reached by "collapsing" when relieved of strain. It also eliminated many of the problems of "snatch" loading, previously encountered.

Problems were encountered with a design deficiency on the foot-brake linkages which siezed on 24.6.80. Investigation revealed there was no provision for lubricating the linkage pivots. A considerable amount of technical effort was required to free them and make temporary provision for lubrication. This matter was reported to Lebus with a request that they provide rectification at the next port call. They were also advised of a similar deficiency in the lubrication of the spooling gear.

iii) Shipek grab - the new Lebus grabbing winch proved an unqualified success, giving good control of the grab during ascent and descent, rapid operation and, via the metering device, a reliable indication of reaching seabed (this could be used for sounding in the event of echosounder failure). Some very slight attention to the metering wheel was required when it showed a tendency to stick after a period of inactivity.

Problems initially encountered with the davit swinging were cured by tightening the wormwheel and worm interlock. However, these are so worn as to require replacement before another season.

iv) Decca Navigator - during most of the leg problems were experienced with erratic cursor movement on the track plotter. Although partially alleviated by cleaning and lubrication, attention by a Decca engineer was requested for the port call.

The failure of the Decca Navigator on 30.6.80 was traced to a faulty aerial junction box. Fortunately, there was a spare junction box and a temporary aerial was rigged through this, resolving the matter. Attention to this during the port call was required.

5. RESULTS

a) Operational

A total of 149 sites were occupied, 66 with the vibrocorer. This compares very favourably with the results on the equivalent leg last year when 171 sites were occupied, 69 with vibrocorer, during a 3 week leg (rept. 79/6). An average of 6 sites per day were occupied, with a maximum of 8. Given shorter steaming distances between stations, these figures would have been considerable improved.

The distribution of the sites, referred to 1:100 000 sheets, was as follows:-

Sheet Area	Total Stations	Shipek Grab	Gravity Corer	Vibrocorer
Peterhead SE	55	55	36	19
Marr Bank NE	44	44	22	20
Marr Bank SW	42	40	20	21
Marr Bank NW	3	3	1	2
Tay-Forth NE	3	3	0	3
Tay-Forth SE	1	1	0	1
Moray-Buchan SE	1	1	0	0

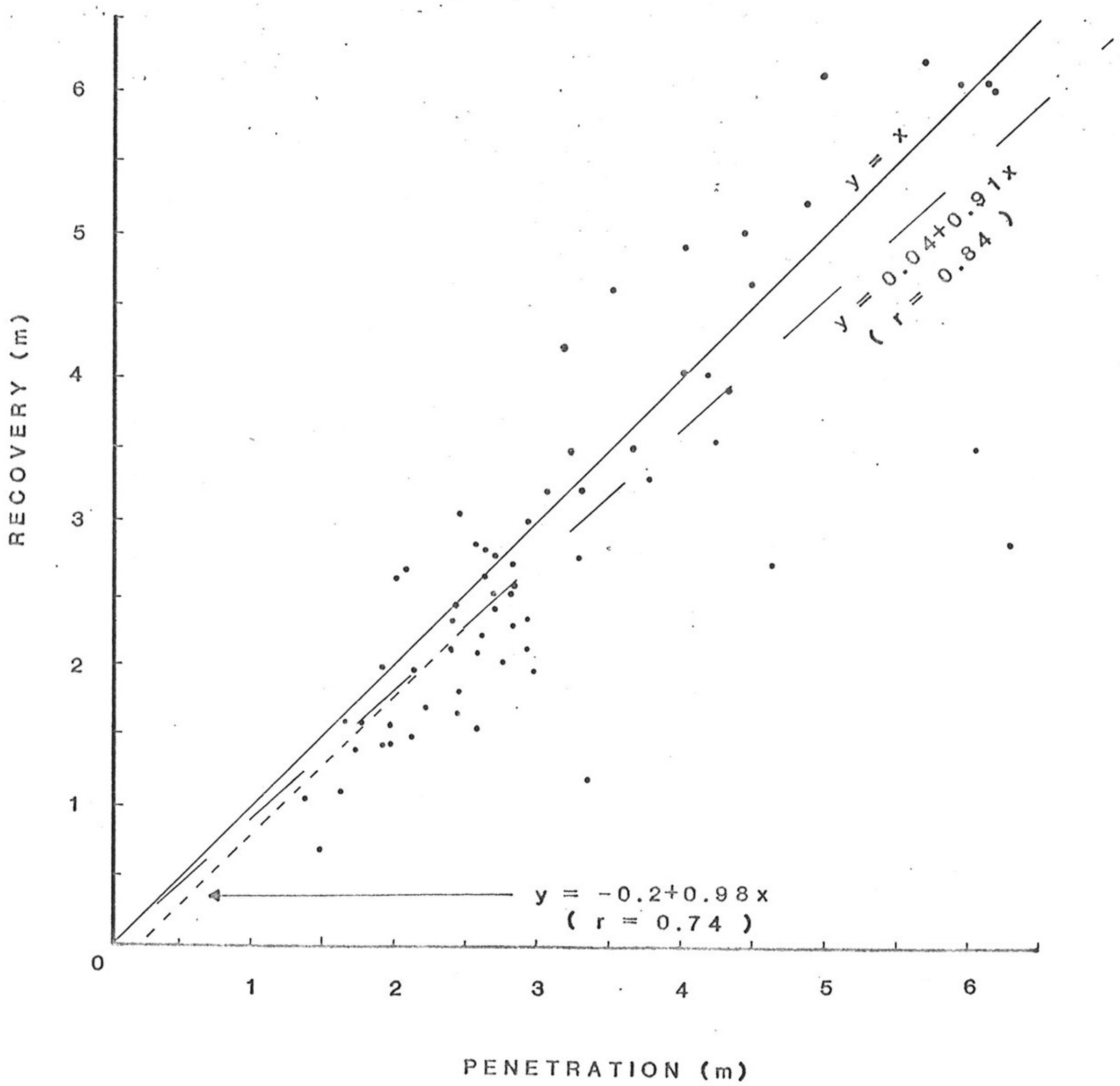
It is clear that, but for the bad weather in the second week, the target for the leg (completion of Peterhead SE, Marr Bank NE/SE and part of Marr Bank SW) could have been met.

b) Technical

In Fig. 1 calculated penetration (from the penetrometer chart using full scale deflection as representing 6m) is plotted against measured recovery (core plus shoe). Although there is scatter around

Fig. 1

CORE RECOVERY vs PENETRATION



the line of theoretical equivalence (i.e. calculated penetration = actual recovery) the intercept and slope of the linear regression (actual recovery = 0.04 + 0.91 x calculated penetration, in meters) is very close to the theoretical line. The correlation coefficient (r) is also good, at r = 0.84.

The scatter about the line of theoretical equivalence can be explained in two ways. In the case where recovery exceeds indicated penetration, it is thought that the entire vibrocorer has sunk into the seabed thus forcing "additional" sediment into the core barrel. It is perhaps significant that "excess" recovery is greatest and most frequent when core length exceeds 3m. Greater penetration and recovery is reasonably anticipated in soft sediments.

The converse argument may apply in the case of cores shorter than 3m. Difficulty of penetration is expected to correspond with poor recovery, since a sediment which resists penetration may reasonably be expected to resist extraction (the exception being the sands overconsolidated by vibrocoring, mentioned above). The linear regression equation for penetration less than 3m supports this (actual recovery = -0.2 + 0.98 x calculated penetration, in meters) by its indicated mean core loss of 20%, as against the mean core loss for all samples of 10%.

The penetrometer chart records should provide useful geological and geotechnical data. However, they must first be "smoothed" and reduced to a standard format. Digitising and subsequent computer reduction and display of the data appear to be the most appropriate techniques.

c) Geological

Infill sampling spread over such a wide area cannot easily be used to draw valid geological conclusions on the work of the leg.

In the Peterhead SE and Marr Bank NE areas sediments similar to some facies of the Errol Clay were sampled at numerous vibrocore stations. An extensive spread of fine to very-fine, almost pure, quartzose sands (? Marr Bank Beds) was cored in Marr Bank SE. The purity of these sands, their apparent large volume and the relatively shallow waters where they occur may render them a possible resource of high-quality glass-making sand.

Two stations were occupied in the field of anomalously located sand-waves at 57°20'N; 1°W (Fig. 2). The vibrocores were located in the trough and on the flank of one of the sandwaves and were positioned after the sandwaves had been identified on an echo-sounder line. The cores proved the sandwaves to consist of yellow-stained coarse to very coarse sand in the trough with similarly stained medium to coarse sand on the flank. In both cases a muddy substrate was reached, in the trough at 0.75m and at 2.25m on the flank. It is hoped these samples will assist in determining whether or not the sandwaves are relict and, if so, on what timescale.

Sample station 56-Ø1/80 proved (?) Marr Bank beds to underly the superficial sediment layer. Penetration ended at 3.24m although only 2.70m of core was recovered. The shoe sample was found to contain disseminated woody and peaty plant fragments, possibly sufficient for radiocarbon dating.

6. CONCLUSIONS

i) The almost complete absence of problems on this leg demonstrates that the troubles experienced in the last two years sampling have (hopefully) been overcome. In particular, the "new-style" vibrocorer with retraction and penetration indication systems is a resounding success. I hope it will soon be possible to implement vibrocoring in the "free" mode with 24 hour operation.

ii) There is still some indication of weakness in the anchoring winches. It will be interesting to learn why the makers have recommended that the winch brakes are not used to hold the ship when at anchor.

7. RECOMMENDATIONS

i) At the end of the season, all technical staff and senior

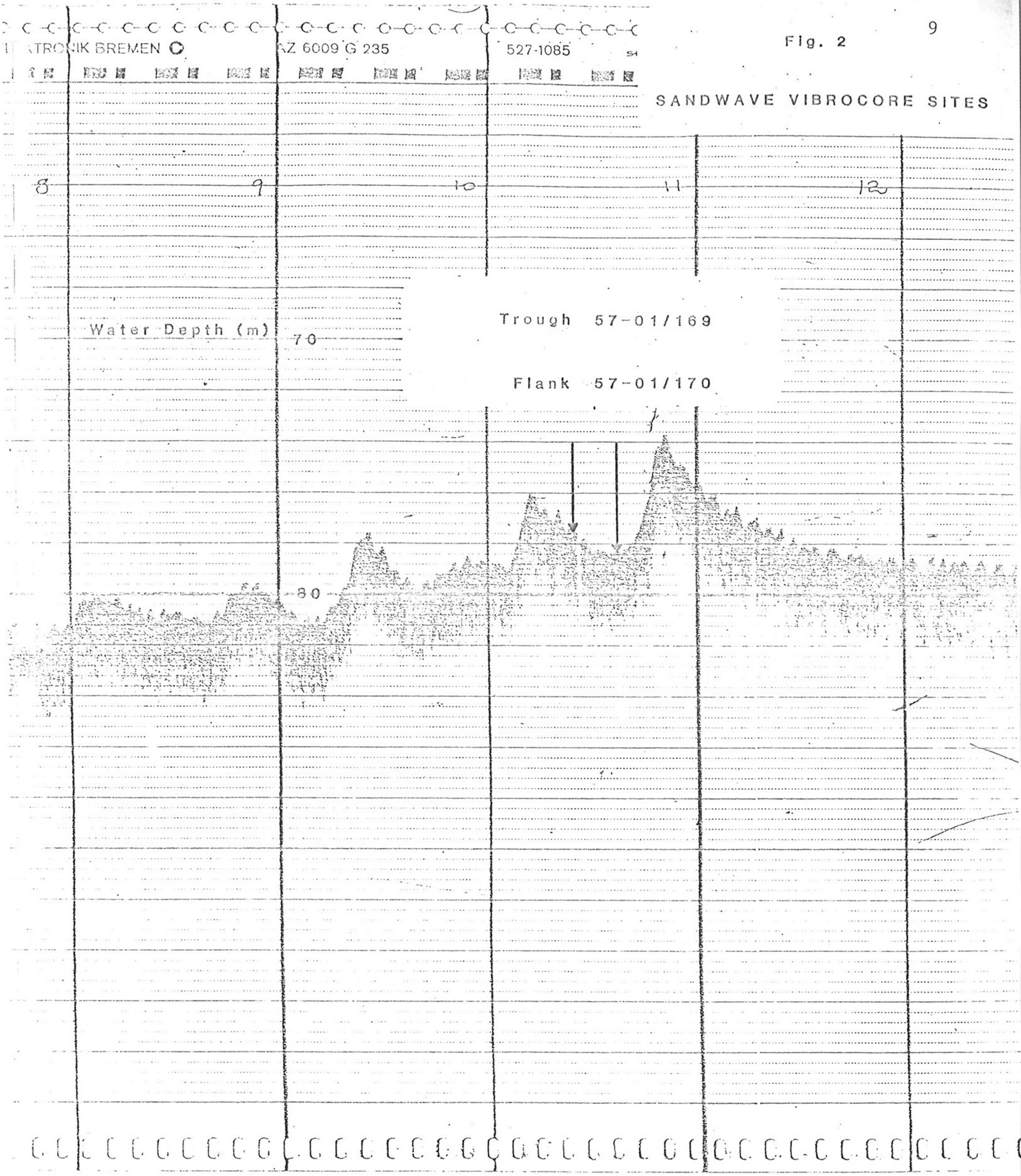


Fig. 2

SANDWAVE VIBROCORE SITES

scientists should meet to discuss the problems and experiences of the season. Otherwise, valuable feedback is lost to the system.

ii) The need for two technicians to be on routine sampling legs should be carefully scrutinised at the end of this season. The present arrangement may not be efficient.

iii) The practice of taking "splits" of grab samples (for archival, particle size analysis, etc.) from the bucket with a scoop is generally unsound and renders our results open to criticism on grounds of unscientific methodology.

iv) The high quality of the watch-keeping deck officers provided and the standardised format Coes have developed for position recording both have taken a significant load from the surveyor. In view of the need to optimise staffing efficiency during possible 24 hour vibrocoring, the continuing need for a surveyor per se needs to be investigated. Rationalisation of effort could allow the job to be performed by the senior scientist and deck officers, thus freeing one IGS berth in a situation where accommodation is at a premium.

APPENDIX I

SURVEY LOG - Leg 2

Thurs. 19.6.80

1100	R. Owens aboard
1430	Agree sailing 1800 hrs 20.6.80
1830	D. Ardus/J. Chesher/N. Fannin OFF

Fri. 20.6.80

1645	T. Hart (Coe Metcalf) advises Problems with hydraulics for "A" Frame. Are contacting Command Hydraulics.
1705	Agreed with Captain to calibrate penetrometer in dock by swinging ship; if necessary
1800	Repairs complete
1830	Left Aberdeen and headed for test site immediately north of harbour.
1920	Anchored on test site; commence calibration of penetrometer.
2330	Completed tests.

Sat. 21.6.80

0015	D. Bottle off
0030	Steaming for first station. ETA 0400hrs. Deploying trough for CS.
0425	Commenced sampling (CS/GS)
0615	Ceased sampling, steamed for start of echo-sounder line to select sand-wave site.
0715	Commenced Line A
0740	E.O.L.A. selecting site and anchoring.
0953	VE deployed
1200	Captain reports Problem with spooling gear on forward starboard anchor winch. Commenced down time.
1330	Repairs complete - change to forward port winch and raise anchors. Down Time 1hr 30mins.
1400	Start of echo-sounder line B
1430	E.O.L. B, steam for night site.

Sun. 22.6.80

0030	Finish vibrocoring - steam for first night site.
0710	Finish night work, head for first VE site
0800	On site, commence vibrocoring.
1800	Suspect penetrometer calibration incorrect; check
2030	Discrepancies confirmed by full core. Will attempt re-calibration tomorrow a.m.
1145	Finish vibrocoring - sail for first night site.

Mon. 23.6.80

0050	Commenced night operations
0730	Completed night operations
0800	Anchoring on 1st VE site (57-Ø1/2Ø5)
0930	Routine call to office; all messages passed.
2330	Finished vibrocoring; steaming for first night site.

Tues. 24.6.80

0040	Commenced night sampling
0705	Completed last night site; steaming for first VE site
0800	Commence anchoring for first VE site
0900	Technicians report seizure of linkages on Lebus winch; commencing rectification. Problem caused by poor design - no possibility of lubricating pivots.
1600	Repair completed but modification by manufacturers required.
2245	Complete last VE site
2300	Commence night sampling

Wed. 25.6.80

0730	Finish night sampling; steam for first vibrocore site.
0800	Commence anchoring
0930	Routine call to IGS. List of items required passed Advised SLO we (PJW) would phone Lebus to discuss.
1115	Call received from SLO (D. Evans)- RVB require list of likely sites for next 3 days sampling.
1415	Called IGS (NGTF) and passed Lats/Longs of 84 sites.
1448	Completed call - £14.85 cost.
2250	Completed vibrocoring, head for first night site.

Thurs. 26.6.80

0708 Finish night sampling, steam for first VE site

0810 Commence vibrocoring

1630 P. Wiggins phones Lebus winches (0795-75324: P. Holman) to advise of problems re:

1. siezure of brake linkage pin joints
2. lack of lubrication to spooling gear pulley
3. need to modify brake return spring fixings.

P. Holman will attempt to resolve problems and will contact SLO.

1650 Phone call from D. Evans re RVB requirement for working positions.

1. for next 4 weeks we must advise RVB of our work positions/areas for 24hr periods
2. Relay corner co-ords of proposed areas to RVB (Chris Evans) via SLO
3. For tomorrow's routine call we must provide positions for Sat., Sun. and ½ Mon.
4. SLO will contact RVB tomorrow am to establish position re bad weather sites; routine call to be made after 1000hrs.

Ref. our last routine call, SLO unable to obtain "potting" compound via ITT Aberdeen. Requested names of other suppliers. PJW refers to 3M's at 041-332-9622, Electro Products Sales for 2130 potting compound to be forwarded to Cooks, Aberdeen.

2330 Finish vibrocoring, steam for first night site.

Fri. 27.6.80

0045 Commenced night work.

0400 Weather deteriorating; gale warning (NW 8) given. Ceased gravity coring but continued grabbing.

0500 Continuing deterioration, cease all work.

0730 Test weather by heaving to. Decide to steam towards NW to obtain sheltered working conditions.

0900 Routine call made (early because of weather) to SLO (ACS). Advised proposed good and bad weather working areas and passed requests/replies.

D. Evans has confirmed from C. Evans (RVB) that any changes in intended work areas, because of weather at weekends should be phoned to RVB direct (044-6737451). Security man should be asked to pass message to Chris Adams or Duty Officer, otherwise SLO to be advised and will pass info. on to RVB. SLO will Advise RVB that we intend to work in Marr Bank Sheet.

1530 Commenced anchoring at 56-02/245 (MBSW).

2400 Still anchored at 56-Ø2/249 - 5th station.

Sat. 28.6.80

0045 Finished VE station, steaming for first night site

0135 Commenced night sampling

0645 Complete night sampling

0800 Commence anchoring at 56-02/257

Sun. 29.6.80

0030 Finished vibrocoring; lift anchors and steam for first night-work site

0110 commenced night work

0632 Finished night work. Weather forecast Forties Cromarty Forth N-NW 6-8 occ 9. Steamed towards possible vibrocore site in west of MBSW sheet.

0845 Commenced anchoring at 56-Ø2/271. Wind NNW 6, seas mod-heavy

2325 Finished vibrocoring at 56-Ø2/276. Steam for first night station.

2400 Commence night work.

Mon. 30.6.80

0625 Decca fails at station 56-Ø2/283 (56°09N; 01°31'W). Swell too heavy (northerly) to continue working towards east and steamed west while investigating Decca fault.

0915	Completed temporary repairs. Fault traced to aerial input transformer and rectified by means of a jury-rigged aerial and spare junction box. Steamed for first VE site.
1040	Commenced anchoring at 56-Ø2/284
1750	Forecast northerly 7. In view of this and continuing northerly swells, abandon intentions to work MBSE after next VE station at 56°36'N; 01°10' and plan stations in MBNW.
2110	Finish vibrocore station and steaming for MBNW. ETA for night work 2400 hrs.
2200	Called SLO (A. Skinner) to advise change of plans and asked him to tell RVB proposed work area 56°30'N; 57°N; 01°01'W to 2° (or coast, depending on weather)

<u>Tues. 1.7.80</u>

0415	Discontinued sampling in northerly 7-8 and steamed SW to obtain sufficient lee to work
0700	Seas still very rough and N 7-8
0800	56°22'N; 01°25'W. Seas still heavy but probably workable.
0830	Call to SLO advising intention to work 56°-57°N; 3°W - 2°W. Decided to wait 1 hr for reaction from RVB before anchoring.
1115	On VE site 56-Ø3/585
2320	Finished sampling at VE site 56-Ø2/289. Steaming for Aberdeen.

<u>Wed. 2.7.80</u>

0815	Docked in Aberdeen
1100	A. Skinner aboard
1600	R. Owens ashore

APPENDIX II

REPORTS AND COMMENTS FROM PARTICIPANTS

i) Report on Equipment (W. Lonie)

After the Penetrometer system was set up and calibrated, the vibrocorer worked very well with only one minor electrical fault (the lead from bottom electrical box to Vibrocorer pot). Penetration in fine sand was poor, but we now seem to recover much of what we penetrate due to the steady pull of the retraction system. We should possibly work at some form of rotation of the core barrel to help penetrate fine sand; it could be done using some of the hydraulic or mechanical power we have available on the base plate.

The Lebus winch for gravity coring required considerable work on the brake system; the pins on the linkage were too tight a fit and no grease or oil ways were provided.

The Shipek grab worked very well, but the Davit needs replacement of the wormwheel and worm.

ii) Gravity coring/Shipek grab sampling - Night Operations (S. Brown)

Generally successful, trouble free operations with the number of samples collected during night adversely influenced by long distances between sites, late finishing of vibrocoring and foul weather. Level of staffing (2 IGS personnel and 1 crew member) was adequate in fair weather, allowing both sampling operations to run concurrently. This minimum staffing level was possible through co-operation of officer-of-the-watch regarding navigation.

In foul weather the Shipek grab requires 2 men for safe operation and 2 IGS personnel on lower deck to unload gravity corer is also prudent. In bad conditions the two pieces of equipment were run at different times, using both IGS staff on each operation.

Gravity coring:

1. Brake and clutch problems on Lebus winch.

2. Peripheral wear on nylon cable c 50-70m out.
3. Core recovery very variable, marginally better with 2½" barrel (qualitative assessment). Main problem encountered was with water draining from barrel during unloading, with consequent disturbance or loss of sandy core.

Shipek Grab:

1. Lebus winch operated very effectively, providing good control of grab during ascent/descent, rapid recovery and accurate, reliable indications of reaching sea bed.
2. Location on upper deck affords better protection for personnel but causes problems in foul weather with swinging grab during ascent.
3. Initial problems with loose, swinging davit now solved.

Sub-sampling of Shipek Grab sample for PSA:

When sub-sampling sand with a mud component held in suspension it is not possible to ensure that the volume of suspended sediment included in the PSA sample reflects the proportion which arrived on deck before sub-sampling. Is this going to be a significant error in terms of the accuracy sought by the later analysis? Both this sub-sampling procedure, before settling of 'fines', and sediment loss from the bucket during ascent will tend to alter the proportion of 'fines' in the sediment.

iii) Report of Engineering Geology Unit testing and sampling (I. Moore)

Engineering Geology Unit staff continued to test vibrocore samples in the same manner as on the first leg.

The onboard testing was carried out at 1m intervals on the cores using:

a) Pocket Penetrometer for unconfined compressive strength
b) Soil Test Torvane for shear strengths
c) The third test (which has not been carried out by E.G.U. on a ship before), involved the use of a Seta cone penetrometer type 710. This test gives results that are related to the unconfined compressive strength of the clays.
d) Sub samples of material were taken for subsequent moisture content determination. They were obtained by pushing in a ring of known

volume into the core, the material in the ring was then pushed into a sample tin and sealed. This technique of sampling has proved satisfactory in the past.

46 tests were carried out using the Pocket Penetrometer and Torvane.
39 Cone penetrometer tests were done.
39 sub samples were taken for moisture content determination.
25 samples were taken by the Building Research Establishment for triascial, oedometer and index testing (plastic and liquid limits, etc.). These samples were not tested by E.G.U., the results will be available to E.G.U. when the samples have been tested.

iv) Geochemistry and Petrology (R.A. Nicholson)

This leg was very successful with only a few minor mishaps. Good recovery on all Shipek grab samples enabled adequate splits to be taken for chemical analysis. These splits were frozen, freeze-dried and subsequently sieved through a 10* screen to remove oversized material. The -10* fraction was quartered down to a suitable size for storage and transport. The quartering operation became almost an impossible task when the vessel was rolling heavily.

Measurements of pH and Eh were not made on any of the grab samples, because they were too coarse to enable any meaningful results to be obtained, but a series of measurement of vibrocore shoe samples were obtained. The pH electrode remaining from the first leg was found to be unreliable and was replaced with a new one. This soon became unserviceable when it fractured after being inserted into a core containing rock fragments. A further replacement was effected and this performed satisfactorily for the rest of the cruise. The Eh electrode remained faultless throughout.

Heavy usage of storage containers prompted request of a further supply from London and these duly arrived in Aberdeen in time for leg III.

Supply of electricity to the laboratory from the Rolls-Royce (RR) generator has been bypassed, for emergency use only, with an extension lead supply from the ship's mains. This can be connected up when the RR needs to be shut down for essential maintenance. The laboratory freezer and freeze-drier have been successfully run from this extension lead. A more permanent back-up system for future use is recommended, so that there is no discontinuity of supply. (On arrival in Aberdeen at the start of this leg the freezer contained samples that had defrosted and decomposed; this may have affected some of the trace element values).

v) Sedimentology and Engineering Properties of Selected Samples (S. Crutchley, University of Keele)

The object of my work on board the M.V. Whitethorn has been to collect samples of sufficient quality and quantity to be able to compare material obtained by vibrocoring with the material obtained by other methods of soft sediment sampling. This will be undertaken in a number of ways. Primarily by exerting each sample to a triaxial compression test, a one dimensional consolidation test and the analysis of micro-fabric using the Scanning Electron Microscope. To facilitate this, a sample of core 20 centimetres long has been taken from each vibrocore at a selected point dependent on the clay and moisture content, extruded from the plastic liner and then sealed in a layer of "cling film" followed by aluminium foil. This "parcel" was then placed into a loose fitting cardboard tube and finally sealed by filling the tube with wax thus totally sealing the sample. A total of 25 such samples have been taken, usually just one from each core but occasionally two if the total recovery was sufficient.

The selection of sample was controlled largely by clay content and moisture content. This was because coarse silt or sandy material tends to reflect more readily the disturbance inevitable from a vibrocore obtained from a ship and so liquidizes easily making it impossible to maintain an intact sample between ship and the home laboratory. It is worth noting, however, that some samples which would not have withstood long transit could have been tested triaxially had the necessary equipment been onboard. Even so, out of such cores which I could not obtain an undisturbed sample I have taken a part of the shoe and catcher sample for later analysis

Further work on the material will include particle size determination and analysis of the distribution, particle shape analysis, determination of the mineral contents of the clay and sand fraction and also the determination of index limits using the drop-core penetrometer. Carbonate analysis will also be considered an integral part of our work and we will, of course, submit the samples to any test from which the I.G.S. requires results to complete its analysis of the core.

I think the samples obtained will be of quite some help to both Keele Soils Laboratory and the Building Research Establishment within the framework of the joint project on the properties of North Sea materials both from a geotechnical view point and a sedimentological one. Not only has this voyage supplied testable samples with which to compare shear strengths obtained on similar materials using different sampling techniques but it will further our work into the genesis of sediments and thus the inherited engineering properties. Sufficient data of this kind will hopefully give us calibrated yard-sticks by which to measure many types of sediments.

Samples Taken by S. Crutchley; M.V. Whitethorn 20.6.80-1.7.80

Position	Station	Core	Depth (m)
57-01	169 VE	C	2.0 -2.2
57-01	170 VE	C	2.75 -2.95
57-01	173 VE	C	2.0 -2.2
57-01	176 VE	Shoe	-
57-01	177 VE	C	2.8 -3.0
57-01	186 VE	A(shoe)	1.0m
57-01	187 VE	C	2.0 -2.2
57-01	187 VE	E	4.0 -4.2
57-01	190 VE	C	2.8 -3.0
57-01	191 VE	C	2.0 -2.2
57-01	193 VE	E	1.8-2.0
57-01	193 VE	E	4.8-5.0
57-01	194 VE	Shoe	-
57-01	205 VE	B	1.0-1.2
57-01	206 VE	A	0.8-1.0
57-01	207 VE	Shoe	1.4
57-01	208 VE	B	1.8-2.0

Position	Station	Core	Depth (m)
57-01	208 VE	E	4.0-4.2
57-01	209 VE	B	1.8-2.0
57-01	210 VE	C	1.62-1.82
57-01	211 VE	D	3.0-3.2
56-01	46 VE	Shoe	3.95
56-01	47 VE	Shoe	1.0
56-01	48 VE	Shoe	2.0
56-01	49 VE	Shoe	2.3
56-01	50 VE	Shoe	1.3
56-01	51 VE	Shoe	1.9
56-01	52 VE	Shoe	2.53
56-01	62 VE	Shoe	1.37
56-01	63 VE	C	2.0-2.2
56-01	64 VE	Shoe	2.42
56-01	65 VE	Shoe	1.36
56-01	66 VE	Shoe	1.52
56-01	67 VE	Shoe	2.78
56-01	68 VE	Shoe	2.45
56-01	70 VE	Shoe	2.68
56-01	80 VE	Shoe	2.62
56-01	81 VE	Shoe	2.66
56-01	82 VE	Shoe	3.53
56-01	83 VE	Shoe	2.58
56-01	84 VE	Shoe	4.60
56-02	245 VE	Shoe	2.94
56-02	246 VE	Shoe	1.99
56-02	247 VE	Shoe	1.57
56-02	248 VE	Shoe	2.48
56-02	249 VE	B	1.8-2.0
56-02	257 VE	Shoe	1.75
56-02	258 VE	Shoe	2.18
56-02	259 VE	Shoe	2.80
56-02	260 VE	Shoe	1.64
56-02	261 VE	Shoe	2.35
56-02	262 VE	Shoe	2.0
56-02	263 VE	Shoe	2.24
56-02	264 VE	Shoe	2.98
56-02	271 VE	Shoe	3.46

Position	Station	Core	Depth (m)
56-02	272 VE	Shoe	1.92
56-02	273 VE	Shoe	3.26
56-02	274 VE	Shoe	2.5
56-02	275 VE	B	1.8-2.0
56-02	275 VE	D	3.8-4.0
56-02	276 VE	B	1.0-1.21
56-02	284 VE	F	5.0-5.2
56-02	285 VE	Shoe	6.01
56-02	286 VE	B	1.8-2.0
56-02	286 VE	E	4.0-4.2
56-02	287 VE	Shoe	3.47
56-02	287 VE	Shoe	2.95
56-03	585 VE	B	1.0-1.2
56-03	585 VE	Shoe	1.9
56-03	586 Ve	Shoe	6.05
56-03	587 VE	Shoe	2.26
56-03	588 VE	Shoe	5.82
56-02	289 VE	Shoe	1.65