Continental Shelf Northern Unit

Internal Report no. 77/10

Report on Emerald Cruise

77/EM/06 - Leg 1

11th August - 23rd August
1977

by

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EMERALD CRUISE REPORT: Leg 1, 12th-22nd August, 1977

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Cruise Object

The primary aim of this leg of the cruise was sampling in the Forties 1:250,000 sheet area, with particular reference to the Forties NW, NE and SE 1:100,000 sheets. Some limited sampling of the Peterhead NE 1:100,000 sheet area was also required, on a lower priority.

The principal mode of sampling intended was by 6m electric vibrocorer with penetrometer system, the samples being required for both geological and soils engineering tests. Grab samples were to be taken at every station. During non-vibrocoring work periods, i.e. the hours of darkness and weather or equipment "down" time, coring was to be continued by gravity corer. Cone dredge samples were also to be obtained at these stations.

Sampling was to be on a pre-arranged pattern, with sites chosen after consideration of geophysical records and pre-existing sample data. Sites to be sampled were accorded priorities (1-3), with occupation of the priority 1 sites the prime aim. Geophysical equipment was carried for work of a "stand-by" nature and consisted of a Simrad PDR, an ORE 'pinger' with an EPC recorder and a MS47 transit sonar.

Cruise Diary

Thursday, 11th August Leith docks (Robb Caledon's yard)

0800 Commence commissioning work.
2000 Work ceases.

Friday, 12th

0800 Work recommences.
1615 Shipyard workers finish, ships' engineers continue strengthening vibrocorer.
2200 Replacement cook delayed at Heathrow airport due to industrial dispute. Sailing postponed from 2400hrs.

Saturday, 13th

1315 Ships' complement complete.
1345 Cast off and steam for work area.
1630 Pinger deployed at north end of Firth of Forth test range.
1740 Recover pinger. Possible fault exists as no bottom returns obtained on records. Steam for first sample station (no. 58) on Forties NE sheet.

Sunday, 14th

0930 On station preparing to launch vibrocorer.
1100 Fault in vibrocorer motor traced to damaged electrical connector on pot, possibly allowing ingress of seawater during tests. Pot to be removed and replaced with spare.
1145 Commenced anchoring.
1725 Vibrocorer tested and ready to deploy. Pinger on vibrocorer leg found to be unserviceable and is replaced.
1805 Vibrocorer on bottom. Penetrometer system appears erratic in operation.
1840 Lift anchors to proceed to next site.
1940 Lay anchors and commence vibrocoring.
2115 Anchors lifted and commenced steaming for first gravity coring site. Rock coring baseplate on corer found to be immoveable therefore deployed using 2½" corers, instead of 4". Gravity coring continued through night as per sampling pattern.

Monday, 15th

1030 Vibrocorer pot found to have jammed neat top of guide rails. Set upright on deck and commence work to free whilst remaining at anchor on station.
1430 Steaming to next station. Transducer pole for MS47 transit somar found damaged by anchor warp. Recovered for repair.
1820 Vibrocorer recovered on second station with full recovery. Planned third site aborted as no satisfactory core extraction system available.
1930 Available 4" sediment core adapters for gravity coring system found to be incapable of accepting barrels as the barrel mounting holes had been drilled to clearance, and not tapped, as required. Commenced modification.

2025 Arrived at gravity coring station. Delayed commencement of work whilst modification of plate completed. Cores eventually extracted from 6m vibrocorer barrels by use of large hub puller and a ship's winch.

Tuesday, 16th

0945 Power cable cut by vibrocorer being dropped on deck during launch. Replaced with non-penetrometer system cable to allow coring to proceed.

1415 Vibrocorer recovered damaged. Main lifting warp had looped under the winch motor for the barrel retraction system and, on commencement of recovery of the vibrocorer, the entire load of extraction and lifting were taken on the motor and its mounts. In consequence the mountings were torn off at the welds and the motor drive shaft bent.

1630 Stops welded at top of runners on vibrocorer found to be 10mm oversize, with result that guillotine could not close. Rectification delayed until after following site to allow repair with minimum delay.

2300 Commence night gravity coring activity. Single, properly made, 4" sediment gravity core adaptor found.

Wednesday, 17th

0830 Commence vibrocoring with corer used as "normal" i.e. non-penetrometer, vibrocoring system.

2112 Ceased vibrocoring and commenced night operations.

Thursday, 18th

0040 On attempting to use the MS47 system, both recorders ceased functioning after a few minutes operation. Power supply suspect.

0925 Vibrocorer control board trips out due to fault in system.

1006 Commence repairs to vibrocorer. Motor suspect.

1340 Vibrocorer repairs continue. Commence gravity coring on low priority sites.

1410 Mounting holes in base of replacement vibrocorer motor found to be apparently incorrectly sized and sited. (Subsequently seen that incorrectly mounted fixing bolts in pot were responsible for this discrepancy). Modification commenced whilst gravity coring continues. When attempting to fit 10' barrel to gravity corer found that barrel mounting hole in baseplate too small to accept stub end of barrel owing to inadequate clearances. Replaced with previously cleaned and prepared 5' barrel.

1930 Repaired pot placed in vibrocorer frame. Expected to be fully operational by 0900hrs. Gravity coring continues.

Friday, 19th

0745 Complete nightwork sampling pattern.

0820 Vibrocorer tested satisfactorily. However, delay in recommencement of coring caused by requirement a) to grind off spot welds on pot base, b) replacing and re-making pot plug and tail.

1032 Recommenced vibrocoring.

2003 Shipek grab lost on recovery due to being drawn up against hoist pulley.

Saturday, 20th

0500 Commenced laying anchors on sample station 57-00/39
0900 Completed anchoring. Delay in normal anchoring time caused by poor holding ground.
1520 Vibrocorer did not operate when power switched on, symptoms of cable fault. On recovery found full penetration achieved under own weight.
1750 Anchored at sample station 57-00/42 awaiting completion of cable repairs.
1841 Vibrocorer deployed.
1950 Lift anchors and steam for first nightwork site.

Sunday 21st

0805 End nightwork and commence vibrocoring on station 57-01/12
1330 Splice at vibrocorer pot end of lifting warp found damaged. Crew commence cutting and re-splicing.
1440 Repairs complete.
1920 Lifted anchors at final vibrocoring site and steamed for nightwork area. Commenced removing pot from vibrocorer to allow frame with penetrometer system to be removed at Aberdeen, the pot to remain as a spare.

Monday, 22nd

0730 Completed final nightwork site and sailed for Aberdeen.
1245 Secured alongside in Aberdeen harbour.

Results

A total of 94 sample stations were occupied, distributed as follows:

	VE[1]	CS[2]	GS[3]	GD[4]	CD[5]
Forties NE ($57^{o}30'N$; $1^{o}E$)	12	27	39	1	27
Forties NW ($57^{o}30'N$; $0^{o}E$)	7	32	38	1	32
Peterhead NE ($57^{o}30'N$; $1^{o}E$)	4	20	27	0	20

[1]Vibrocorer (electric) [2]Corer (sediment) [3]Grab (Shipek)
[4]Grab (Day) [5]Cone Dredge.

The sediments sampled at each station were described geologically, and, in the case of cores containing appropriate material, shear strengths (lab and hand vane) and unconfined compressive strengths (pocket penetrometer) were measured. Subsamples were taken for particle size analysis, bulk density determination and micropalaeontological examination. Live macrofauna were extracted from grab and dredge samples and preserved in a Formalin solution.

In order that the maximum number of sample stations could be occupied, only a single, short geophysical traverse was run.

The samples obtained from this, and any succeeding legs in the Forties area, will be fully examined and tested by CSNU and EGU at IGS, Edinburgh. The data will be incorporated in a study of the geological and soils engineering properties of the sediments in the Forties area.

Equipment Deployed and Performance

Vibrocorer (VE) - the 6m electric vibrocorer used was modified by the addition of a barrel retraction and penetrometer system. These additional systems had not been fully field tested prior to the cruise and their performance gave rise to problems, delay and loss of sampling time. However, the first major problem to manifest itself (14.8.77) was a simple failure of the plastic body of the electrical connector on the vibrocorer pot. On examination the plastic was found to be fractured, either by impact or over-tightening, and had allowed entry of water to the main body of the vibrocorer pot thus rendering the motor unserviceable. It is thought this damage may have occurred during trials.

The barrel retraction system appeared to work satisfactorily. However, the absence of an electrical stop mechanism above the pot meant the only indication that the barrel was fully retracted was a sudden increase in the current drawn by the retraction winch motor as it pulled the pot against the top of the frame. The absence of a clutch in the winch drive system, coupled with the low gearing meant that the retraction cable was drawn so tight it was impossible to release the driving dogs to allow slack to move the pot on deck.

Whilst coring, it became apparent that the data from the penetrometer mechanism was erroneous. It was suspected that slack in the retraction cable, which passed over (and drove) the pulley actuating the penetrometer recorder, was allowing the pulley wheel to rotate in response to the vibration of the corer. These rotations gave rise to spurious "penetration" data.

The Rikkadinki four pen chart recorder, used to record the data from the vibrocorer and penetrometer/retraction system, occasionally exhibited a full range pen oscillation on a single channel. This appeared to be symptomatic of positive feedback in the electronics and indicates a need for investigation and more thorough development.

Incorrectly mounted pot shoes appear to have been the cause of the incidence of the vibrocorer pot "jamming" in the guides. The method of fitting the shoes should be clearly indicated.

The incident on 16.8.77 when the penetrometer system was badly damaged revealed several defects in construction or design. Welds securing the assembly to the vibrocorer frame revealed paint underneath when torn off by the accident.

The fact that the incident occurred also revealed a severe defect in design or deployment. The vertical protrusion of the retraction motor offered a definite hazard by being very much exposed to the risk of entanglement in any excess cable reaching the bottom. Shielding would be one solution to this problem, with buoying off an appropriate length of cable an alternative. However, it is difficult to see how the buoys could be attached or positioned, bearing in mind the warp involved must pass over a pulley on the ship's "A" frame.

Replacement of the vibrocorer motor on 18.8.77 was rendered

inordinately difficult by the siting of the motor mounting studs in the pot in non-standard positions. This meant the baseplate on the replacement motor had to be substantially modified. It was evident that this problem had already been met when installing the original motor.

When the vibrocorer was being used in its normal mode (i.e. pre-penetrometer/seabed retraction) its operation was satisfactory. The need for a penetrometer or similar system was indicated by the usual inability to determine when maximum penetration had been attained. Success in the use of the vibrocorer brought its own problems, viz: core extraction. No operational, or standardised, core extraction equipment was available and an ad hoc arrangement had to be devised. A large "gear-puller" (ship's equipment) was used to push a machined plug (made by the ship's engineers) against the top of the liner tube. This allowed extrusion of a minimum of 100mm of the liner plus core from the bottom end of the barrel. A rope, secured to the liner with a rolling hitch, could then be used to pull the liner plus core from the barrel. Manpower was usually sufficient but, occasionally, a ship's winch or the "Hyab" had to be utilized to provide the necessary pull.

Most of the core extraction problem is a direct result of sediment passing from the cutter or catcher(s) to lie between the liner and the barrel, resulting in a wedging effect. The use of "O" rings limits this sediment movement only if the "O" ring is securely taped in posiiton with plastic tape. Otherwise the "O" ring is merely forced up the barrel ahead of the incoming sediment. It is possible the amount of sediment occupying this undesirable position could be severely limited if a rubber or plastic annulus were placed between the cutter and the barrel (at the base of the thread, between the cutter

and the catcher and between the catcher and the liner). A small portable jig would also allow the liner to be cut to a true right angle, thus enhancing the possibility of a correct seal.

Gravity Corer (CS)

The incorrectly constructed 4" sediment core adaptor plates highlighted the need for a quality control system to check that work done by contractors does, in fact, meet our specifications. However, in this case, our specifications must also include an allowance for tolerances in the construction of the barrels since great difficulty was experienced in fitting the stub ends of the barrels into the adaptor plate owing to absence of clearance in the latter.

Operation of the Sykes free-fall winch proved hazardous. On two occasions the starting handle did not disengage from the starting dog when the engine started. A requirement for some form of self starting device is indicated.

Shipek Grab (GS)

No problems were experienced with this sampler, apart from the loss of one grab due to the lifting wire parting.

Day Grab (GD)

The operation of this large clamshell grab appeared completely satisfactory in areas of sands and soft sediments. However, no return was obtained in areas of hard ground or suspected gravel. It had been hoped the Day Grab would have been more suitable than the Shipek Grab for operation in this type of sediment and the results are accordingly disappointing.

A Smith-MacIntyre grab of similar size and design to the Day Grab (but with a more positive closing action due to the use of springs) was embarked from RVB. Tests aboard ship demonstrated that this grab could not safely be operated owing

to the presence of considerable wear on two locking pawls. This matter is being referred to RVB.

Cone Dredge (CD)

No problems experienced with this dredge; all operations were satisfactory.

ORE Pinger

When tested at the start of the leg no bottom returns could be perceived on the EPC recorder. Transceiver and recorder settings were checked with RVB and confirmed to be in order. The matter was not resolved as no further tests were undertaken.

MS47 Transit Sonar

With the exception of the initial power supply problem, this sonar equipment functioned well under test and in brief usage.

Simrad Echosounder

No problems were experienced with this, apart from the inconvenience of the scale in fathoms.

Conclusions:

The progress of sampling on this leg was initially impeded by problems arising from attempts to use in field conditions the vibrocorer/penetrometer system without it having been field tested and proved as an operational system. Other evidence indicates a need for a tightening up of our quality control procedures and a general re-thinking of the shipboard work involved in a sampling exercise.

It is also evident that the intitial or "shake-down" leg of any cruise should only be led, on the scientific side, and staffed, on the technical side, by personnel fully experienced in the operation of all systems to be deployed.