I.O.S.

R V EDWARDS FORBES CRUISE 5/77

18 April–3 May 1977

INVESTIGATION OF TURBIDITY STRUCTURES IN THE SEVERN ESTUARY AND INNER BRISTOL CHANNEL

CRUISE REPORT No 92

1977

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

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SCIENTIFIC PERSONNEL

R Kirby	SSO	Senior Scientist	18 April - 3 May 1977
M A S Moore	ASO		18 April - 3 May 1977
G P Le Good	SO		18 April - 28 April 1977
M R Lees	SO		28 April - 3 May 1977
W R Parker	PSO		18 April - 1 May 1977
D Hill	ASO		1 May - 3 May 1977

Day visitors

Mrs C A Kirk	ASO
G Fox	Sandwich course student IOS
P Mason	MSES
R Parker, R Larne	Partech Electronics

SUMMARY

Suspended sediment correlation experiments were undertaken to investigate the stability of stepped suspension structures in the Severn. A fixed geometry array of silt and current meters was deployed over one side of the vessel and adjusted until the siltmeters spanned a major step. Vertical traverses of concentration were measured from the other side of the vessel making 6 traverses in each 5 minute experiment. These concentration profiles were then compared with each other and with the fixed geometry data to examine the stability of the structures, altitudes of steps from the 2 techniques and, as initially attempted, the velocities above and below the step.

An investigation of the practicability of using telemetered data from a self-recording current meter was undertaken and the equipment for establishing a sedimentation rate experiment in the Bridgwater Bay settled mud area was set up but not deployed.

OBJECTIVES

The cruise was one of a series commenced in 1974 to investigate the structure of estuarine fine sediment suspensions as part of the IOS Cohesive Sediment Mobility

Project. On this cruise the emphasis was on anchored experiments to examine the stability of stepped suspension structures and to assess the representativeness of individual suspended sediment traverses in respect of both short (< 1 min) and long (5–60 min) timescales. This was to be accomplished by rapid profiling involving recording both downward and upward profiles and rapid repetition of traverses. Groups of closely spaced traverses at half hour intervals were to be taken for comparison.

In addition the fixed geometry array consisting of a group of 3 siltmeters and a Braystoke current meter would provide complementary data on:

1. The altitude of steps to check on possible dynamic offsets on the depth sensor on the vertical profiling array.
2. The spectrum of variations of concentration at one elevation, of which the vertical profiles would represent 1 instant in time.
3. The water velocity to provide information on the length scales of individual steps.

Throughout the cruise twice daily formazine calibrations were to be undertaken to monitor the internal stability of the siltmeters themselves.

NARRATIVE

Of the available 14 days, 7 were totally lost owing to bad weather. On the remaining days the weather was generally marginal but a further day was gained owing to a day of crew leave becoming available. The first day was lost owing to equipment failures. Consequently only 2 of the scheduled 6 13 hour silt correlation experiments was completed. However on other days experience with the data acquisition system was obtained which will be useful for further surveys.

The ship itself also caused difficulties in the collection of high quality data as the shearing of the vessel at anchor resulted in spurious current velocities, and the regular rise and fall of the fixed geometry array in and out of the layer under investigation.

The most valuable results to come from the survey are the confirmation that single instantaneous vertical turbidity traverses are remarkably representative. The stepped suspension structures proved to be stable not only within the 5 minute interval spanning the experiment period but also on occasion across the intervening 25 minute rest periods.

No time was available to extend coverage of time series cross sections or for deployment of sedimentation experiment rigs and the Barium Sulphate marker layers.

The test with the transponding Anderaa current meter rig was unsuccessful.

ITINERARY

15.4.77. Travel to Barry and load equipment on Edward Forbes.

16-17.4.77. Set up equipment on Edward Forbes.

18.4.77. Sailing postponed, continued assembly and testing of equipment. Sailed 2200.

19.4.77. Anchored near Hope Buoy, Severn Estuary, for trials of fixed geometry current and siltmeter array.

20.4.77. Self-recording current meter trials using bed mounted frame in Bridgwater Bay. Tested hydrophone and telemetry unit. P Mason, MSES, day visitor. 1500 rig recovered.

21.4.77. Weather unfavourable for silt correlation experiment. Tested vertical profiling and mag. tape recording system. Silt calibration samples obtained. Entered Barry owing to weather.

22.4.77. Lost due to weather.

23.4.77. Crew Leave. Prepared railway wheel rigs for sedimentation experiment in Bridgwater Bay. Cook ill.

24.4.77. Lost due to weather. Replacement Cook ill.

25.4.77. Sailed Barry 0900. 1015 water leak reported in main engine block. Anchored Clevedon Buoy, Severn Estuary. Silt correlation experiment attempted but abandoned owing to fierce tide and ship shearing badly. Vertical profiles satisfactory. Entered Avonmouth owing to unfavourable forecast.

26.4.77. Lost due to weather.

27.4.77. Sailed Avonmouth 1030. Weather unsuitable for anchored experiment but tested modified fixed geometry array. Silt correlation experiment undertaken until 2140. Entered Avonmouth owing to unfavourable forecast.

28.4.77. Day visitors R Parker, R Larne of Partech Electronics. Sailing postponed until 1230 owing to unfavourable weather. Sailed to line 6 for demonstration of vertical profiling technique. Anchored 1330 at station 6 (3) for silt correlation experiment. Entered Avonmouth 1730.

29.4.77. Sailing postponed until 1330 owing to unfavourable weather. Anchored Walton Bay 1430 for silt correlation experiment using fixed geometry array and vertical profiles. Completed 2200. Weather moderating.

30.4.77. 13 hour silt correlation experiment at Walton Bay, terminated 2300.

1.5.77. Sail to Newport Deep to obtain suspended sediment samples for siltmeter calibration. Anchored silt correlation experiment 1330-1830. Sailed to anchor at Hope Buoy Station 2130.

2.5.77. 13 hour silt correlation experiment sailed to Bridgwater Bay and anchored 2030 in preparation for laying railway wheel rigs.

3.5.77. Raised anchor and steamed during night owing to unfavourable weather survey abandoned. Entered Barry 0900. Scientific party returned to Taunton.

EQUIPMENT PERFORMANCE

Ship's equipment:

The main problem with the ship was its inability to anchor at stations previously occupied successfully by other vessels. The vessel also sheared about at anchor to an excessive degree even in calm weather presenting a severe limitation on data quality from the anchored experiments.

A cylinder head block on the main engine cracked and the domestic water heater pump failed but both were repaired with minimal inconvenience to the scientific programme.

Scientific equipment:

1. Failure of 1 HP depth sensor before the cruise started caused early problems until a spare could be made available.
2. The initial fixed geometry array had insufficient weight and too much drag and consequently would not reach the bed. When the array was lightened by removing the salinometers and 2 Braystoke rotors, and further weight added it performed satisfactorily.
3. The internal stability of the siltmeters proved excellent.
4. No dynamic offsets were apparent in the output of the pressure sensor caused by traversing the vertical profiling array. This confirms that all previous vertical profiles are acceptable in regard to this aspect.
5. A surface interrogation unit designed and built by MSES to read the output from an Anderaa self-recording current meter was tested in Bridgwater Bay but could not distinguish real telemetered data from spurious signals.

6. A Braystoke current meter cable failed due to sea water ingress and had to be repaired.

7. Non-compatibility of the input impedance of the siltmeters and Bell & Howell tape recorder resulted in a volts drop in the inputs to other on-line recorders.

8. 1 Braystoke Interface board developed a fault and would not count pulses. This was rectified by swapping boards.

9. The Bell & Howell tape recorder suffered a failure which resulted in the output voltage varying at random.

ACKNOWLEDGEMENTS

We are indebted to the crew of RV Edward Forbes for their hard work on our behalf and their interest in our work. On 1 May 1977 the crew volunteered to give up one day of their leave in view of the previous delays to the cruise and this turned out to be one of the few days when worthwhile work was possible. Research Vessel Services and the crew cooperated to replace the cracked cylinder block on 26 April so that no useable survey time was lost.

CRUISE REPORTS

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* Reports 1 to 3 were published and distributed by the Royal Society following the International Indian Ocean Expedition.

** NIO CR: National Institute of Oceanography, Cruise Report.

*** IOS CR: Institute of Oceanographic Sciences, Cruise Report.

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