

I.O.S.

M. I. A. S.

12 JUN 1980

(BIDSTON)

RV EDWARD FORBES CRUISE 7/75

1 MAY - 12 MAY 1975

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

CRUISE REPORT NO 32

1975

NATURAL ENVIRONMENT
INSTITUTE OF OCEANOGRAPHIC SCIENCES
RESEARCH COUNCIL

RV EDWARD FORBES CRUISE 7/75

1 May - 12 May 1975

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

CRUISE REPORT NO 32

1975

Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

CONTENTS

| | Page |
|-----------------------------|------|
| Scientific Personnel | 1 |
| Ship's Officers | 1 |
| Itinerary | 2 |
| Summary | 3 |
| Objectives | 3 |
| Narrative | 3 |
| Equipment Performance | 5 |
| Acknowledgments | 6 |

SCIENTIFIC PERSONNEL

| | |
|--------------------------------|-------------------|
| R Kirby SSO (Senior Scientist) | 1.5.75 - 12.5.75 |
| W R Parker SSO | 1.5.75 - 6.5.75 |
| M R Lees SO | 1.5.75 - 6.5.75 |
| C N Puckett ASO | 1.5.75 - 7.5.75 |
| A G Davies HSO | 7.5.75 - 12.5.75 |
| G P Le Good SO | 7.5.75 - 12.5.75 |
| D Joyce Ind.Band 6 | 10.5.75 - 12.5.75 |

SHIP'S OFFICERS

| | |
|---------------------|------------------|
| Captain B Chapman | 1.5.75 - 6.5.75 |
| Captain P McDermott | 7.5.75 - 12.5.75 |
| 1st Officer D Pye | 1.5.75 - 12.5.75 |
| 2nd Officer G Price | 1.5.75 - 12.5.75 |

ITINERARY

- 1.5.75 Commission Edward Forbes in Barry
- 2.5.75 Sail from Barry morning tide to work off Avonmouth.
1800 Siltmeter cables cut by propeller. Abandoned survey
and sailed to Walton Bay to anchor.
- 3.5.75 Work between Shoots and Portishead. Scientific a.c. failure,
20 mins. Anchored Walton Bay
- 4.5.75 Work between Clevedon and Newport Deep. Winch motors
overheated due to cooling water failure. Off for $2\frac{1}{4}$ hrs.
Later hydraulic line to winch ruptured, off for $1\frac{1}{2}$ hours.
Anchored Cardiff Roads.
- 5.5.75 Work between Newport Deep and Holms Islands. Enter Barry
evening tide.
- 6.5.75 Sail from Barry morning tide to work in Bridgwater Bay.
Failures of both sparker generator and main scientific a.c.
during day. Enter Barry evening tide.
- 7.5.75 Crew leave.
- 8.5.75 Sail from Barry. Delayed till afternoon tide by bad weather.
Work off Avonmouth. Enter Avonmouth evening tide.
- 9.5.75 Sail from Avonmouth to work between Shoots and Portishead.
0810 Ran aground near No 1 Beacon, English Stones.
Refloated 1545 and entered Avonmouth 1645.
- 10.5.75 No work possible owing to diver inspection of Edward Forbes hull.
- 11.5.75 Sail from Avonmouth to work between Clevedon and Newport Deep.
1300 Ran aground Newport Deep. 1305 refloated. 1735 Main
engine failure near E & W light vessel. 1810 Engines
repaired, raise anchor and proceed to Barry.
- 12.5.75 Sail from Barry to work in Bridgwater Bay. Enter Barry on
evening tide.
- 13.5.75 Decommission Edward Forbes.

SUMMARY

Vertical profiles and horizontal traverses of turbidity were obtained by repeat visits to approximately 100 standard stations established on cross-sections of the Severn. Vertical profiles were measured to investigate the nature and variations of the structure of fine sediment suspensions in estuaries. The horizontal traverses provide information on changes in suspended solids on a regional basis at shallow depth and together with the vertical profiles allow the changes in the three dimensional distribution of turbidity on both a semi-diurnal and on a Neap-Spring timescale to be investigated. Recorded turbidity profiles were complex and showed wide variations on both timescales.

OBJECTIVES

The cruise was one of a series commenced in 1974 to investigate the structure of estuarine suspensions as part of the IOS Cohesive Sediment Mobility Project in the Severn Estuary. On this cruise the emphasis of the work was on examining the temporal and spatial variations in turbidity structure in the area between The Shoots Channel and $3^{\circ}30'W$. The day to day programme was based on the series of standard cross-section lines and stations established for the purpose of these investigations (see track chart). The cruise dates were selected to run from a Neap to a Spring tide and attempts were made to visit each station on the ebb and the flood of a Neap and a Spring tide at least. Thus the cruise was divided into two legs with the object of surveying the whole estuary starting from The Shoots and finishing at Bridgwater Bay over the Neap cycle and repeating the programme over the Spring cycle.

The equipment used for the investigation is a tow-fish upon which are mounted two siltmeters operating over the range 300 - 50,000 ppm, a depth sensor, a spot reading and a continuous reading conductivity meter. The fish is towed at 5 knots at 3m below the surface to determine the horizontal variations in turbidity and lowered rapidly (15 - 20 secs) to the bed, on each of the standard stations to provide virtually instantaneous vertical turbidity profiles. An MS26 echo sounder was also used to investigate the fine sediments on the bed of the estuary.

NARRATIVE

On the first leg of the cruise between 2 and 6 May, the whole estuary between The Shoots and Bridgwater Bay was surveyed whilst in a Neap condition. The echo sounder showed that virtually no dense static suspensions (fluid mud) occurred off Avonmouth but that many patches did

occur in the channel between Clevedon and the Holms Islands. Almost the whole of Newport Deep was filled by a single dense static suspension pool. It is unusual to find so little fluid mud around Avonmouth on Neap tides since previous experience has shown that the survival conditions for the suspensions are normally good. Very little fluid mud occurred in Bridgwater Bay either due to unsuitable accumulation conditions or to the fact that by the 6th the tides were increasing rapidly in range.

In general the active suspensions were of low concentration and at an embryonic development stage, most of the sediment being resident in the mud pools. On frequent occasions dense static suspensions were recorded by both the echo sounder and the siltmeter giving good comparative data on concentrations in the upper layers of acoustically visible static suspensions.

A good sequence of vertical turbidity profiles on a flooding tide was obtained in the channel between the Holms Islands and the English and Welsh Light vessel. Four hours before high water (Avonmouth) dense suspensions had been differentiated from the profile which had disappeared, presumably upstream, by two hours before high water. The water was then completely marine with no detectable sediment from water surface to bed until high water. On the succeeding day further downstream in Bridgwater Bay no dense active suspensions were detected.

The object of the second leg of the cruise was to obtain comparable information for the cycle rising up to spring tides from 8 to 12 May. Unfortunately very little of this part of the programme was achieved. On the 8th a weather delay resulted in virtually the whole day being lost, on the 9th the vessel ran aground and on the 10th the whole day was spent on hull inspection. On the 11th a proportion of the survey programme was lost due to the ship going aground, due to the winch motors overheating necessitating abandonment of the programme until they had cooled and due to a failure of the main engine.

On this leg no dense static suspensions could be found on the sea bed and the general turbidity level was higher than on the Neap cycle. Downstream from the Holms the survey revealed that the northern side of the Channel off Barry had an extremely low turbidity. A more turbid zone occurred in the westerly extension of the deep channel between Steep Holme and Flat Holm (1,000 ppm), whilst stepped and highly turbid suspension profiles were encountered in Bridgwater Bay, the marked junction with the lower turbidity water to the north coinciding with the

edge of the settled mud area in Bridgwater Bay.

EQUIPMENT PERFORMANCE

Ship's Equipment

Although only half a day of the survey was lost due to weather, two days were completely lost owing to the vessel running aground on 9.5.75. A large number of ship's equipment failures delayed the programme, put undue strain on the ship's engineer and caused problems with the cruise programme owing to the frequent need to amend the schedule.

The failures were with both the ship's scientific a.c. electrical supply and winches, both faults being continuations of the faults encountered on the earlier cruise (Edward Forbes cruise No 5/75) in April. Faults occurred on both the main scientific a.c. supply and the sparker generator. Fortunately the two generators were never unserviceable at the same time and both were permanently rigged to facilitate rapid changeover. Most faults with the main scientific a.c. supply were caused by air locks in the cooling water system and it should be possible to rectify these.

On three occasions problems with the winches caused losses of survey time amounting to 6 hours in all. On two occasions the winches had to be shut down to allow them to cool off. This is a frequent occurrence and is apparently difficult to overcome on Edward Forbes.

Scientific Equipment

In general the scientific equipment performed well. On the 2.5.75 one of the siltmeters (Y2) kept drifting. At 1800 the cables were cut by the ship's propeller. These were repaired overnight and from then onwards the siltmeter stabilised. At 1600 on 6.5.75, Y2 siltmeter started reading negative. It was re-zeroed and the new reading noted. On testing on 8.5.75, the next occasion when the siltmeters were to be used, the Y2 siltmeter would not zero due to water in the cable. The cable was finally scrapped and a new cable fitted. At the end of the survey on 12.5.75 the other siltmeter (Y1) failed, also due to water entering the cable.

An intermittent fault with the Maglog occurred on 6.5.75 and at the end of the survey on 12.5.75 the tape deck functions would not operate. No data was lost however. During subsequent laboratory testing this fault appears to have rectified itself.

ACKNOWLEDGMENTS

We wish to thank the crew of RV Edward Forbes for their assistance and the shoreside staff of RVB for their support.

