

65

CRUISE REPORT

CRUISE: RVS Cruise 65/90; PML Humber Plume Cruise II

VESSEL: RRS *Challenger*

PERIOD: 06-17 May, 1990

PERSONNEL:	A W Morris	PML, Principal Scientist
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ACKNOWLEDGEMENT:

The excellent services afforded by Capt. G Long and his officers and crew throughout this cruise are most gratefully acknowledged.

OBJECTIVES:

- (1) To define spatial and temporal characteristics of the plumes emanating from the estuaries of the Humber and Wash within an area off the east coast of England.
- (2) To determine the principal mechanisms for transport of water borne conservative tracers away from estuary mouths in order to parameterise them in water quality models.
- (3) To determine pathways for non-conservative tracers in plumes in relation to sediment/water interactions and biological processes in the water column.
- (4) To reinforce the study of sediment/water exchanges and bioturbation effects on water column chemistry through further work at the SERE resuspension sites previously studied during cruises 44, 52, 60.

ITINERARY:

Sat 05 May.

Scientific party muster at Great Yarmouth (pm). Embark with equipment.

Set up and commission equipment.

Sun 06 May.

Depart Great Yarmouth 0800(BST). Proceed northward towards Humber Estuary. Take grab samples en route and box core where suitable. Subsample box cores for organic contaminant analysis. Commence on-board incubation of box core samples for measurements of sediment-water metal and nutrient exchange. Commence pumped sampling for dissolved and particulate trace metals, chlorophyll, suspended particle load. Commence continuous shipboard recording of salinity, temperature, transmissometer and fluorimeter outputs and nutrients (silicate, phosphate, nitrate, nitrite). Arrive at anchor station in mouth of Humber Estuary 2300. Start of time series observations delayed for adjustments to Go-Flo bottles.

Mon 07 May.

Commence time-series observations at Humber mouth anchor station at 0022. CTD casts at hourly intervals. Water sampling from bottles for trace metals, chlorophyll, suspended particle load and low molecular weight (volatile) halocarbons. Continue continuous recording of near-surface salinity, temperature, transmissometer and fluorimeter outputs and nutrients. Box core for organic contaminant analysis and on-board incubation experiments collected at 1245. Terminate time-series at 2335. Depart anchor station 2400 and commence first circuit round plume grid.

Tues 08 May.

Continue round first grid circuit with continuous ship-board recordings as noted above. Take grab samples at selected sites (approximately hourly intervals). Take pumped samples at approximately hourly intervals for chemical analysis as noted above. At first light 0430, take CTD water bottle cast for primary production measurement. Box cores taken at five selected sites on route for ship-board incubation experiments.

Wed 09 May.

Continue first grid circuit. Take box cores at selected sites for ship-board incubation experiments. Tube on metal sample pump system ruptured 02.22; system irreparable, metal sampling curtailed for this circuit. Sampling for suspended solids load, chlorophyll transferred to ship's non-toxic supply. Take water bottle cast for primary production measurement 0435. First circuit complete at 2122. Depart for southern resuspension experiment site.

Thur 10 May.

Southern resuspension site ( $52^{\circ} 40'N$ ,  $03^{\circ} 40'E$ ) successfully box cored at 0515. Core sampled for chemical analysis and ship-board incubation. Depart for northern resuspension experiment site. Northern site ( $54^{\circ} 35'N$ ,  $4^{\circ} 50'E$ ) successfully box cored at 1830. Take CTD cast 1842. Proceed to northeastern corner of Humber/Wash plume grid circuit.

Fri 11 May.

Second grid circuit commenced at 0933. This circuit to concentrate on CTD casts, with trace metal sampling by water bottles (replacing failed pumping system) at approximately 90 min intervals. Halocarbons, suspended solids load and chlorophyll also by water bottles. Continuously recording instruments as above. CTD failure on first cast. Cured by cutting off short length of cable and reconnecting. Box coring attempted during repairs; successful core collected 1040. Recommence second grid circuit 1100. Electrical fault at 2043;

electrical power to container shut down. Continue around grid circuit, omitting dissolved and particulate metal sampling whilst awaiting repair attempts scheduled for next morning.

Sat 12 May.

Continue round second circuit. CTD water bottle cast for primary production measurement taken at 0422. Power restored to clean chemistry container 0950; immediately recommence metal sampling. Final box core for on board incubation collected at 2220.

Sun 13 May.

Second circuit completed 0730; start third circuit, track slightly modified to consolidate coverage of Wash region where abundant *Phaeocystis* was observed. Day grabs and CTD profiling, especially for trace metal sampling operations, at selected sites to complete geographical coverage of plume zone.

Mon 14 May.

Continue round third circuit of station grid. Take CTD bottle cast for primary production measurement at 0517.

Tues 15 May.

Third circuit completed 0130. Start fourth circuit. Continuous run round track, pumped sampling for continuous recording equipment and discrete samples from ship's non-toxic supply for suspended solids load and chlorophyll measurements. Repeat CTD profiling at four stations in Wash region which showed bed sediment resuspension during earlier transects. CTD failure at 1000; faulty cable junction at winch repaired. CTD cable near instrument head damaged during deployment. Repaired by reconnecting after removing short length of cable.

Wed 16 May.

Declined closing anchor station at Humber mouth in favour of fifth circuit around a curtailed grid; also in view of potential for an estuary transect with rearranged docking at Hull. Shortened fifth circuit commenced at 1200.

Thur 17 May.

Fifth circuit completed around 0200. Chemical recording continued during passage in Humber Estuary to Hull; reach lock gates at 0615 and end scientific work. Commence decommissioning of equipment. Tie up in Hull ca. 1000. Unload scientific gear and depart for Plymouth at ca. 1400.

#### SUMMARY

This cruise was completed successfully according to plan. Apart from the temporary loss of power to the clean container, there were no major disruptions due either to instrument breakdown or to weather, which was clement throughout with only slight winds. Four complete circuits of the Humber plume grid were achieved, together with a final shortened transect. Work at the two sediment resuspension study sites was successfully incorporated, consolidating earlier visits during cruises 44, 52 and 60 in

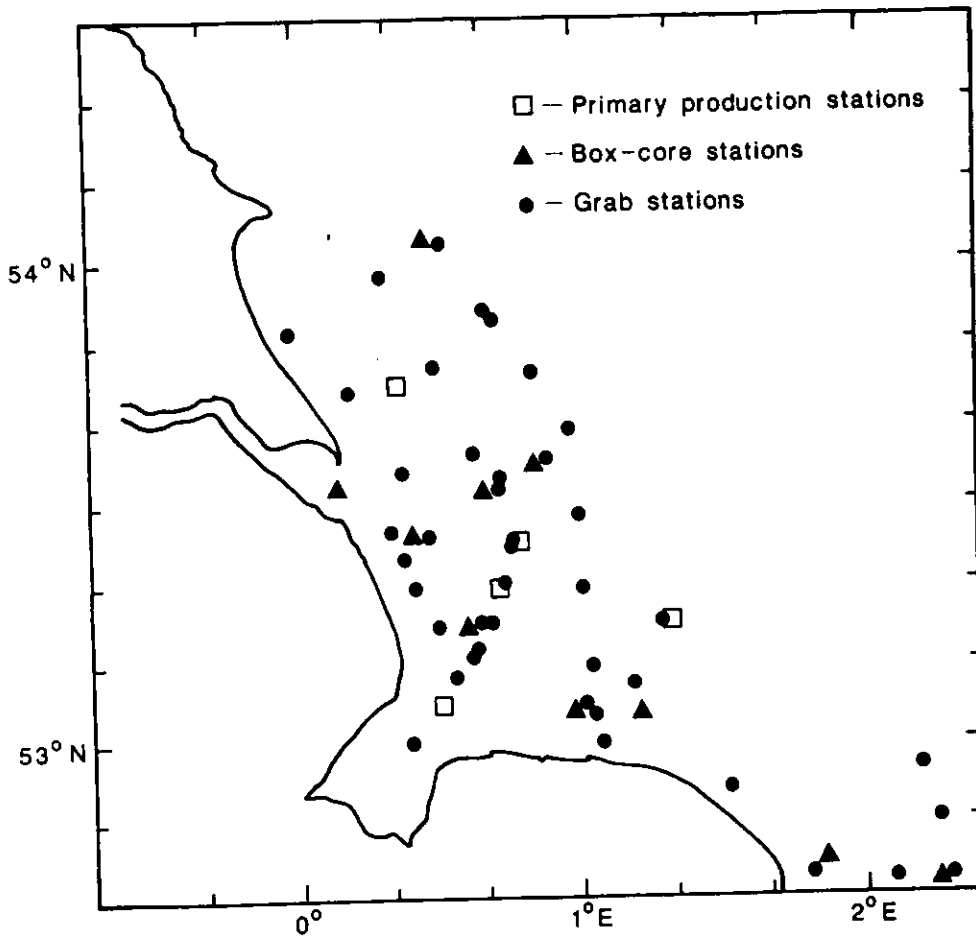


Figure 1. Stations worked in the Humber/Wash plume region.

1989. The latter of the two planned anchor stations in the mouth of the Humber was abandoned, taking advantage of the opportunity to make observations along the estuary prior to the rearranged docking at Hull instead of Great Yarmouth at the end of the cruise.

On-board incubation experiments were carried out throughout the cruise. These were: (1) radiochemical techniques applied to water samples for assessing the rates and equilibrium states of particle/water metal exchange, and (2) macrocosm techniques applied to box cores for measuring directly the rates of transfer of nutrients and metals across the sediment/water interface under undisturbed and disturbed (resuspension) conditions. In addition, pore water chemical profiles were measured for indirect estimation of diffusional fluxes across the interface.

Figure 1 shows the positions of grab, box core and primary production stations within the Humber/Wash plume zone.

The entire data set obtained during the cruise and through subsequent laboratory analyses of samples has been lodged at BODC.

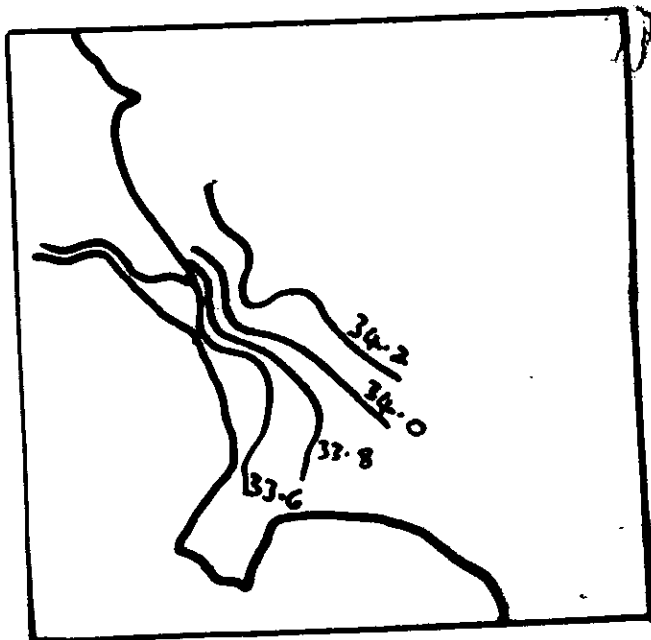
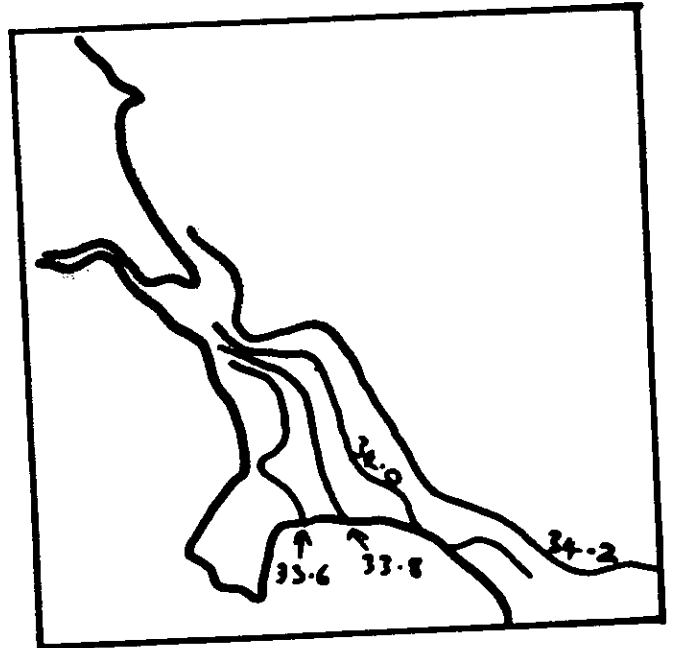
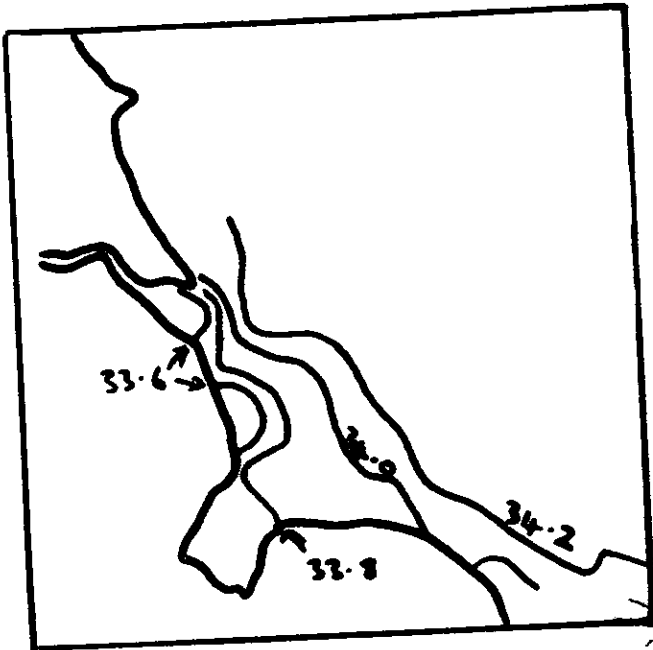
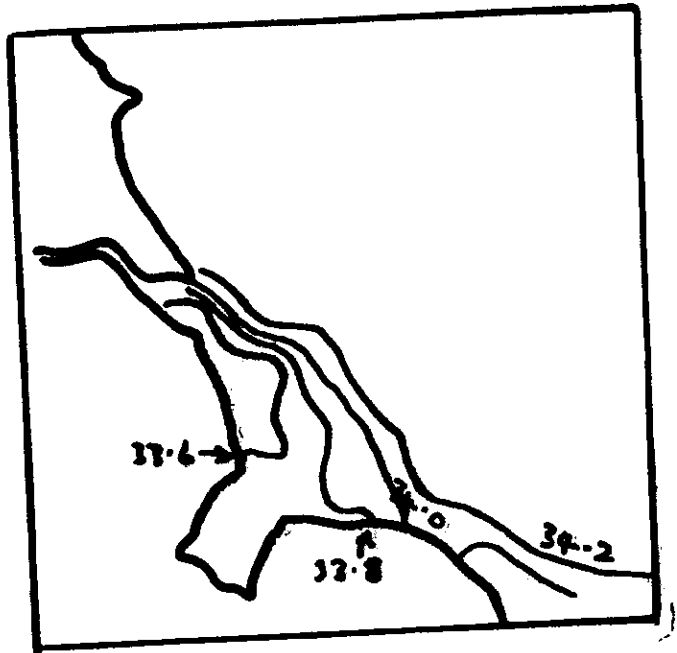
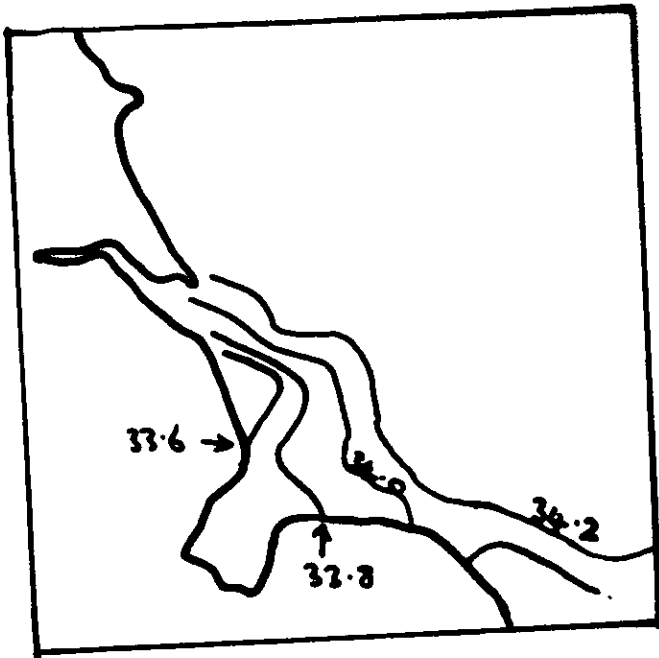


Figure 2. Near surface salinity distributions recorded during each of the five circuits of the Humber/Wash plume zone.

## RESULTS

### Hydrography

Figure 2 shows the near surface salinity distribution recorded during each of the five circuits of the plume grid, traced without tidal correction from UNIRAS plots. The differences in the locations of isohalines, most noticeable nearest to the Humber mouth, are predominantly due to differences in tidal displacement at the times of sampling. These distributions indicate a confined Humber plume without a strong signal emanating from the Wash. This is in keeping with the relatively low river run-off before and during the cruise period. The Humber discharge tends to move southward, hugging the coastline, with indications of some easterly transport along the axis of Silver Fit, an E-W oriented deep channel ending south east of the mouth of the Humber. This form of distribution closely corresponds with our model predictions for windless conditions.

The water column was well-mixed over the entire grid.

### Water column chemistry

The chemical data has not yet been fully validated and only a descriptive summary is presently available. Nutrients, dissolved metals and suspended solid load distributions closely followed the salinity distribution, as expected. The Humber nutrient signal predominated; the nutrient discharge from the Wash region was not strongly evident. Water fluorescence and chlorophyll content were enhanced in the Wash region, with a distinct patch of highest levels offshore. Patches of *Phaeocystis* approaching bloom proportions were observed in this region. This evidence for locally high primary production offers an explanation for the lower nutrient levels (relative to salinity) encountered in the Wash region.

### On board experiments

Metal particle/water distribution coefficients were determined radiochemically on sixteen water samples dispersed around the plume grid. Results were similar to those obtained in the previous Humber/Wash plume cruise (no. 42 in 1988). Similar on board experiments with mixed samples containing Ouse river water and coastal sea water provided distribution coefficients applicable to the estuary. On board incubation of large volume sea water samples dosed with radiotracer metals were used to investigate metal uptake during phytoplankton growth. The amount of metal uptake increased with the phytoplankton stock; this uptake was predominantly passive, as indicated by the close similarity between uptake in illuminated and dark incubations.

Macrocosm experiments incubating undisturbed box core samples were completed on samples from eight sites. Measurements of nutrient transfer rates across the sediment/water interface were completed on board; samples for metal transfer rates were returned to the laboratory.

Report prepared by:



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Report authorised by:



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