MINISTRY OF AGRICULTURE FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, NR33 0HT, ENGLAND

1993 RESEARCH VESSEL PROGRAMME

REPORT: CIROLANA 9b/93 JoNuS 20

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DURATION: 30 September 1993 - 11 October 1993

LOCALITY: Wash, Humber and southern North Sea

AIMS:

10. To identify and quantify the fate of river-borne nutrients entering the Wash and Humber estuary, examining nutrient distributions from the river inputs through to the North Sea. (AE0504A0)
11. To examine sediment biogeochemical processes that control the behaviour of nutrients in the North Sea. (AE0504A0)
12. To take samples over a grid in the North Sea to improve knowledge of the seasonal signal in nutrient concentration, particularly phosphate (AE0503A0).

Additional aims:

13. To recover 2 moorings from the Wash, one containing an *in situ* nitrate analyser. (AE0504A0).
14. To collect air and water samples for low molecular weight hydrocarbon studies. (W Broadgate, P S Liss, S Penkett, University of East Anglia)

NARRATIVE: (all times are Greenwich Mean Time)

RV Cirolana departed from Lowestoft at 2036h on Thursday 30 September 1993 for passage to the Wash. Work commenced the following morning (1 October 1993) with sediment coring operations at 0600h and a water column profile using the FSI ICTD and rosette at 0930h. The next task was to recover the moorings deployed in early September. Mooring A2 was recovered without problem at the first attempt and all gear including an *in situ* nitrate analyser recovered. Mooring B2 proved to be more

difficult. The Guard Toroid was recovered successfully but the combination of wind and tide and the alignment of the mooring prevented the recovery of the current meters.

Saturday 2 October 1993 saw further coring work at a site to the south of Inner Dowsing which had proved difficult to sample on previous cruises. The NIOZ corer worked well and recovered 10 box cores. Another attempt was made to recover mooring B2 at high water, again without success. A third and successful attempt was made at recovery just on low water slack. Sampling of the Wash Grid was disrupted by failure of the CTD logging system, sampling was therefore confined to surface water samples until the problems were solved later in the day.

Relatively calm conditions on Sunday 3 October 1993 allowed for rapid sampling of the offshore grid between the Wash and the Humber. Cirolana proceeded to anchor in the Bull anchorage ready for the pilot for the run up river to North Killingholme the following morning.

Cirolana was anchored off the jetty at North Killingholme by 0630h on Monday 4 October 1993 and sediment sampling operations were quickly completed. An exchange of staff by searider took place before Cirolana returned to the Bull anchorage to commence sampling over a tidal cycle.

Sediment sampling at the anchor site took place early morning on Tuesday 5 October 1993, and on completion of the tidal cycle sampling Cirolana weighed anchor and steamed to the Outer Silver Pit collecting surface water samples *en route*.

On Wednesday 6 October 1993 sediment samples were collected in the Outer Silver Pit and surface water samples were collected between the OSPIT and the Norfolk coast. Sampling for the analysis of historic trends in nutrients (the Phosphate Grid) commenced late in the evening and continued to the end of the cruise.

On the mornings of Thursday 7 October 1993 and of Friday 8 October 1993 sediment sampling at sites BELS2 and SAND1, respectively, completed all the sediment sampling objectives.

Cirolana docked at Lowestoft at 0500h on Monday 11 October 1993, ahead of plan and as a result of the good weather during the cruise.

RESULTS:

The good weather experienced during most of the cruise allowed the completion of all cruise objectives without problem. The professional approach of the ship's officers and crew aided in achieving the aims and the ship's equipment worked reliably, apart from one fault which was fixed by the engineering department.

All samples from both the sediment process studies and the water column were measured for nitrate, nitrite, ammonium and phosphate concentration. Aliquots of samples have been retained for subsequent determination of silicate concentration. All salinity samples have also been measured on board using the portable salinometer and

all samples have been entered into the sea-going LSDM system. The cruise therefore returns with much of the donkey work completed and thus avoids the inevitable delays that occur when these tasks are not completed at sea.

All water column samples have been filtered for the subsequent determination of suspended load, chlorophyll-a and particulate carbon, nitrogen and phosphorus.

Aim 10

The Wash was stratified, in part, showing the clear influence of inputs from the tributary estuaries. Phytoplankton production is entering its winter decline and nitrate concentrations are increasing. Small elevations of ammonium in bottom water suggest that increasing nitrogen concentration is partly fed by inputs from the seabed sediments.

The Humber Grid area is dominated by the discharge from the Humber with high nutrient concentrations close inshore along the Lincolnshire coast. Most of the water in this area is vertically well mixed but approaching the estuary stratification develops.

The offshore waters are in a transition from the significant phytoplankton production of the spring and summer to relatively quiescent winter conditions. The comparatively high concentrations of the intermediate species nitrite and ammonium suggest that significant nutrient regeneration is occurring in all areas. The central Southern Bight waters show clear evidence of continuing nutrient depletion which is in contrast to the central North Sea water in the Outer Silver Pit area.

Aim 11

Sediment process samples were collected at 7 sites in estuaries and the North Sea. Sediment cores were incubated at in situ temperature to determine denitrification rates. The results are shown in Table 1. Highest rates of denitrification occur inshore, progressively decreasing offshore, and are within ranges found for similar sites in the North Sea. There appears to be a significant seasonal component in denitrification fluxes with values typically 2 - 10 fold higher in summer months. Samples were collected to determine sediment/water interface fluxes of nutrients, interstitial water chemistry, sediment properties (including porosity/grain size, solid phase composition, X-radiography),natural series radionuclide distribution. The samples will be worked up after the cruise.

Aim 12

Samples were collected from the entire Southern Bight Phosphate grid to assess the seasonal signal exhibited by phosphate in this area. A preliminary estimate of the mean phosphate concentration in the area is 0.32 μM which is consistent, within an assumed error, with the signal expected for October reported by Dickson and Kirkwood. The estimate is subject to revision based on full interpretation.

Aim 13

The recovery of the NAS-1 nitrate sensor after a month long deployment on a mooring in the Wash proved disappointing. The sensor had only collected 5 days of data before a mechanical problem resulted in instrument failure.

Aim 14

Air and water samples for light non-methane hydrocarbon analysis were collected at 20 sites. Analysis was completed on board using a purge and trap preparation combined with gas chromatography. Initial inspection of the results suggest alkene concentrations (in the parts per trillion (by volume) range) to be lower than previously measured in June 1993

This cruise marks the successful completion of the offshore JoNuS sediment sampling programme and was the penultimate cruise of the JoNuS series

S J Malcolm
Scientist-in-Charge
11 October 1993

SEEN IN DRAFT: Master
Senior Fishing Skipper

INITIALED:

DISTRIBUTION
Basic list+
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Table 1. Sediment denitrification results

SITE	DENITRIFICATION FLUX umol N m^{-2} d^{-1}	% of DENITRIFICATION FLUX FROM NITRIFICATION*
HSP2	315 ± 250	0 - 20
WSS8	50±26	1 - 2
A5	30±21	0
OSPIT	22±9	0 - 10
OS10	12±24	0 - 30
SAND1	6±9	0 - 35
BELS2	1±1	0 - 100

* percentage of denitrification derived from nitrate production *in situ*