

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD  
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND

1992 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA : CRUISE 12

DURATION:

1-18 December 1992 (Planned 1-21 December)

STAFF:

B R Harvey (SIC)	
M B Lovett	
K S Leonard	1-15 December
R D Ibbett	
D McCubbin	
P Blowers	
R Bonfield	
T Brooks	
D Cooper (Univ. Newcastle)	} 1-9 December
A J Poole	
A K Young	} 9-11 December
D J Allington	9-18 December
N D Pearson	
J M Rees	} 15-18 December

AIMS:

1. To collect and process surface water (and bottom water from selected sites) from UK coastal waters for the analysis of Tc, I, Co (Cs) and transuranic radionuclides as part of a pre-EARP survey (AE0104, NFSP, MAST II).
2. To determine the present oxidation state distribution of transuranium elements in UK coastal waters and the speciation of Co in the eastern Irish Sea (AE0104A).
3. To conduct further studies of actinide colloid distributions in the Irish Sea and run supporting trials to investigate the ultra-filtration technique for seawater colloid separations (AE0104A, NFSP).
4. To isolate and concentrate the dissolved organic carbon in sea water in order to assess the nature, size distribution and relative amounts of the various colloidal organic components present (University of Newcastle).
5. To study the surface sediment and water concentrations of U, Th, Ra, Po and Pb radionuclides and nutrients in the immediate vicinity of the Marchon outfall and further offshore in the eastern Irish Sea. Part of this work is to be done in conjunction with a small charter vessel (AE0104B).
6. To collect a large volume sample of surface Atlantic water for low-level radionuclide intercomparison purposes (Tc etc) as part of ongoing collaborative studies with our colleagues in other European countries (AE0104A).
7. To deploy near-bed rigs in Newburgh Bay (AE0207AO).

## NARRATIVE:

CIROLANA sailed from Lowestoft at 1330 h on 1 December 1992 following the southern route to the Irish Sea. Because of south westerly gales, the ship had to dodge just north east of the Goodwin sands for several hours before proceeding slowly to the Scilly Isles which were eventually reached at breakfast time on 4 December. Despite the poor weather, surface seawater samples were collected en route at 7 stations and processed for radionuclide analysis.

A planned transect of water stations between the southern coast of Ireland and Stumble Head (A) was abandoned because of shortage of time but a transect from Arklow to the Lley Peninsula (B) and 5 other scheduled locations were worked for the determination of radionuclides as the ship made its way towards the Sellafield outfall area (see figure 1).

During the period 5-8 December, 4 sites (UF1, 2, 3 and 6) in the eastern Irish Sea were visited to collect large volume (up to 300 litres) water samples for the separation of colloid phase radionuclides using the FILTRON high pressure ultra-filtration equipment with a 1 k Dalton nominal molecular weight cut off cross-flow cartridge. Aliquots of both permeate and retentate water were taken for transuranic speciation analysis and for dissolved organic carbon (DOC), the preliminary radiochemical separation work being carried out immediately on board ship. Whilst these time consuming ultra-filtration separations were taking place, the proposed survey of radionuclide concentrations and speciation within the whole Irish Sea area continued with transects from Dublin to Anglesey (C), Dundalk to Morecambe Bay (D) and the southern end of the North Channel (E) being worked along with intermediate sites as shown in figure 2.

On Wednesday 9 December, an exchange of scientific staff took place at Whitehaven using the ship's Searider. In the calm weather conditions, the opportunity was taken immediately to collect samples from several inshore sites (figure 3) in the vicinity of the Marchon outfall as part of aim 5. Both water and surface sediment samples were collected and brought back to CIROLANA where the samples for  $^{226}\text{Ra}$  analysis were processed on-board during the subsequent time that the ship was at sea. This survey continued for the next two days with the sea rider again collecting samples from the inshore sites both to the north and south of St Bees Head. Failure of both the rear starboard winch and the Atlas crane on 10 December meant that sediment sampling with the Day Grab had to be transferred to the port side of the ship. Fortunately the Atlas crane fault was rectified by mid-morning on 11 December and, with the Marchon survey largely completed, the opportunity was taken to put 2 of the scientific staff involved in that work ashore at Whitehaven just before lunch, whilst the weather conditions remained favourable. After completing a series of offshore stations for suspended load and nutrient analysis to complete this survey, the ship proceeded towards the north Channel to resume the work of aims 1 and 2.

During the next three days, further samples for the analysis of artificial radionuclides were collected from the Mull of Kintyre and Hebrides through to the north Scottish coast. During a short period of reasonable weather conditions on 12 December, several CTD profiles were obtained with the Rosette array to the south west of the Hebrides (towards the LOIS study area on the Malin shelf edge). Surface and bottom waters were also collected for the analysis of  $^{99}\text{Tc}$ . During this work and in earlier trial runs, problems were experienced with the winch tending to stall whilst raising the Rosette array fully laden with eleven 30 litre Niskin bottles. This may be due to the misalignment of the cable-guide relative to the layering of the cable on the drum, but after consulting with the Chief engineer, it was concluded that nothing could be done to correct the problem until the cable can be disconnected from the Rosette array CTD in harbour.

CIROLANA docked at Peterhead during the morning of Tuesday 15 December to take on board the Tetrapod, the University of Cambridge Quadrapod and guard buoys for deployment in Newburgh Bay. These had only recently been retrieved from the same location (3 December) by the SOAFD research vessel CLUPEA and had been stored and serviced at the Aberdeen

laboratory. With the exchange of scientific staff and loading completed, the ship sailed again at 1400 hr and proceeded slowly toward Newburgh Bay whilst the rigs were being assembled. Deployment was completed without difficulty in good weather on Wednesday 16 December after which CIROLANA commenced the journey back to Lowestoft. The remainder of the scheduled water sampling stations were visited en route - timed to allow the chemical processing to be completed between the major sampling locations.

Shortly after the start of the cruise, instructions had been received from the laboratory at Lowestoft to shorten the cruise by at least 2 days in order to save sea-going overtime payments for the MAFF scientific staff. With extremely favourable weather conditions at crucial periods of the cruise, damage to the scientific programme was ultimately quite small and the ship was able to dock at Lowestoft on the afternoon tide of Friday 18 December. Our success was undoubtedly helped considerably by the enthusiasm and first class support provided by the ship's officers and crew for which we record our thanks.

#### RESULTS:

1. Samples of 50 or 100 l of surface seawater were collected from 72 locations around the UK coast and passed through anion-exchange columns to extract  $^{99}\text{Tc}$ . At 22 of these sites (10 within the Irish Sea), radiocaesium was extracted by cation exchange (AMP columns), with  $^{60}\text{Co}$  and the transuranic nuclides being removed by co-precipitation methods. Further radiochemical purification and radio-assay will take place later at the Lowestoft laboratory. In addition, duplicate 1 litre samples were collected at the same sites for the determination of  $^{129}\text{I}$ . One will go to Dr Raisbeck (CNRS, France) for analysis by accelerator mass spectrometry, the other to Dr McCartney (SURRC) for neutron activation analysis. The primary purpose of this survey is to establish a baseline concentration for key nuclides before discharges from the new BNF Enhanced actinide removal plant (EARP) comes on stream some time during 1993 - not simply for monitoring purposes but to enable advantage to be taken of significant changes in concentration in nuclides such as  $^{99}\text{Tc}$  to help validate hydrographic models for the transfer of contaminants in the region.

2. Samples of 50 or 100 l of seawater collected from 22 locations were subjected to preliminary chemical separation procedures to separate the higher and lower oxidation states of plutonium radionuclides and  $^{60}\text{Co}$ . Forty two similar separations of plutonium species were also undertaken in support of the ultra-filtration field experiments and methodology investigations carried out on the cruise. As well as providing information in support of general dispersion studies and modelling of the behaviour of radionuclides discharged from major UK nuclear sites, these analyses are also required to assist the interpretation of radio colloid studies currently in progress as part of a CEC research contract (NFSP) and on-going DFR investigations into the role of marine colloids in aiding dispersion of radionuclides in the sea.

3. In order to try to confirm the existence and to establish the distribution of radionuclides discharged in the form of colloids from the BNF reprocessing plant at Sellafield, samples of up to 300 litres of seawater from five eastern Irish Sea sites and one at the Scilly Isles were size fractionated using  $0.45\ \mu\text{m}$  membrane filters followed by 1 k Dalton (NMWCO) ultra-filters. Aliquots of the total permeate and retentate fractions were taken for transuranic and other analyses. In addition, a further 8 experiments were carried out to investigate the stability of radio colloids in relation to the techniques employed for size-fractionation. Parameters investigated included trans-membrane pressure permeate/retentate ratios and the duration of processing. The work is in part funded by a CEC contract under its Nuclear Fission Safety Programme.

4. In support of the DFR radio colloid studies 200-1000 l seawater samples were collected from the Thames estuary, at the Scillies and at 4 sites in the eastern Irish Sea. These were ultra-filtered using 3 K Dalton hollow fibre cartridges to give a final retentate volume of 5

litres or less which will be analysed at the University of Newcastle to characterize the marine colloids. Material collected on the 0.45 µm pre-filters will also be investigated by electron microscopy to determine the extent of organic coatings on mineral surfaces. This work also offers a means by which the performance of the ultra-filtration and ion-exchange processes used in the isolation of marine colloids may be reviewed.

5. Sampling for water and surface sediments for natural radionuclides, nutrients and suspended particulate matter was carried out at 37 locations in an area close to the Marchon discharge at Whitehaven and to the south of St Bees Head. Preliminary separations of U, Th, Po and Pb radionuclides took place on board. Analyses were also carried out for <sup>226</sup>Ra, the <sup>226</sup>Rn first being stripped out from 50 l water samples then allowed to grow back in and subsequently removed again for radiometric assay in alpha scintillation counters on board the ship. Nutrient samples were filtered (glass fibre) then preserved with Hg Cl<sub>2</sub> for subsequent analysis at Lowestoft. This work forms part of a down-run study now that the Marchon Works no longer processes the raw phosphate rock.

6. Plans to collect a very large (4500 litre) sample of Atlantic water were abandoned before the ship sailed because of financial constraints on the AEP4 current budget.

7. Both the Quadrapod and the Tetrapod were deployed successfully in Newburgh Bay as part of the on-going COSEDS programme.

8. Additional samples collected on the cruise included filtered seawater (50 l) and suspended particulate material from 200 l of water at 6 locations - St Georges Channel, eastern Irish Sea, Isle of Man, North Channel, Mull of Kintyre and the Hebrides. These will be analysed by Dr McCartney at SURRC for <sup>99</sup>Tc by ICPMS as part of the SURRC pre-EARP discharge survey.

9. The opportunity was taken to compare the ship's clean seawater supply with the AEP4 acid-cleanable Jabsco pump by collecting duplicate samples at the Scillies (before visiting Sellafield) and at the Hebrides (after leaving the Irish Sea). Of particular importance is the need to establish whether or not the ship's supply has any memory effect for low particle-reactive species such as pertechnetate.

B R Harvey, SIC  
13 January 1993

INITIALLED:  
PG-S

SEEN IN DRAFT:  
B C (Captain)  
J B W H (Fishing Skipper)

DISTRIBUTION:

Basic List +  
B R Harvey  
M B Lovett  
K S Leonard  
R D Ibbett

D McCubbin  
P Blowers  
R Bonfield  
T Brooks  
D Cooper

A J Poole  
A K Young  
D J Allington  
N D Pearson  
J M Rees

