

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

1989 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA: CRUISE 6

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DURATION: 21 June-20 July

LOCATION: North Sea and north-west Atlantic

AIMS:

1. To lay a line of 5 current meter moorings off the Tyne for later recovery by CORYSTES.
2. To recover the East Greenland current meter array of 8 moorings (3 c/m per mooring; 2 thermistor chains; 1 Seacat salinity recorder) and relay the array for recovery 1990.
3. To work CTD, Freons (113, 11 and 12) and CCl₄ (if available) at a range of locations from the Greenland Sea to the Labrador coast.
4. To conduct near-bottom hydrography of a few days duration at the foot of the Continental Slope of Porcupine Bank.
5. To test-run the PML pCO₂ apparatus continuously around the entire cruise track.
6. To work XBTs for MOD(N) at 6-hour intervals throughout the cruise when in water depths > 200 m.
7. To collect bulk (50 l) water samples where required for AEP 1 and for ICES nutrient intercalibration work.

NARRATIVE: (All times GMT)

CIROLANA left Lowestoft at 0945 h 21 June, and, after a brief calibration of the log against the measured mile off Corton, proceeded to her working area off the Tyne. Between 0738 h and 1309 h 22 June, 5 rigs incorporating 11 current meters were laid in a line offshore as planned, but shortly after leaving the area the vessel was recalled to recover all moorings on directive from DFR following objections from local salmon fishermen. Between 1512 h and 1822 h

all 5 rigs were recovered without damage and after floating the toroids forward for stowage in the buoy-flat, the ship continued north to her main working area off Greenland.

Continuous monitoring of pCO_2 and chlorophyll fluorescence began on crossing the continental slope west of Shetlands and 6-hourly XBT dips in daylight hours began at 0800 h 24 June. Both were continued throughout the cruise.

Following a test lowering of the CTD on 25 June, and cleansing of the 30 Niskins with Decon, the first CTD/Freon stations proper were worked with 12 bottle casts in the Southern Greenland Sea close to the pack ice on 26 June, and in the western Denmark Strait on 27 June. Although the intended oceanographic features were encountered and sampled, it became clear after running the first Freon samples that the Niskins were likely to be contaminated despite their earlier cleaning. The ship turned south to service the current-meter array off Angmagssalik while the cause of the contamination was investigated. On the evening of 27 June, after completely dismantling the large Niskins and punching-out their taps with hammer and drift, a heavy contamination with silicon grease was discovered on the inner surfaces of the taps and on all O-seals. The twin O-seals on each tap were washed in a mixture of acetone, isopropyl alcohol and methanol, the large O-seals around the end-caps were wiped, deconned, wiped again and baked in an oven at $50^\circ C$, and the surfaces of the bottles were deconned once again to remove any film of grease that might have accumulated.

From the vessel's arrival on the mooring line at 1232 h 28 June to 1616 h 29 June, all 8 moorings, incorporating 24 current meters, 2 thermistor chains and the Seattle Seacat salinity recording instrument, were recovered without loss or significant damage. The vessel then returned to re-work the CTD stations in the Denmark Strait while the current meter records were processed to provide the basis for planning the 1989 array. By 1930 h 30 June an XBT survey with CTD casts in the Strait had been completed and the ship returned south to the mooring line, carrying out acoustic release tests on the hydro-wire en route during 1 July.

During 2-5 July CIROLANA worked a total of 6 full depth CTD/Freon/nutrient stations at the locations of the 1988 current meter deployments, completed the deep a/r tests, deployed 6 moorings (3 instruments per mooring) covering positions and/or depths not previously covered on our WOCE array and worked a brief bathymetric survey up the upper part of the Greenland Slope and across the shelf to the pack-ice.

With work in our main working area completed, CIROLANA then proceeded southwest to the Labrador Slope region with XBT and pCO_2 coverage as before en route. On arrival 8 July 30 knot winds and moderate to heavy swell initially forced the vessel to dodge but at 1131 h with wind dropped to 15 knots and reducing swell, the first of our intended sections of CTD/Freon stations was begun. Failure of the CTD winch clutch and drive train with the CTD at 3038 m during recovery however forced us to abandon this station and the section, with the CTD wire stoppered, chopped and recovered on the trawl winch but with the CTD, rosette and water samples undamaged.

CIROLANA then continued to St Johns, Newfoundland, docking at 1013 h 10 July. In port, the representative of PMEL, Seattle met the ship to analyse the SEACAT salinity record, copy it to disc and return the instrument to Seattle. CIROLANA left for home the following day at 2000 h. The next few days were spent making very slow eastward progress across the Grand Banks and Flemish Cap in high wind/swell, thick fog and ice.

Although the 30 l Niskins were readied for use on the hydro-wire in case a slant offered, heavy weather persisted until we approached mid-Atlantic on 14-15 July, providing no chance to work further stations in the Labrador Current. A deep cast of large Niskins to 4100 m was conducted over the Porcupine Abyssal Plain on 17 July to provide a blank for the past Freon analyses.

CIROLANA then ran eastwards to the Armorican Shelf west of Ushant where after a brief search in calm weather, the FSM 3 Argos buoy was recovered at 1825 h 18 July. The vessel then continued to Lowestoft, docking 0930 h 20 July.

RESULTS:

1. The planned c/m array was laid (if only temporarily) off the Tyne.
2. The full east Greenland array of 24 current meters was recovered bringing our recovery rate since the trial instruments were laid in 1986 to 42 instruments out of 44. Though battery and encoder faults caused some short records, the average good data duration is ~ 243 d this year, ~ 276 d overall. Of the two thermistor chains recovered, one worked perfectly throughout, while the other failed through a bad battery; the SEACAT worked well and is under analysis at Seattle.
3. Though originally intended for 5-year operation to assess interannual variability, the flow speeds recorded on all 3 years are perfectly controllable, achieve stable means after 30-50 d, and show very little variability, either seasonally or interannually. The 6 moorings deployed will therefore complete the coverage needed on this line and the array will be moved up close to the Denmark Strait in 1990 to confirm the volume transport of the source.
4. According to whether one uses the July 1988 or July 1989 potential density distribution, the volume transport at $\sigma_\theta > 27.80 = 6.2 - 6.8$ Sv ($1 \text{ Sv} = 10^6 \text{ m}^3 \text{ s}^{-1}$).
5. Following the alarm over grease-contamination of the Niskins, the Freon sampling and analysis worked well for Freon 11 and 12, confirmed in a near-zero blank from the deep water of the eastern Atlantic. An anomalous mid-depth 'F-113' signal off Greenland, not observed last year, is thought due to masking by a quite different compound to which the GC apparatus has become sensitive and will need laboratory study to identify and eliminate.
6. A 4 end-member mixing model constructed on board and using θ , F-12 and salinity identified the percentages of Denmark Strait water and 'local' entrainment passing through our section. This model suggests that only a minor 1.65 Sv of the dense water passing through the section is of true Denmark Strait origin, the rest being local entrainment. This is at variance with the 2.5-2.9 Sv of overflow measured in the Denmark Strait by Ross in 1973, albeit from short (37 d) current measurements. Though winch and weather prevented the planned Freon sections across the deep Labrador Current, the one station completed there confirmed the extension of Denmark Strait overflow close to the bottom in high F-12 concentrations there. CCl_4 was not available as a tracer.

7. The almost continuous pCO₂ measurements carried out around the entire deep water circuit of the cruise are more extensive than the only previous set (TTO, 1981) and are remarkable in the amplitude of the CO₂ disequilibrium between air and surface water encountered at points on the circuit, particularly close to the ice. Interpretation in conjunction with chlorophyll fluorescence is underway. The ship's position recording to the HP proved impossible; instead the Magnavox output was tapped and logged via an Apricot.
8. The days of heavy weather at slow speeds east of Newfoundland prevented the planned hydrography on the Rise off Porcupine Bank.
9. A total of 49 XBT dips were made and reported to MOD(N).
10. The Argos buoy, tracking crab larvae on the Armorican shelf was found, and recovered without damage.
11. Occasional bulk water samples were collected north and west of Iceland and off south-east Greenland for AEP 1, and for the ICES nutrient intercalibration work. The various phosphate methods employed by 70 of the 85 participants in the latter exercise were reviewed for the intercalibration report.

The success of this cruise is due largely to the cooperation of all ship's staff in maintaining a scrupulously clean environment for Freon measurement and to their skill in trying conditions during the recovery of all gear. Their help is gratefully acknowledged.

TOTAL MILES RUN: 6055 n.mi.

R R Dickson
(SIC)

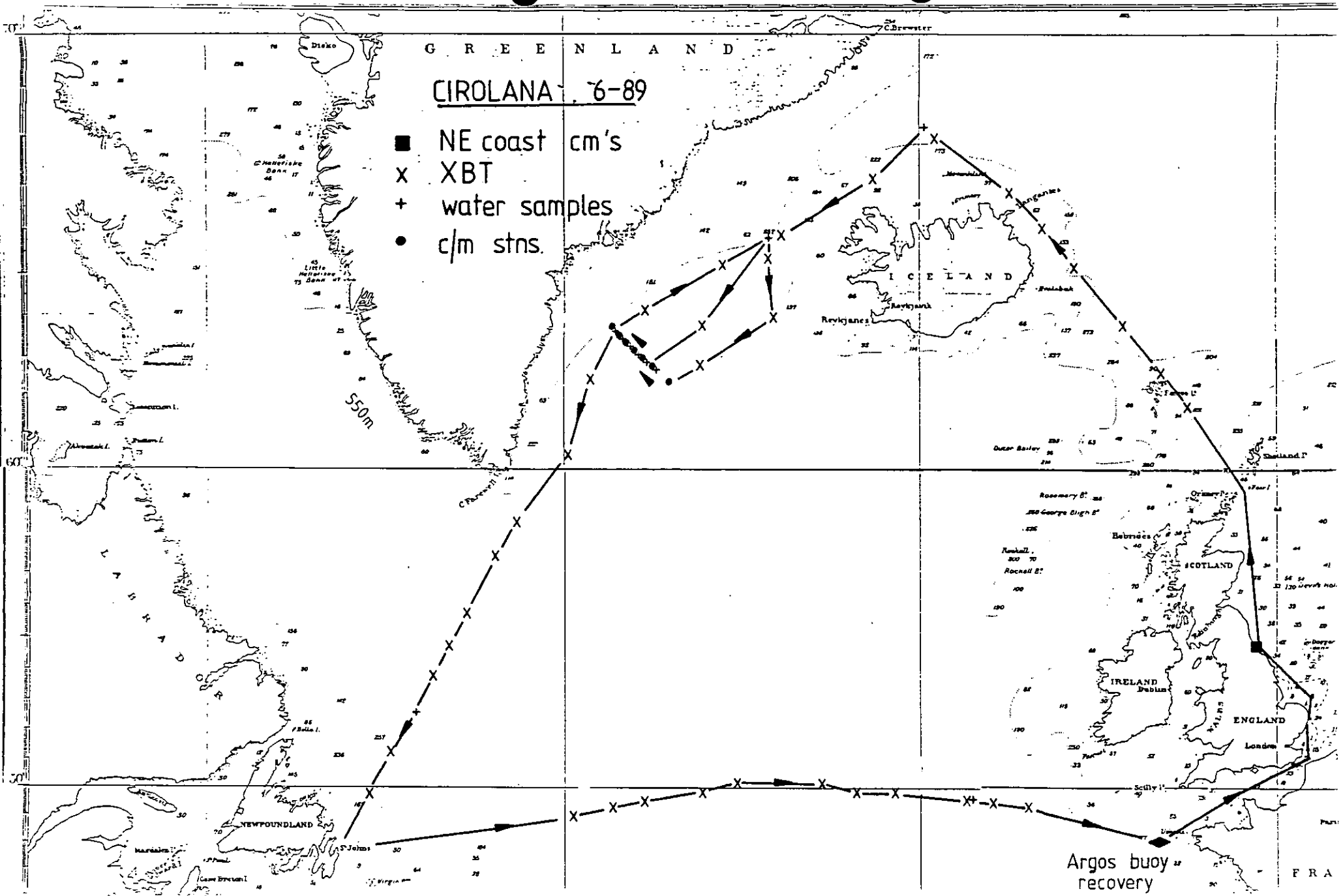
2 August 1989

SEEN IN DRAFT: Seen and approved
by D J Garrod
pp P Lock

INITIALED: G Sinclair (Master)
J Harper (Fishing Skipper)

DISTRIBUTION:

Basic list +	M C Fulcher
R R Dickson	S R Jones
D S Kirkwood	P R King
E M Gmitrowicz	A Watson (PML)
J W Read	M Liddicoat (PML)
J Wooltorton	R Ling (PML)



CIROLANA 76-89

- NE coast cm's
- X XBT
- + water samples
- c/m stns.

Argos buoy
recovery

F R A