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FRV *Scotia*

CRUISE REPORT 10/90

10SR90

15 September-5 October 1990

Personnel

W R Turrell	SSO (in charge)
R Payne	HSO
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R D Adams	SO
P Gillibrand	SO
Miss N Harrison	(NCC) 26 September-5 October

Objectives:

1. To perform a hydrographic survey of the northern North Sea and shelf seas west of Orkney in order to examine northerly inflows of Atlantic water.
2. To perform repeated surveys of set sections using the vessel mounted ADCP prior to sailing)
3. To recover four current meter moorings previously deployed during *Scotia* Part 1.
4. To perform the standard hydrographic sections across the Faroe/Shetland channel.

Narrative

Scotia set sail from Greenock at 1500 (all times GMT) on Saturday 15 September, and proceeded to the start of the East Coast (EC) hydrographic section. Over the three days, 49 CTD stations were performed along lines east (the JONSIS line), west and north of Orkney (see Fig. 1 - cruise track). On commencement of the first line east of Shetland on Wednesday 19 September the weather and *Scotia* shelter until 1300 the following day. Although force 9 gales still an ADCP hour survey of a section east of Shetland commenced. This consisted of a track covered at five knots, owing to the sea state, and of 7.5 nm in length. The thus took 1.5 hours to complete and in all 18 passes were performed in 25 hours.

Hydrographic work recommenced at 0317 on Saturday 22 September. In all 26 CTD stations were performed along two lines east of Shetland over the next 36 hours. At 1123 on Sunday 23rd, *Scotia* had reached the northerly tip of and the first of the two Faroe Shetland Channel sections commenced. Owing to the unexpectedly good weather the Nolso Flugga section was completed within 10 hours leaving time free before *Scotia* was due in for the half landing in Thorshavn. Time was used to preform an ADCP survey south of Faroe.

Scotia sailed from Thorshavn at 0900 on Wednesday 26 September. The second Faroe Shetland Channel section was completed by 0352 the following day, and five CTD stations were then performed west of Shetland. At 1230 the weather again deteriorated, forcing *Scotia* to seek shelter east of Shetland. Prior to sailing seven attempts were made to collect a sediment sample at a NSTF standard station, but all failed owing to the worsening sea state.

Work restarted at 1740 on Thursday 27th with six CTD stations completed along a line to the north of Shetland. After consideration of the long term weather forecasts it was decided to recover mooring ES2 next, and this was successfully done by 0830 on Friday 28th. (Mooring ES3 had been caught in a trawl in the year). During passage to the position of mooring ES1 the surface buoy was found adrift and severely damaged. After two attempts to drag for this mooring over rough ground, the search was abandoned.

Over the next two days hydrographic work continued with 19 CTD stations being completed, along with a NSTF sediment sampling station. By 1800 on 30 September *Scotia* had reached the mooring WOC west of Orkney and this had been successfully recovered. A 25 hour ADCP survey was then completed west of Orkney and at 0900 on Tuesday 2 October the current meter mooring EC4NE had been successfully recovered, and a third ADCP survey commenced. This work was twice interrupted by worsening weather and sea state, until at 2310 on Wednesday 3 October all work ceased and *Scotia* sought shelter off Peterhead. During this time extensive software development took place, and tested with both Hydrographic Section CTDs. This work was completed by 2300 that night, and *Scotia* entered Aberdeen harbour at 0800 on Friday 5 October.

In addition to the total 139 hydrographic stations performed during the cruise, 4 water samples were taken for the Clyde River Purification Board, 2 samples for Caesium analysis by MAFF and a sediment sample at a NSTF station.

Results

Hydrography: The basic hydrographic results obtained within the Scottish shelf seas are summarised by Figures 2 and 3. There was distinct evidence of the vertically well mixed Atlantic/coastal water entering the North Sea through the Fair Isle passage, as has been noted on many previous cruises. Of more interest was the narrow strip of well-mixed water east of Shetland (see Fig. 3 - Log V less than 1 indicates well-mixed areas). Tidal mixing theory does not predict well-mixed water in this area, and hence it has been deduced that this strip of warm, saline water represents a previously discounted Atlantic inflow entering the North Sea from the north. Further analysis is planned using the data gathered during this cruise.

Water Mass Indices:

Index	Derived from	T	S	SigT
SEPTEMBER 1990:				
Fair Isle Current	JONSIS 1-1a-2	12.9	35.07	26.46
Offshore Northern North Sea	JONSIS 5-10	9.3	35.27	27.28
Atlantic Water	Nolso/Flugga 1-2	10.5	35.34	27.13
20 YEAR MEAN (SUMMER):				
Fair Isle Current	JONSIS 1-1a-2	10.4	34.93	26.82
Offshore Northern North Sea	JONSIS 5-10	7.9	35.21	27.44
Atlantic Water	Nolso/Flugga 1-2	9.7	35.34	26.26

Hence the northern North Sea was generally warmer (2°C) and of slightly higher salinity than is general for the summer months. The salinity of the source Atlantic water was the same as the 20 year mean value.

Current Meter Results: It is unfortunate that the current meter lying close to the Shetland coast (ES1) was not recovered owing to interference from fishing activity. This mooring may well have provided conclusive evidence of an inflow east of Shetland as suggested by the hydrographic results. The mooring lying further out into the North Sea certainly demonstrated a mean south-westerly flow throughout the deployment period, but this lay offshore from the main well-mixed zone.

25 Hour ADCP Surveys: These proved to be a useful method of employing the ship-bourne ADCP, and were also able to be carried out in sea states when standard hydrographic work was not possible. The survey east of Shetland within the well-mixed strip provided the first clear evidence of a narrow, persistent Atlantic inflow of a magnitude greater than that within the Fair Isle current. It was estimated that approximately $26 \times 10^8 \text{ m}^3 \text{ s}^{-1}$ of Atlantic water entered the North Sea through the 15 km wide survey section. If this is extrapolated across the well-mixed zone, then approximately $43 \times 10^8 \text{ m}^3 \text{ s}^{-1}$ Atlantic water entered the North Sea. Thus 70% of the total estimated Atlantic Inflow to the North Sea was the result of a 20-30 km wide current adjacent to the coast of Shetland.

W R Turrell
27 August 1991





