NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH

CRUISE REPORT

IMER C2/83 (MICRON 1)
RVS REF. FR 6/83

VESSEL R.V. FREDERICK RUSSELL

CRUISE PERIOD 5 - 18 April, 1983

PERSONNEL

N.J.P. Owens (Principal Scientist)
D.V.P. Conway
R.J.M. Howland
C.M. Hoyle
M.B. Jordan
C.A. Llewellyn
D.B. Robins
E.M. Woodward

ITINERARY (See charts)

Tuesday 5 April Departure from Plymouth delayed because of bad weather.

Wednesday 6 April 1100 departed from Plymouth. Set course for station A1. Arrived A1 1354, commenced vertical profile for chlorophyll, nutrients temperature, particle size and distribution. Completed A1 1439. Set course for CS2. Arrived Crow Sound, Scilly Isles 1800, shelter from bad weather.

Thursday 7 April Shelter in Crow Sound. Obtained new heating block for NH4 analyser. Depart anchorage 1900. Set course for CS2. Arrived station S-C1 2100 chlorophyll sensor vertical profile. Started monitoring leg toward CS2. Continuous measurement of nutrients $T^{o}C$ and S^{o}/oo and surface chlorophyll fluorescence.

Friday 8 April 0530 commenced 36 hour vertical profiling at CS2 for nutrients, NH4, chlorophyll, particle size and distribution. Vertical profiles
@ 0640
1300
1824
2304
LHPR tows at 0530
1130
1750

^{15}N isotope dilution experiment. Particulate material collected for zooplankton feeding and assimilation experiments. Thymidine incorporation experiment.

Saturday 9 April Continued vertical profiling. Profiles at 0600, 1100, 1804, 2021. LHPR tows at 0005
1855
Deployed <u>in-situ</u> light and incubation rig 0930. Rig recovered 2015. Hand netting for zooplankton.

Sunday 10 April 0005 depart CS2 for shelter in Crow Sound because of severe weather. NO_x analyser-Technicon nutrient analyser intercalibration experiment. Feeding/assimilation experiment started.

Monday 11 April	Shelter in Crow Sound. Experiments with a variety of pump vertical profiling arrangements. Further reproducibility - intercalibration experiments with NO_x - technicon autoanalyser. Short incubation - trace ^{15}N addition experiments. Hand netting for zooplankton. ^{15}N natural abundance sample collection. Current meter profile using pendulum current meters.
Tuesday 12 April	Depart Crow Sound 1300, arrive CS2 1800. Commenced South-Westerly sampling leg. Vertical profiles for chlorophyll, particle size and distribution. Continuous monitoring of nutrients, NH_4, T°, S°/oo, surface chlorophyll fluorescence.
Wednesday 13 April	Arrived shelf break at position 48° 22' N 9° 30' W (approx) 1600. Commenced vertical profiling. LHPR tow 2400.
Thursday 14 April	Continued vertical profiling, deployed in-situ light meter-incubation rig 0930. LHPR tow 1300. Recovered in-situ rig 2000. Hand netting for zooplankton at intervals. Thymidine incorporation experiment.
Friday 15 April	0100 completed station set course for CS2. 1000 commenced surface chlorophyll sample collection. Arrived CS2 1600. Commenced vertical profiling. LHPR tow 1845.
Saturday 16 April	LHPR tow 0630. Hand netting at intervals for zooplankton somatic condition observations. 0930 deployed in-situ light and incubation rig. Thymidine incorporation experiment. 6 hourly vertical profiling, for nutrients particle, size, temperature. Assimilation and starvation experiments.
Sunday 17 April	Vertical profiling. Deployed incubation rig 0945. Hand netting at intervals. Recovered light incubation rig at 2000. Depart from CS2 set course for Plymouth. Continued assimilation and starvation experiments.
Monday 18 April	Arrive Plymouth 0900. Unloaded equipment and disembarkation.

OBJECTIVES

1) To investigate the role of the microbiota in primary production and nutrient recycling processes in oligotrophic shelf waters.

2) To continue the studies of the copepod Calanus helgolandicus in shelf seas.

3) To ascertain the horizontal and vertical structure of the biological and physical environment around CS2.

4) To contribute towards a seasonal study of phytoplankton at station A1 (joint MBA/IMER project).

OUTLINE OF PROCEDURES AND METHODS

A variety of procedures were adopted in order to meet the objectives. These entailed the measurement of rate and state variables. Rate measurements were made using a variety of incubation techniques. These included in situ incubations for estimating nitrogen assimilation and primary production using the isotopes ^{15}N and ^{14}C. Three size fractions of material were collected after each experiment (>5μm, 5 - 0.8μ > 0.2μ). These measurements will be coupled to the incident and submarine light regimes which were measured continuously for the duration of the in situ experiments. ^{15}N isotope dilution incubations were carried out to quantify the rates of nitrogen remineralization. Bacterial production was estimated using the incorporation of ^{3}H - thymidine. Copepod feeding and assimilation was measured by incubation techniques involving the use of ^{14}c labelled Thalassiosira Weisflogii and natural particulate material. The investigations on zooplankton were continued by the observation of somatic condition, collection of animals for biochemical analysis and quantitative sampling by Double net LHPR tows over diurnal cycles. State measurements were made on a series of vertical profiles. The measurements made included nutrients, (using spectrophotometric/new chemiluminescence techniques) NH_4, $T^{o}C$ and particle size and distribution and chlorophyll fluorescence. Samples were also collected for the later analysis of chlorophyll by both standard spectrophotometric techniques and HPLC, bacteria and phytoplankton species and abundance. Horizontal variability was investigated by the continuous monitoring of nutrients, surface fluorescence and $T^{o}c$ and S^{o}/oo on a series of legs between sampling stations.

EQUIPMENT PERFORMANCE AND OVERALL CRUISE SUCCESS

Despite losing a total of four days working time because of bad weather the majority of the sampling and experimental objectives were met. 4½ days were spent on station at CS2, 1½ days at the shelf-break. Only the south-westerly sampling leg was worked, there being insufficient time to sample the transect into Carmarthen Bay. No major breakdown of equipment occurred. There was some slight malfunctioning of IMER equipment. A minor breakdown occurred to the NH_4 analyser during the early stages of the cruise which necessitated a replacement part being flown to the Scilly Isles. The Silicate Channel on the Technician analyser was non-functional for the whole of the cruise. Several breakdowns were experienced with the chlorophyll sensors; for approximately 2/3 rds of the cruise only one sensor was operational. The performance of the 2 1 bottle holders for the in situ light rig was satisfactory. One set of bottles was lost on the first deployment by dragging on the ship's quarter during recovery and 2 sets lost during the final deployment possibly caused by a run-down by a vessel. The NO_x analyser functioned adequately at sea.

The ship and RVS equipment performed satisfactorily. There was a slight malfunction on the dredge which necessitated hand operation on two occas ions. There were some electrical problems in the main laboratory caused by the low rating of the ring circuits (6 amps). The constant temperature facility operated satisfactorily. The NIO water bottles supplied by RVS required constant running repairs to keep them in service. It is felt that the ship's non-toxic water supply is unsuitable as a sampling device for critical bio-chemical analyses.

A preliminary examination of the data obtained on this cruise suggests that the cruise was divisible into two distinct periods:

(a) 8 - 14 April, the first visit to CS2 and the shelf break.

(b) 14 - 17 April, the second visit to CS2.

During period (a), chlorophyll concentrations were found to be in the region of approximately 0.5 $\mu g\ l^{-1}$: no vertical structure of any of the measured variables was apparent. Nutrient concentrations were high, however, NH_4 concentrations were low (approximately (0.5μM). Size fractionated ^{14}C productivity measurements (see Table 1) showed that the majority (43%) of the surface activity was in the largest size fraction. A significant proportion of the ^{14}C activity was also found in the smaller size fractions. ^{3}H - thymidine uptake ($\bar{x}$ for all depths = 540, range 318 - 1012 DPM) showed slightly elevated values at 5, 10 and 20m depth.

No large horizontal variation of any variable was apparent during the horizontal transect between CS2 and the shelf break although a gradual increase in temperature and salinity was observed (8.9°C and 34.9°/oo at CS2; 12.2°C and 35.6°/oo at the shelf break). The zooplankton observed during this first period appeared to be in good somatic condition.

Chlorophyll and nutrient concentrations at the shelf break were similar to those observed at CS2. There was some evidence of elevated NO_3^- concentrations at depth (400 + M) suggestive of possible upwelled nutrient inputs. ^{3}H-Thymidine incorporation was lower at the shelf break than at CS2 ($\bar{\bar{x}}$ for depths <200m 192, range 117 - 297 DPM) with no detectable incorporation above the blank at depths > 200m. ^{14}C activity (Table 1) was greatest in the 0.8 - 5 μm size fraction.

On the return to CS2 it was found that the chlorophyll concentrations had increased markedly (1 - 1.5 $\mu g l^{-1}$) and preliminary evidence from Coulter counts indicated an increase in both particle number and volume. The temperature increased by 0.5°C between the 8th and 14th April in response to the period of very calm weather experienced; no vertical temperature structure was apparent. ^{14}C activity was greatest in the largest size fraction (>5μm) with an increasingly large proportion compared with the first period. The absolute values of ^{14}C DPM were greater than twice those observed previously at CS2 and at the shelf break, however, little significance can be placed on these data until they have been normalised for light and chlorophyll. ^{3}H - Thymidine incorporation was considerably greater than previously observed ($\bar{x}$ for all depths 1,380 range 254 - 4931) with a pronounced maximum in the surface 10m. Of considerable interest was the vertical profile of nutrients observed during the second time series investigation. There was an apparent depletion of NO_3 and NO_2 of the order of 15 - 30% in the surface 20m compared with concentrations at depths greater than 20 - 25m. There was some slight evidence of structure within the depleted zone. The degree of depletion varied over the 36 hour period of investigation and may have been caused by diurnal variations in the <u>in-situ</u> assimilation and regeneration processes; it is, however, unclear at this time to what extent horizontal variability in nutrient concentrations may have contributed to the apparent temporal variations. Zooplankton were again observed to be in good somatic condition and preliminary evidence from feeding experiments indicates that ^{14}C - labelled natural particulate material was incorporated into the zooplankton biomass.

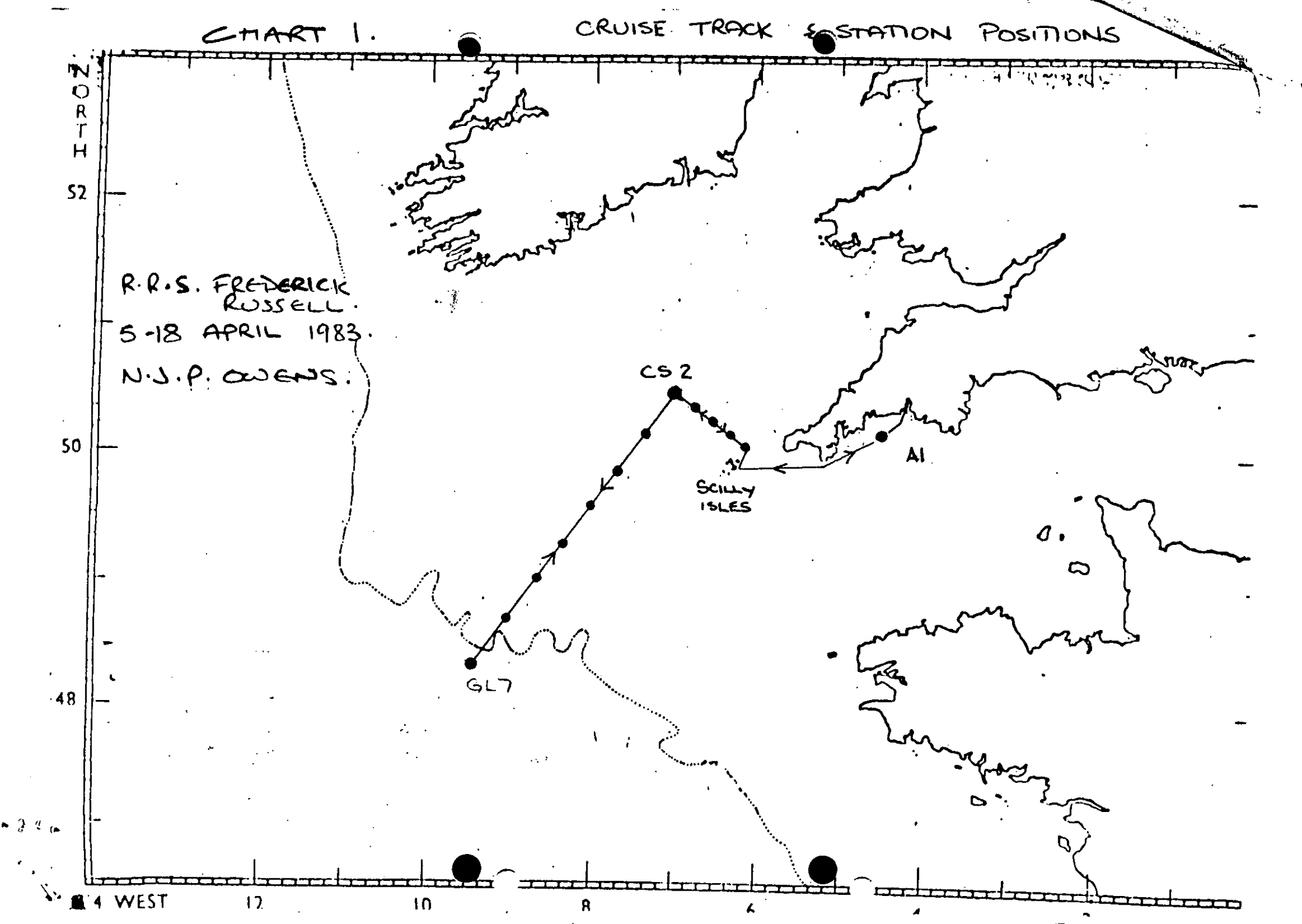
CHART 1. CRUISE TRACK & STATION POSITIONS
R.R.S. FREDERICK RUSSELL.
5-18 APRIL 1983.
N.J.P. OWENS.
CS 2
A1
SCILLY ISLES
GL7
NORTH
52
50
48
4 WEST
12
10
8
6

TABLE 1 PERCENT ^{14}C INCORPORATED INTO VARIOUS SIZE FRACTIONS DURING FOUR IN-SITU INCUBATIONS

SIZE FRACTION ↓ / SAMPLE DATE →	← CS 2 →			SHELF BREAK
	9/4	16/4	17/4	14/4
5 um	43	53	61	26
0.8 - 5 um	34	32	29	52
0.2 - 0.8 um	22	14	9	22