

John Wallace

DIVISION OF FISHERIES

1995 RESEARCH VESSEL PROGRAM

CRUISE PLAN

**FRV SOUTHERN SURVEYOR
CRUISE SS1/95**

14 JANUARY - 3 FEBRUARY 1995

**CSIRO DIVISION OF FISHERIES
MARINE LABORATORIES
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ITINERARY

DEPART: HOBART 10:00 HRS SATURDAY, 14 JANUARY 1995

RETURN: HOBART 15:00 HRS FRIDAY, 3 FEBRUARY 1995

AREA OF OPERATION

West and south of Tasmania between 40°S - 53°S, and 140°E and 148°E.

RESEARCH BACKGROUND

One of the objectives of the INRE Climate Research Program is to identify and understand the interactions of the physical, chemical and biological processes controlling the pools and fluxes of carbon within and between the atmosphere and the ocean in the Southern Ocean in the Australian region. The sub-tropical convergence zone (STCZ), subantarctic front (SAF) and the subantarctic zone between 40° and 55°S are known to be important global sinks of atmospheric CO₂. The physical, chemical and biological factors responsible for drawing down CO₂ in surface waters in this zone are still a subject of international research. It seems probable that both physical factors (cooling of subtropical water advected south) and biogeochemical factors (biological production and export of organic carbon, supported by nutrients supplied by Antarctic water advected north) contribute to this draw-down. Quantifying these processes, and predicting their response to changes in ocean climate and circulation, will be carried out by the analysis of repeat sections of biogeochemical properties, and through the development of process-based models of carbon and nutrient cycling based on field observations and experiments. The repeated sections are being carried out along the SR3 line as part of the WOCE series of cruises on *Aurora Australis*, and a repeat of this *Southern Surveyor* cruise in November 1995 (see below).

The Marine Carbon Cycles Project is carrying out this research as part of an international research program, the Joint Global Ocean Flux Study. This cruise will provide a first look at the physical, chemical and biological environment in the region, and will allow cruise planning for two major opportunities for international collaboration. First, a U.S. JGOFS Southern Ocean program conducting similar studies east of New Zealand is expected to start in the November-December 1995 time frame. More importantly, a major multi-disciplinary international experiment (ACE-1) is planned for the waters south of Australia in this period. This experiment will primarily address atmospheric chemistry and cloud dynamics over the Southern Ocean. It will focus especially on sulphate aerosols which are thought to form the principal cloud condensation nuclei in this region, and to derive primarily from DMS produced by phytoplankton. The DMS-aerosol-cloud link is regarded as one of the major uncertainties in feedbacks in climate models. The experiment will involve a

large team of US and Australian scientists, US research aircraft, and one US NOAA research vessel. A group of US oceanographers are planning to participate in the experiment, to look at atmosphere-ocean exchanges.

Previously, data have been collected in the Convergence Zone east and directly south of Tasmania. The proposed cruise will sample an area west of Tasmania where very little is known about the latitudinal variations in nutrients, trace elements, primary production and carbon dioxide in north of about 50°S. This region is expected to provide an interesting contrast, in that the input of subtropical water from the East Australian Current should be much reduced or absent. It is thought that inputs of iron from atmospheric aerosols to surface waters are also lower west of Tasmania. Comparisons of properties along sections and results from biological process experiments obtained east and west of Tasmania should throw light on competing hypotheses about the role of physics and biology in CO₂ draw-down, and the effects of iron in regulating phytoplankton production. A major reason for holding this experiment west of Tasmania is the long time series of atmospheric chemistry measurements made at Cape Grim. A number of the atmospheric variables measured at Cape Grim, including oxygen, ammonia and nitrate, potentially provide information about large scale changes in ocean biology upstream of Cape Grim. The data collected in this experiment will improve understanding of the relationship between ocean biology and atmospheric composition, and potentially help to open another window on seasonal and interannual variation in the Southern Ocean.

CRUISE OBJECTIVES

1. To characterise the in-situ optical properties, including spectral absorption and upwelling and down-welling spectral irradiance in different water masses west of Tasmania. (Parslow)
2. To determine how carbon fluxes, measured by primary production, direct measures of growth rates, sedimentation, microzooplankton grazing, and respiration vary in response to differences in chemical and physical forcing in different water masses west of Tasmania. (Parslow/Griffiths)
3. To determine dissolved and suspended particulate carbon concentrations with respect to vertical and mesoscale oceanic structure, and to compare these standing stocks with primary production estimates. (Trull)
4. To determine the isotopic composition of phytoplankton carbon and nitrogen to examine the validity of using sedimentary organic matter isotopic compositions as tracers of surface-ocean paleo-CO₂ and paleo-productivity. (Trull)
5. To determine the mixed-layer distribution of dissolved Fe, Mn, and Al in relation to dissolved organic carbon concentrations and phytoplankton biomass, in order to explore the possible control of organic matter production and transformation in nutrient-rich waters by trace-metal availability. (Sedwick)
6. The acoustic backscatter of organisms at 12, 38 and 120 kHz will be recorded continuously as part of a long term study to describe the distribution and movement of biological organisms in the Southern ocean. (Kloser)

CRUISE PLAN

Southern Surveyor will leave Hobart and head for 53°S, 140°E, and then transect up 140E until low nitrate, subtropical water is reached about 42°S. We will then steam towards Cape Grim, and conduct a station just off the shelf break near 40 45°S, 144 °30E, and then transect to Hobart. We plan on conducting 6 process stations, each taking between 44-48 hours, at the following locations:

LOCATION	
53°S, 140°E	in the Polar water mass
51°S, 140°E	in the Subantarctic Front (move as necessary)
47°S, 140°E	N of the Subantarctic Front in the southern Subtropical convergence zone
44° 30S, 140°E	in the northern Subtropical convergence zone
42°S, 140°E	in low nitrate, subtropical water, and begin Cape Grim transect (move north if necessary)
40° 45S, 144° 30E	off shelf break, Cape Grim

As time permits, CTD casts will be made at intervals of 1° of latitude to a depth of 1000m to provide a section along 140°E and the thermosalinograph, fluorometer and autoanalyser will be run to obtain surface temperature, salinity, fluorescence and nutrients. CTD casts to 1000m and one additional 24 hour station may be worked along the Cape Grim transect if time permits.

Each process station will involve multiple CTD casts and casts with a kevlar line plus trace metal bottles to sample for iron and manganese. The free-floating sediment traps plus sample bottles for in-situ primary production (using both the 14C and oxygen methods) and phytoplankton growth rates will be deployed at each process station. A number of casts will be made using the prototype spectroradiometer during daylight.

The suggested cruise track and station time allocations are as follows:

STEAMING TIMES:

DEPART	ARRIVE	DISTANCE (n.mi)	TIME
Hobart	53°S, 140°E	660	60 hrs @ 11 kts
53°S, 140°E	42°S,140°E	660	55 hrs @ 12 kts
42°S, 140°E	40° 45S,144° 30E	210	18 hrs @ 12 kts
40° 45S, 144° 30E	Hobart	280	24 hrs

STATION TIMES AND STEAMING SUMMARY:

JOB	REQUIREMENTS	TOTALS
Total steaming time		157 hours
Station time	6 * 48 hr stations	288 hours
	10 * 1000m casts	20 hours
Total time required		465 hours
Total time available		504 hours
Weather allowance		39 hours

A substantial weather allowance has been incorporated because the cruise is in the region of the "Roaring 40's" and "Furious 50's".

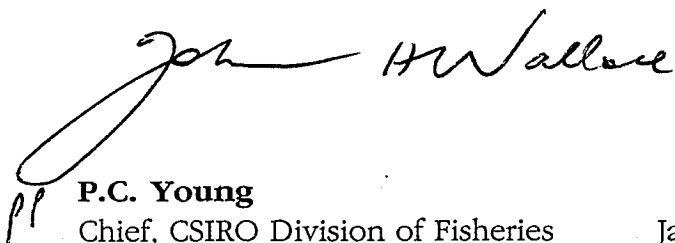
PERSONNEL

Dr. John Parslow (Chief Scientist)
Mr. Brian Griffiths (Cruise Leader)
Mr. Don McKenzie
Mr. Matt Sherlock
Mr. Lindsay McDonald
Ms. Kate Berry (OMS)
Ms. Val Latham (Division of Oceanography, OMS)
Dr. Peter Sedwick (IASOS)
Dt. Tom Trull (IASOS)
Mr. Ross Edwards (IASOS)
Mr Michael Mackey (IASOS)
Mr. Kazuhiko Matsumoto (Japan Marine Science and Technology Centre)

CONTACTS

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PP **P.C. Young**

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