FRANKLIN

National Facility
Oceanographic Research Vessel

TROPICS97

CRUISE PLAN

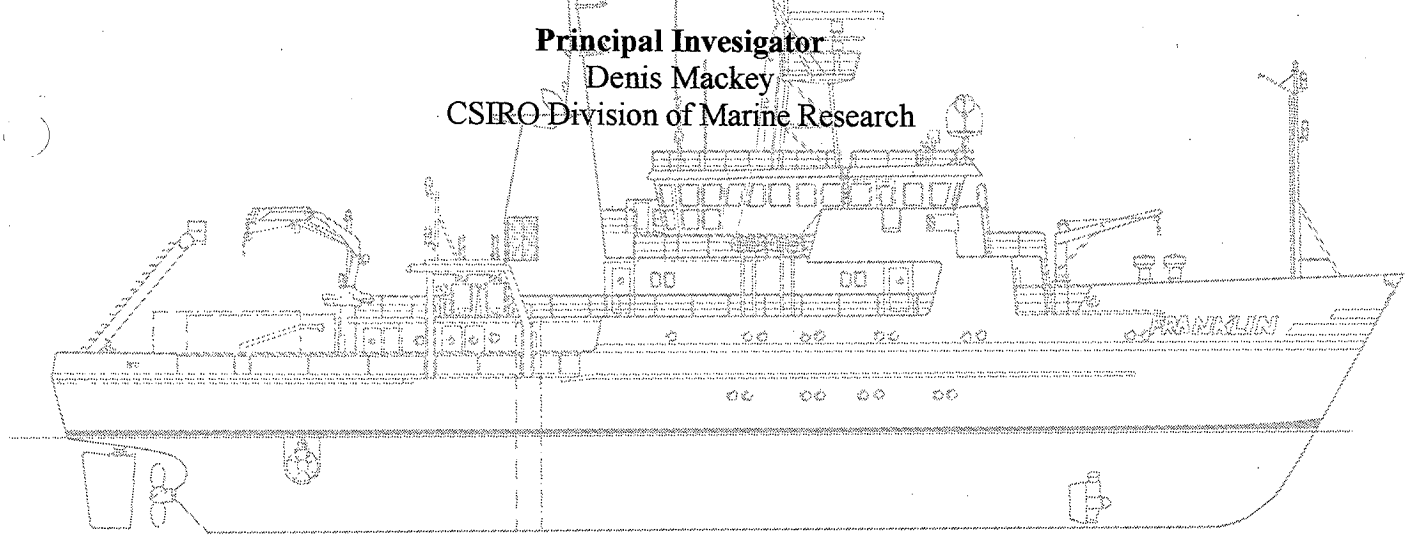
R/V FRANKLIN

Fr07/97

Depart:	Townsville	1000 hrs 4 August 1997
Arrive:	Madang	1000 hrs 22 August 1997

Project Coordinator
G.J. Brunskill
Australian Institute of Marine Science

Principal Invesigator
Denis Mackey
CSIRO Division of Marine Research



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AUSTRALIA

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1. Project Title

TROPICS (Leg 4)

2. Itinerary

Depart:	Townsville	1000 hrs 4 August 1997
Arrive:	Madang	1000 hrs 22 August 1997

3. Participants

Denis Mackey	Chief Scientist	CSIRO DMR
Harry Higgins		"
Ros Watson		"
Brian Griffiths		"
Don McKenzie		"
Kathy Burns		AIMS
Gillian Beck		U. of Melb.
David Smith		"
Mark Rayner		CSIRO ORV
Rebecca Deed		CSIRO ORV
Helen Beggs		CSIRO ORV
Dave Edwards		CSIRO ORV

4. Objectives of the research

The major objectives of this part of the TROPICS program would be to investigate the supply of nutrients, organics and trace metals to the equatorial region from the Sepik River. This supply will depend on a range of physical (river flow, mixing, current regimes), biological (biological uptake, light penetration, grazing) and chemical process (adsorption, desorption, precipitation, chemical transformation) that would necessitate a multidisciplinary approach. The is part of an integrated TROPICS program and will involve considerable interaction with other research groups.

The high sediment loadings in the river flows from the island of New Guinea are expected to have a major influence on the cycling of trace elements in equatorial waters. Over the past 5 years, the Equatorial Pacific JGOFS program has provided much information on the factors controlling the productivity of equatorial waters. Contrary to the widespread view that the productivity is driven by the supply of upwelling nutrients from waters originating in the eastern Pacific, it is now proposed that that the major supply of nutrients is the Equatorial Undercurrent (EUC). Lindstrom and Lucas have suggested that the EUC originates in waters flowing along the northern edge of New Guinea and hence rivers such as the Sepik may be a major source of nutrients for the whole equatorial Pacific. There are indications that iron may be a limiting nutrient and the trapping and/or release of trace elements,

particularly iron, at the interface between the fresh and saline waters and the recycling of these elements on the continental shelf may have an impact extending far beyond the region.

The biogeochemical cycling of trace elements is strongly coupled to that of organic matter since organic ligands can form complexes with trace elements and can be adsorbed by particles. Both of these processes have a major effect on the speciation and reactivity of trace metals. In addition, organic matter is involved in redox processes both in the euphotic zone and in the sediments. These processes may be biologically mediated and also affect the cycling of nutrients and trace elements such as iron and manganese.

Organic geochemical studies involving the use of specific organic markers have in the past been used investigate a variety of sedimentary environments. However, there are still several important issues to be addressed. It has recently been recognised that refractory organic carbon plays an important role as part of the total sedimentary carbon and ultimately as a precursor to kerogen. Much of this material is thought to be derived from the cell walls of algae but this study presents a good opportunity to assess possible terrestrial components to this material and to determine if there are any markers that can be used to detect it. A second issue is that organic geochemists frequently look at surface sedimentary material and make assumptions about the overlying water column. These assumptions may then be transferred to studies of ancient sediments and environments. However, it has never been fully established exactly what the sedimentary material represents as a representation of the total organic carbon input to the water column. Again, this study provides a perfect opportunity to assess this in a quantitative way.

Thus one of the objectives of this cruise is to identify organic biomarkers and isotopic signatures that can be used to trace sediment transport from riverine to oceanic regimes. Use of these biomarkers will, as part of the TROPICS studies allow comparisons of sediment deposition in estuarine and non-estuarine systems. Comparisons of labile and non-labile organic material will be useful to assess scavenging effects and how this relates to organic matter signatures in recent sediments, preservation and subsequent diagenetic products.

Measurements of biological productivity and phytoplankton biomass will enable us to assess the relative importance of nutrients (including micronutrients such as iron), light and grazing in this region. Sediment traps may be deployed both on the continental shelf and in the open ocean to determine the vertical fluxes of carbon and related elements. We will also measure the disequilibrium between naturally occurring actinides to provide an independent estimate of particle fluxes and to calibrate the collection efficiency of the sediment traps.

Some estimates of phytoplankton class abundances will be made by direct counting and these will be compared with estimates of class abundances from HPLC measurements of photosynthetic pigments. A program for calculating these abundances has been developed at the Division of Oceanography.

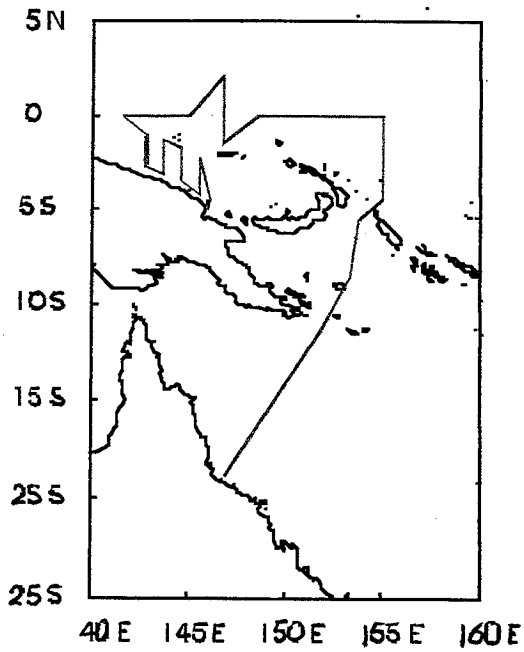
5. Time estimates

(based on 11.5 kt whereas the recommended speed is 11 kt)

Madang - 0, 155^{0}E - Townsville (≈ 3300 nm at 11.5 kt)	286 h
Casts (16 x bottom)	64 h

Casts (61 x 300 m)	61 h
Hydrocasts (10 x 300 m)	20 h
Contingency	24 h
Total	**455 h (19 days)**

6. Cruise Track



7. Nominal Station Positions and Casts

4 x Stations along:

3.0 ^{0}S, 145.2 ^{0}E to 4.5 ^{0}S, 145.2 ^{0}E
3.7 ^{0}S, 144.5 ^{0}E to 2.0 ^{0}S, 144.5 ^{0}E
1.5 ^{0}S, 143.5 ^{0}E to 3.3 ^{0}S, 143.5 ^{0}E
3.2 ^{0}S, 142.5 ^{0}E to 1.5 ^{0}S, 142.5 ^{0}E

16 x 2 casts to 300 m, 8 casts to bottom

Stations at:

0, 142 ^{0}E
0, 143 ^{0}E
0, 145 ^{0}E
2 ^{0}N, 147 ^{0}E
1.5 ^{0}N, 147 ^{0}E
1 ^{0}N, 147 ^{0}E
0, 147 ^{0}E

1 ^{0}S, 147 ^{0}E
1.5 ^{0}S, 147 ^{0}E
0, 149 ^{0}E
0, 151 ^{0}E
0, 153 ^{0}E
0, 155 ^{0}E

13 x 2 casts to 300 m
8 casts to bottom
3 stations to 300 m for ^{210}Po, ^{210}Pb
10 hydrocasts to 300 m trace metals

Total of 71 casts to 300, 16 to bottom

8. Equipment

Provided by *Franklin*:

CTD unit fitted with SeaTech, Transmissometer and light meter
24 x 10 L rosette
Hydrowinch (covered with polyethylene, no spooling gear, and fitted with kevlar wire)
Clean sheave and meter block for hydrowinch
Rear A-frame and conducting cable for Aquashuttle or Seabird
Clean Container
Biological Container
Clean cabinet installed in the GP lab
Scintillation counter
Thermosalinograph
GPS
ADCP
Underway fluorometer for chlorophyll (Turner)
Meteorological data
Nutrients (including NO_2 and O_2)
Liquid N_2 dewar (plus transfer tube)
As many 5 L and 10 L Niskin bottles as possible
Storage for acids and/or organics

NOTE: Request that all CTD data be processed at 1 m bin depth intervals

Provided by user:

OBS (to be interfaced to CTD if possible)
Aquashuttle and/or Seabird CTD to provide data between *Franklin* CTD casts
Conducting hydrowinch for Aquashuttle
Trace metal Helmond-Byrne bottles
Trace metal bottle fittings and messengers
Trace metal Niskin bottles
Kevlar hydrowire (4 mm) fitted to hydrowinch

Filtration systems
Transmissometer
Light meter
Fast repetition rate fluorometer and conducting winch (deployed from HIAB)
Fluorometer for humics (logged underway in place of one pH meter)
Fluorometer (WetStar) for chllorophyll (logged underway in place of one pH meter)
Liquid N_2 dewars
Equipment for collecting natural actinides
pH electrodes
Spectroradiometer
ISE electrodes for measurements of pFe and pCu

This cruise plan is in accordance with the directions of the National Facility Steering committee for the oceanographic research vessel *Franklin*.

C B Fandry
CSIRO Division of Marine Research

Prof. G W Paltridge
National Facility Steering
Committee