CRUISE REPORT: Repeat Hydrography on Line PR6:
WOCE Cruise No. 18DD9609/1

Chief Scientist: Philip Boyd
Ship: John P. Tully
Ports of Call: none
Cruise Dates: May 6 to May 30, 1996
Expedition Designation: 18DD9609/1

Cruise Narrative
Our repeat hydrography section continues to be a joint program with Canadian JGOFS.

A CTD survey along Line PR6 was completed. Salinity, oxygen and nutrients (NO3 & NO2, PO4 and Si) were analyzed onboard ship from rosette casts to 400 m and B-20 (bottom depth minus 20 m) at 5 stations (MP 04, MP12, MP 16, MP 20, and PRS1). DMS was analyzed in sea water at the same stations to a depth of 400 m. and at three different time periods at station PRS1. DOC/N was sampled in sea water at the same stations to 600 m and several deeper samples at station PRS1. The DON samples were analyzed onboard.

Free drifting sediment traps were deployed at MP04 to 300 m and PRS1 to 1000 m. and recovered two and six days later respectively. Sequential sediment traps were recovered and redeployed at stations MP04, MP12, MP16, MP20 and PRS1.

A transition zone survey was carried out north to south of line P from P11 to P09. Ten stations were sampled to 200 m by rosette and transmissometer. Samples were collected to 100 m for salinity, chlorophyll and nutrients.

JGOFS participants collected samples for biomass estimates at 5 stations, and incubated water to measure growth and grazing rates of various groups of plankton. A large volume in situ pumping system (J. Bishop) was successfully deployed at 6 stations.

Cruise Summary Information
Cruise track
Line PR6 starts at the mouth of Juan de Fuca Strait on the west coast of Canada, and heads almost due west for 900 n mi. The terminal station is PRS1, formerly designated Ocean Weather Station Papa (50 N, 145 W).

Table of Stations by type

Sample type:	No. stations:	Max. depth (m):
CTD casts	28	3000 db
Rosette/Hydro casts	14	4250
Loop samples	31	5
Surface drifter	1	1000 m
Moorings	1	4300 m

Floats, Moorings and Drifters deployed

A mooring with an optical package and S4 current meter, both in the mixed layer, was recovered and redeployed. A surface drifter that collects temperature and barometric pressure data was deployed at station PRS1 for AES. Sequential sediment traps were recovered and redeployed at 5 stations. A free drifting string of sediment traps was deployed at P04 and P26.

Principal Investigators

Howard Freeland	Ocean circulation	IOS
C.S. Wong	Climate chemistry	IOS
Frank Whitney	WOCE coordinator	IOS
Philip Boyd	JGOFS coordinator	UBC

Goals Achieved

CTD survey of Line PR6.
Successful Rosette casts at 5 stations on Line P.
Completion of JGOFS sampling for plankton and productivity measurements.
Six large volume pump stations on Line P for particulates.
Recovery of sediment trap samples from 6 traps.

Problems and Goals not Achieved

None.

Cruise Participants & Affiliations

Tim Soutar	Mooring coordinator	IOS
John Love	Watch coordinator	IOS
Bernard Minkley	Oxygens, watch	IOS
Ron Bellegay	Moorings, pC02, watch	IOS
Wendy Richardson	DMS, DOC/N	IOS
Janet Barwell-Clarke	Nutrients, WOCE files	IOS
Ken Morgan	Bird, mammal Observer, Watch	IOS
Philip Boyd	Phytoplankton	UBC
Robert Goldblatt	Zooplankton biomass	UBC
Hugh Maclean	Watch, plankton sampling	UBC
Nelson Sherry	Bacteria	UBC
Maureen Soon	particulate ^{13}C & ^{15}N	UBC
Delphine Thibault	Zooplankton excretion	Rimouski U.
Ken Crocker	Mesozooplankton grazing	Memorial U.
Paul Matthews	Bacterial production	Memorial U.
Jennifer Putland	Micro-zooplankton	Memorial U.
Jim Bishop	pump sampling	U. Victoria
Todd Mudge	pump sampling	U. Victoria
Robert Schultz	pump sampling	U. Victoria

IOS = Institute of Ocean Sciences, Sidney, B.C., Canada.
UBC = University of British Columbia, Vancouver, B.C., Canada

Measurement Techniques and Calibrations

CTD profiles

At all stations, a Guildline 8715 CTD (S.N. 58483) coupled with a transmissometer was lowered to a maximum of 3000 m.

Water sampling

A rosette holding a Guildline WOCE CTD (S.N. 59607) and 23-10 L polycarbonate Niskin bottles was used for most water sampling. Go-Flo bottles clamped on Kevlar hydro line were used to collect clean water for plankton studies.

At each station, samples for surface chlorophyll, salinity and nutrients, and O18 were collected from the ship's sea water loop which pumps water from about 5 m continuously into the laboratory.

Salinity

Samples were collected in glass bottles and analyzed onboard ship using a Guildline Model 8410 Portasal. The Portasal was standardized daily with IAPSO standard sea water Batch P128.

Oxygen

An automated titration system (Brinkman Dosimat and Fiber Optic Probe Colorimeter) using the micro-Winkler method (Carpenter, 1965), titrated samples to the iodine end-point. Standards were prepared as outlined in WOCE Report 73/91.

Nutrients

Samples from hydro casts were collected in polystyrene tubes and refrigerated for a maximum of 12 h before being analyzed. Loop samples (USW) were stored up to 2 days at $4^{o}C$ before being analyzed. NO_3+NO_2, PO_4 and Si were analyzed using a Technicon Autoanalyzer.

NO_3+NO_2 samples were reduced with Cd/Cu, then complexed with sulfanilamide and N-Naphthylethylene-diamine to form an azo dye (Technicon Method No. 158-71W/B). PO_4 produces a molybdenum blue complex in presence of acidic molybdate and ascorbic acid (Technicon Method No. 155-71W). Dissolved Si also forms a molybdenum blue complex and oxalic acid removes PO_4 interference (Technicon Method 186-72W).

Concentrated standards were freshly prepared the week before the cruise from oven dried reagents. Working standards were made every 1 to 2 days by diluting 1 to 6 mL of various stock solutions to 250 mL with 3.2% NaCl (w/v in double run Milli-Q water). Standards were checked against Acculute Standards (Anachemia Science) with good agreement (peak heights agreed to within 1%).

Silicate samples 105 to 95 (1000 to 3600 m) from Station MP16 are flagged Quality 3. The standards run as samples on this day were low. The high standard should have been 135 uM and was actually 129.2 uM and the extra high standard should have been 180 uM and was actually 175 uM. Nitrate and phosphate standards were not affected, indicating a problem with the silicate channel only.

Table. Laboratory temperatures for nutrients and salinity.

date	temp (C)	date	temp (C)
May 9	24.1 - 26.1	May 13	24.0 - 21.0
May 16	22.5 - 23.8	May 19	23.5
May 20	22.7 - 22.3	May 21	22.4 - 23.5
May 24	21.3 - 23.7	May 26	23.1 - 24.1

May 27	27.2 - 27.5	May 28	27.8 - 28.1

TCO_2, ^{13}C, and Alkalinity, were collected at MP04, MP12, MP16, MP20 and PRS1. Samples were fixed with $HgCl_2$ and refrigerated.

O18/O16 - samples were collected in 60 mL polyethylene bottles at stations MP04, MP12, MP16, MP20, and PRS1 and refrigerated.

JGOFS sampling - Go-flo bottles were used to collect water for POC/N, DOC/N, chlorophyll, nano- and micro-plankton and incubation experiments. At PRS1, an *in situ* drifter was deployed for 7 h to measure primary production rates. Deck incubations were conducted to measure growth rates of bacteria, phytoplankton and micro-zooplankton.

References

Carpenter, J.H. 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. Limnol. Oceanogr., 10: 141-143.

Technicon Industrial Method No. 155-71W. 1973. Orthophosphate in water and seawater.

Technicon Industrial Method No. 158-71W/A. 1977. Nitrate and nitrite in water and seawater.

Technicon Industrial Method No. 186-72W/B. 1977. Silicates in water and seawater.

WOCE Report 73/91. 1991. A comparison of methods for the determination of dissolved oxygen in seawater.