“Beagle 2003”R / V Mirai

Report Leg 1

(Brisbane – Papeete)

August – September

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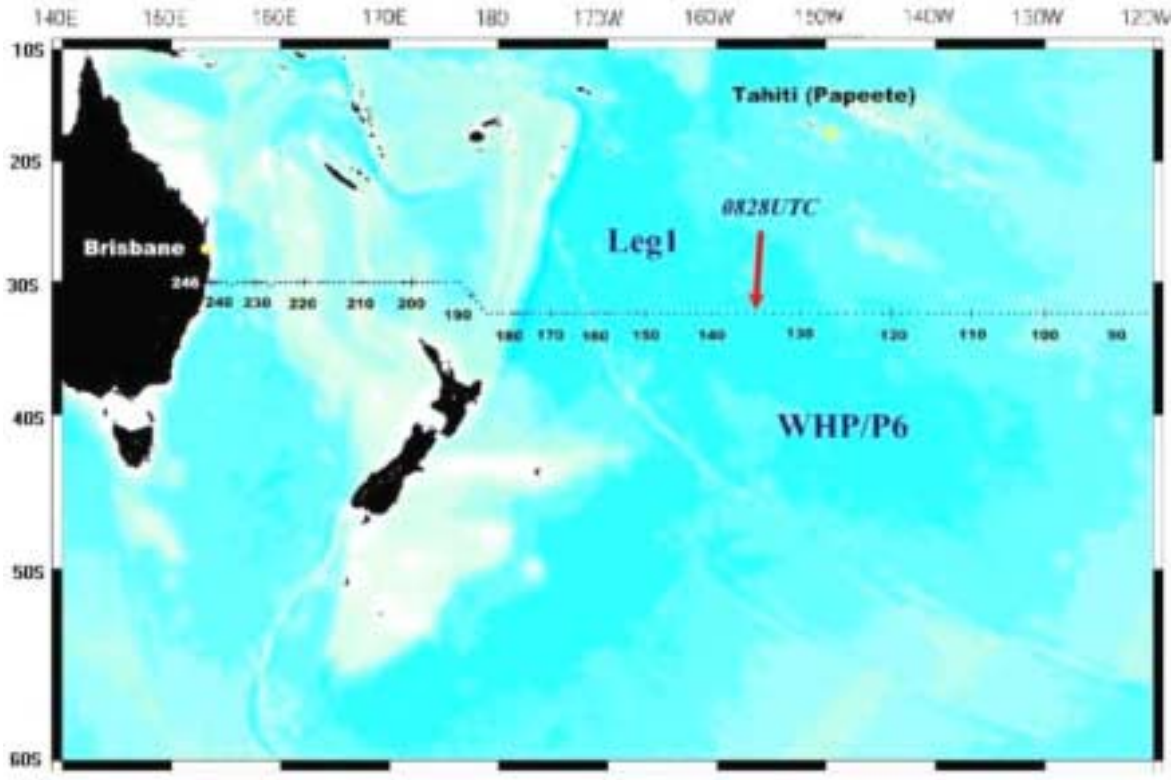
introduction

The **B**lue **EA**rth **GL**obal **E**xpedition 2003, "**BEAGLE 2003**", is an oceanographic research program developed by Japan Marine Science and Technology Centre (JAMSTEC). The principal objective of this is to enhance oceanographic research activities in Southern Hemisphere, in accordance with the Sao Paulo Declaration (POGO, 2000).

As part of this program, a series of stations were stipulated across the distance between Brisbane city (Australia) and Papette city (Tahiti) in the Pacific Ocean (sea map 1).



Map 1

Details of the cruise realized across the Pacific Ocean. Leg 1 started at Brisbane (Australia) and ended at Papeete (Tahiti) August / September 2003.

This cruise was done on board the R/V Mirai (Picture 1).

Picture 1
R/V Mirai JAMSTEC.

At each station during this cruise different types of analyses were made onboard. In general, these analyses included:

★ Water samples for measuring and analyzing chemical and biological variables.

★ Profiles of physical properties of water column

★ Bio-optical measurements.

The work groups on board consist of people from different places and with different backgrounds. The group from Japan had researchers, technicians and personal from Marine Works Japan and also the crew of R/V Mirai. In total the group had 71 persons. On the other hand, our bio-optical group is composed of 4 persons from different countries who are working on different fields of studies, Mr. Brian Irwin (BIO – Canada), Mrs. Kanthi Yapa (Univ. of Ruhune – Sri Lanka), Mr. Andreas Albertino (Indonesia) and me, Ms. Elena Barbieri (Argentina). Our principal objective during this cruise is to estimate the primary production as well as the pigment composition and light absorption by these small cells across this line in the Pacific Ocean and the variation on light conditions at the sea surface of the ocean.

OUR DAYS ON THE R/V MIRAI

The first day that we arrived to the ship the crew and all the people who came from Japan were so kind during our accommodation and helped us on everything. After of a small touring on the ship, we started to organize our lab, putting all the things that we would need during the trip in a safer place, holding them with stretching wires. Also we got familiar with the instruments and with the help of manuals that we would use during the trip.

On 2nd Saturday afternoon, the scientist responsible for the project, Dr. Fukasawa, organized the first meeting at the conference room for all the people who took part in this trip. The subject of this meeting was to explain the arrangement of the cruise (i.e. safety strategies, areas off limit). They also explained in detail all the things that we had to know about the sampling system as well as the teams in which we had been designated for this activity. In this meeting, all of us were notified to introduce our selves about the activities that we take part in our own countries. When this meeting was finished, the captain of the vessel Mr. Hashimoto organized a routine safety strategy in case that we would have to leave the ship in the middle of the trip. The crew of the ship shown us each step to follow as well as the correct way to reach our respective lifeboats and all necessary things for a safe environment.

The departure

During the beautiful sunny Sunday morning, JAMSTEC had organized a traditional celebration for the Mirai's departure. In this celebration, after short speeches of Dr. Masso, an official fromJAMSTEC as well as the Captain of the vessel, a big container of sake was opened with wooden hammers and all drank for a good and safe trip (Picture 2).

Picture 2
Sunday 03rd August. Typical japanese celebration before the Mirai's departure.

Our departure was around 11 AM on 3rd August 2003 from Brisbane port (Australia) directly to Papette (Tahiti) (Picture 3).

Picture 3
View of Brisbane city from the sea after the departure. Sunday 3rd August.

Laboratory work

During the first day, we carried out the first P vs. I experiment and also we started with light measurements at sea surface. These experiments continued during all through the leg. Basically our activities during the leg were:

- Primary production measurements.

These experiments were done twice a day, one during the morning and the other during the afternoon when the weather conditions allowed it. The samples were taken from around 5 metres depth using two Niskin bottles from the CTD rosette, or manually using a Niskin bottle or a bucket (Picture 4).

Picture 4
The water samples were taken using Niskin bottles from the rosette or manually using a bucket.

In the lab, the samples were mixed with 1 ml of carbon 13 (0.2 mmol) per litre of sample in a carboy and put in individual polycarbonate bottles (125 ml). The bottles with carbon 13 were incubated for 3 hours in the PI light box (Picture 5).

Picture 5
Working at the lab preparing the samples for incubation.

Inside of the box the irradiance received by the cells varied from 1.21 10^{17} to 0.745 10^{17} Quanta * cm^{-2} * sec^{-1}. Likewise, we had a dark treatment that was put in the same water bath but in a different place (Picture 6).

Picture 6

Different parts of the PI box. There are the filters that attenuate the light, the light source and finally the control temperature bath where the dark treatment was put during the incubation.

After the incubation period, the samples were filtered in-groups of three bottles (i.e. 1,2,3 – 4,5,6) through a 25-mm GF/F filter. It is important to say that the filters were pre combusted as requested by the method. After the filtration, the filters were put in individual glassine envelope and dried (Picture 7). All the samples that we collected will be analyse at Concepcion (Chile) after the cruise. The light measurements at each bottle position were done once every evening.

All the station and the ID number are described on table 1 on annex 1.

Picture 7

Here are the filtration system and the envelopes, with the identification number written on it, where the filter was put after the sample filtration. Also, the extraction vials containing 10 ml of acetone for pigments extraction are shown here.

Others analysis and determination.

Collected samples had been analyzed for following:

★ Photosynthetic Pigments:

Chlorophyll-a and phaeophytin concentrations were determined using a Turner Fuorometer in each daily sample. One hundred millilitre of sample water was filtered onto 25 mm GF/F filter and put into a vial containing 10 ml of acetone (85%) (Picture 7). The vials were kept into the freezer for 24 hours for total extraction. After this period, the samples were read on the fluorometer and the chlorophylls and phaeophytin concentration were calculated before and after acidification (table 1 in annex 1). It should be mentioned that all of these measurements were done by triplicate.

These pigment determination were done under a different situation as well. As I mentioned in the first paragraph, the surface samples were collected during the day and in the evening (we used the flow-through system) (Picture 8). However, after station number 166, we had to start collecting samples from Niskin bottles of the rosette at different depths

(i.e. 10, 50, 100, 150, and 200m) because the fluorometer on CTD rosette was broken. The data were shown in table 2 (Annex 1).

Picture 8

This fluorometer which continuously measures fluorescence of surface water, is in the second deck of the ship next to the flow-through system. On the right is the flow through system where chlorophyll samples were taken daily in the evening.

★ Particulate Absorption Measurements:

The particulate absorption measurements were determined using a Carey BIO 50 UV/VIS spectrophotometer (Picture 9), the scanning was always done from 250 – 750 nm. Two water samples, approximately 2 litres per sample, were filtered onto 25 mm GF/F filter. One of the samples was frozen in liquid nitrogen and later put in the freezer at –80 degrees, and the other sample was analysed on board using the spectrophotometer. The sample absorption was contrasted with filtered seawater blank.

Picture 9

The top picture shows the spectrophotometer Cary BIO 50 UV/VIS and the computer which the data was stored. Below picture shows the spectrophotometer with lid open and the cuvette support. On the spectrophotometer is the cuvette that was used for the CDOM analysis.

★ Coloured Dissolved Organic Matter (CDOM):

Water sample was filtered through a 47mm 0.2 µm nucleopore membrane filter that was in 10% HCL solution for 15 minutes. After a few washes, the water sample collected in the Erlenmeyer was kept in a clean vessel. After that, the CDOM was analysed from 250 to 750 nm using quartz cuvette (10 ml) in the Cary 50 BIO UV/VIS spectrophotometer (Picture 9). Millipore water was used like a blank.

★ High Performance Liquid Chromatography (HPLC):

Duplicate samples were collected daily for determining phytoplankton pigment compositions. The samples will be analysed after the leg using the high performance liquid chromatography (HPLC). Approximately two litres of water samples were filtered onto 25-mm GF/F filters. After that

the filters were wrapped in individual aluminium paper and kept inside of a cryo-vial in liquid nitrogen and frozen later at -80°C. (Picture 10).

Picture 10

The liquid nitrogen container and the moment when the samples were placed inside.

★ Flow cytometric analysis of Picoplankton photosynthetic cells

The picoplanktonic cells are small cells (less than 2 µm) that are impossible to see using conventional microscopic techniques. For this reason, we collected phytoplankton samples for later analysis using a flow cytometry. An aliquot of sample (1.8 ml) was put in a cryo-vial and 0.2 ml of Para formaldehyde was added for the sample conservation. After 10 minutes, the samples were kept at –80 degrees until future analysis (Picture 10). These samples, like others, were done by duplicate.

Light measurements.

The light measurements were done at each station (See details on table 3 - annex 1) during the day. These measurements were recorded using three different instruments:

★ Simbad 07:

This instrument is a hand-held battery operated radiometer (Picture 11). It collects data in five spectral bands which are centred at 443, 490, 560, 670 and 870 nm and has a GPS antenna as well. This instrument measures direct sunlight intensity by viewing the sun and water leaving radiance by viewing the ocean surface.

Picture 11

Simbad 07. The left picture shows the front panel of the instrument and also the GPS antenna. The right picture shows another view of the instrument.

★ Simbada 21:

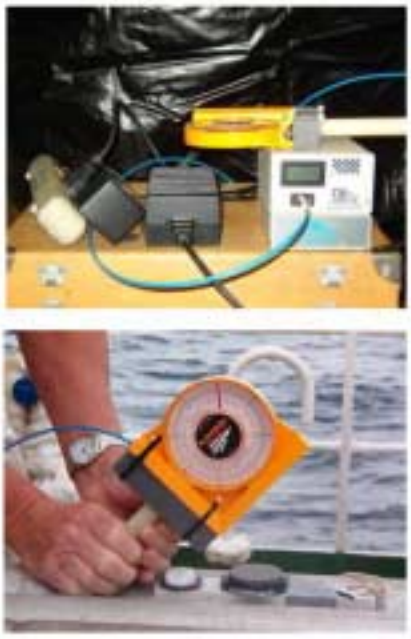
Simbada is another instrument that we used for taking light measurements during this cruise (Picture 12). This instrument is an above-water radiometer and it measures water-leaving radiance and aerosol optical thickness in 11 spectral bands. The bands are centered at 350, 380, 412, 443, 490, 510, 565, 620, 670, 750 and 870 nm. It has also a GPS antenna but in this case the antenna is built into the instrument.

Picture 12

Simbada 21. On the left there is the view of the front panel and on the right it shows the GPS antenna (the black box)

★ Ocean Optics Hyperspectral Radiometer:

Unlike the first two radiometers, this instrument measures the irradiance from 350 to 1000 nm at 0.5 nm intervals. This instrument has a special fiber optic which collects the irradiance from the sky and the sea surface. The downwelling irradiance is measured using a spectralon which could diffuse the incident irradiance (Picture 13).



Picture 13

In the top picture, the Ocean Optics Hyperspectral Radiometer with its accessories; In the bottom picture there is an example showing the correct position that the fiber optic has to be placed during the measurements.

Simbad 07 and Ocean Optics have software associated for data analysis but this is not the Simbada-21 case. So, data of Simbad 07 and Ocean Optic were pre-analysed to verify the validy of the data but the full analyses will be carry out at BIO in Canada after the cruise. The preliminary data are shown in Figure 1 and 2 (annex 2).

Others activities during the cruise:

Our trainees group not only have carried out bio-optical activities on the ship, we also took part on the activities of the JAMSTEC program. These activities were related to seawater sampling at each station during the cruise.

CTD sampling:

We were designated to different sampling groups for CTD and water samples. In my particular case, I was working almost the time in the early group (sampling time 3 AM to 3 PM). This group was consisted of participents from Marine Work Japan (WMJ) and sometimes technicians also came for sampling (Picture 14).

Picture 14

This is my sampling team taking samples, checking the basket and smiling for the picture after the hard work (up on the left).

During the CTD sampling, a lot of samples were taken for different analyses (Picture 15), in the following order:

a) DO - dissolve oxygen: this sample was the first of the list. We have to measure the temperature and after that the oxygen was fixed for later analysis. The analyses were done on board.

b) Salinity: these samples were taken using brown bottles which we had to wash 3 times before the sampling. The analyses were done on board.

c) PH: these were the taken using glass bottles with esmerile conic tap. We had to be careful with the bubbles that might be could keep inside of the bottles. The analyses were done on board.

d) DOC – dissolved organic carbon: these sample also were taken using glass bottles with esmeril conic tap and the bubbles were very important in this case too. The analyses were done on board.

e) C14: these samples were taken like the two last samples but these were prepared for later analysis in Japan.

f) Alkalinity: These samples were taken in small glass vessel (about 300 ml). The analyses were done on board.

g) Nutrients: these samples always were taken by duplicate in small tubes. The analyses were done on board.

h) DOM: these samples were taken in large glass tubes. The analyses were done on board.

i) CFCs: Sometimes samples for determining the CFCs concentration were taken using special bottles. These analyses were done on board.

Picture 15

The baskets in which the sampling bottles were carried next to the CTD for sampling. Down on the right there is a special bottle for CFCs sampling.

CTD data analysis:

The phytoplanktonic cells live in the upper layer of the vertical column structure of the ocean. For these reason the oxygen and temperature data collected by CTD sensor were analysed (Example plotted Figure 3 –

annex 2). These data shown that in general, the depth of the upper mixed layer was always around 150 meter and this is related to the values of pigments determined in the lab.

Acknowledgement

This trip was wonderful for me. I could learn so much and I gained a lot of experience and knowledge from the participents who were with me. But, this would not have happened if Dr. Shubha Sathyendranath and Dr. Trevor Platt not given me this opportunity. So, here I would to express my gratitude to them ... Thank you so much for trusting me.

I would like to thank Brian for the moments that he gave us, telling about his experiences and always trying to help us in everything. Also, I would like to thank Kanthi and Andreas for their helps and friendship.

I would like also to thank Dr. Massao for his help and all the person who were so kind throughout this trip.

Annex 1: Tables

Table 1

Details of all PI stations during the R/V Mirai cruise Leg 1. Also the chlorophylls-a and phaeophytin values were calculated in the last two columns.

	Sampling time		Time CTD								
Date gmt	GMT	LST	Start - End (gmt)	STATION #	LATITUDE	LONGITUDE	ID#	ROSETTE	NISKIN	BUCKET	CHL	PHAEO
4-Aug	2:30	12:30		PO6W-244	30 05.05S	153 35.90E	264001	X			0.701	0
4-Aug	1:15	11:15		PO6W-238	30 05.13S	154 29.80E	264003		X		0.323	0
5-Aug	2:15	12:15		PO6W-234	30 04.97S	156 31.78E	264005	X			0.202	0
6-Aug	7:15	17:15		PO6W-232	30 04.94S	156 55.26E	264006	X			0.233	0
6-Aug	0:00	11:00		PO6W-227	30 04.64S	158 40.96E	264008	X			0.302	0.006
7-Aug	4:00	15:00		PO6W-226	30 19.93S	159 04.98E	264009	X			0.552	0
7-Aug	21:50	8:15		PO6W-221	30 04.99S	161 30.26E	264011	X			0.311	0.013
8-Aug	1:15	12:15		PO6W-220	30 05.30S	162 10.00E	264012	X			0.241	0.001
8-Aug	0:00	11:00		PO6W-215	30 05.06S	164 49.90E	254014	X			0.492	0
9-Aug	4:30	15:30		PO6W-213	30 04.99S	165 24.50E	264015	X			0.253	0
9-Aug	0:15	11:15	1315 -1537	PO6W-212**	30 04.65S	166 29.48E	264017		X		0.232	0.006
10-Aug	2:15	13:15		PO6W-210	30 04.92S	167 29.90E	264019	X			0.263	0.003
11-Aug	5:30	16:30		PO6W-209	30 04.92S	167 59.90E	264020	X			0.262	0.002
11-Aug	23:30	10:30		PO6W-205	30 04.82S	169 59.82E	264022	X			0.256	0.027
12-Aug	3:45	14:45		PO6W-204	30 05.70S	170 29.94E	264023	X			0.298	0
12-Aug	23:00	10:00		PO6W-199	30 04.98S	172 29.92E	264025	X			0.199	0.018
13-Aug	2:30	13:30		PO6W-198	30 05.06S	172 59.95E	264026	X			0.22	0.011
13-Aug	21:00	9:00	1820 -2127	PO6W-194	30 04.86S	175 10.08E	264028			X	0.225	0.011
14-Aug	4:30	16:30		PO6W-X14	30 00.50S	176 00.60E	264029	X			0.383	0
14-Aug	23:00	11:00		PO6W-190	31 05.06S	177 32.25E	264031	X			0.316	0
15-Aug	4:30	16:30		PO6C-186	31 34.99S	177 59.20E	264032	X			0.319	0
15-Aug	22:00	10:00		PO6C-182	32 30.00S	179 55.06E	264034	X			0.3	0.008
15-Aug	2:00	14:00		PO6C-181	32 30.15S	179 34.98W	264035	X			0.361	0.023
16-Aug	23:00	11:00		XXXXXXXX	31 56.04S	177 19.05W	264037			X	0.31	0.006
17-Aug	21:45	9:45		PO6C-177	32 30.00S	178 17.02W	264039	X			0.248	0.001

17-Aug	1:30	13:30	2238 - 0240	PO6C-176	32 30.05S	178 00.03W	264040			X	0.295	0.022
18-Aug	21:00	9:00		XXXXXXXX	31 59.81S	177 19.76W	264042			X	0.338	0.005
19-Aug	3:30	15:30	0031 - 0444	PO6C-173	32 29.96S	176 45.08W	264043			X	0.294	0.002
19-Aug	21:15	9:15	1825 - 2208	PO6C-170	32 28.87S	175 15.29W	264045			X	0.297	0.026
19-Aug	2:00	14:00	2355 - 0340	PO6C-169	32 30.10S	174 50.13W	264046			X	0.301	0.014
20-Aug	18:40	6:40	2116 - 2317	PO6C-166	32 30.25S	173 39.97W	264048			X	0.299	0.049
21-Aug	2:00	14:00	0107 - 0503	PO6C-165	32 29.95S	173 10.39W	264049			X	0.287	0.024
21-Aug			1742 - 2036	PO6C-162	32 29.95S	171 55.03W	264056	X			0.245	0
21-Aug	1:00	14:00	2200 - 0112	PO6C-161	32 30.11S	171 35.07W	264062	X			0.229	0
22-Aug	21:00	10:00	1920 - 2255	PO6C-X15	32 30.15S	170 00.13W	264069			X	0.245	0
23-Aug	1:00	14:00	0041 - 0421	PO6C-156	32 30.02S	169 30.23W	264075			X	0.161	0.025
23-Aug	20:00	9:00	1717 - 2054	PO6C-153	32 30.11S	168 00.92W	264082			X	0.211	0.001
23-Aug	1:00	14:00	2257 - 0245	PO6C-152	32 30.15S	167 29.97W	264088			X	0.138	0
24-Aug	20:00	9:00	1619 - 2001	PO6C-149	32 29.87S	165 49.93W	264095	X			0.184	0.024
25-Aug	20:00	9:00		PO6C-148**	32 29.98S	165 09.97W	264101			X	0.161	0.048
26-Aug	2:00	15:00	0305 - 0748	PO6C-148**	32 29.98S	165 09.97W	264108			X	0.176	0.023
26-Aug	20:00	9:00	1749 - 2133	PO6C-146	32 30.05S	163 50.12W	264110			X	0.124	0.02
26-Aug	1:00	14:00	0005 - 0337	PO6C-145	32 29.94S	163 10.03W	264116			X	0.132	0.014
27-Aug	20:30	9:30	1803 - 2126	PO6C-142	32 29.94S	161 09.91W	264123			X	0.155	0.019
27-Aug	2:00	15:00	2340 - 0317	PO6C-140	32 29.72W	160 29.62W	264129			X	0.151	0.028
28-Aug	21:00	10:00	1820 - 2202	PO6C-137	32 30.04S	158 09.95W	264136			X	0.157	0.022
29-Aug	2:00	15:00	0053 - 0420	PO6C-136	32 29.73S	157 19.98W	264142			X	0.088	0.005
29-Aug	23:00	12:00	1937 - 2256	PO6C-133	32 30.17S	154 50.49W	264149	X			0.1	0.002
30-Aug	3:00	16:00	0149 - 0515	PO6C-132	32 30.00S	153 59.69W	264155			X	0.103	0.006
30-Aug	18:10	7:10	1642 - 1930	PO6C-130	32 29.95S	152 20.05W	264162			X	0.095	0.004
30-Aug	1:00	14:00	2223 - 0200	PO6C-129	32 29.92S	151 29.62W	264168			X	0.103	0
31-Aug	21:30	10:30	1804 - 2116	PO6C-126	32 29.98S	148 59.94W	264176	X			0.107	0
1-Sep	3:15	16:15	0008 - 0317	PO6C-125	32 30.13S	148 09.99W	264182			X	0.071	0
1-Sep	22:15	11:15	1837 - 2159	PO6C-122	32 29.97S	145 39.81W	264189	X			0.074	0
2-Sep	2:00	15:00	0051 - 0417	PO6C-121	32 30.35S	144 49.87	264195			X	0.06	0

Table 2

Details of the stations on which light measurements were done.

SIMBAD-07 Radiometer Log Sheet --- R/V Mirai Leg 1 (Brisbane, Australia ---- Papeete, Tahiti) 03 August - 06 September, 2003

Date(LST/UTC)	Station ID	Time (LST)/(UTC)	Latitude	Longitude
Aug. 04/	PO6W 244	/0145	30° 06.03S	153° 35.45E
Aug. 05/Aug.04	PO6W 238	0942/2342	30° 04.94S	155° 00.00E
Aug06/Aug. 05	PO6W 234	0905/2305	30° 04.97S	156° 31.78E
Aug07/Aug 06	PO6W 227	0830/2230	30° 04.64S	158° 40.96E
/Aug07	PO6W 226	/0230	30° 19.96S	159° 04.98E
Aug08/	PO6W 220	1045/0045	30° 05.03S	162° 10.00E
Aug08/	PO6W 219	1500/0500	30° 04.98 S	162° 49.78E
Aug09/	PO6W 215	0810/2110	30° 05.06S	164° 49.90E
Aug10/Aug09	PO6W 212	1000/2300	30° 04.66S	166° 29.48E
Aug11/Aug11	PO6W 210	1145/0045	30° 04.92S	167° 29.9E
Aug11/Aug11	PO6W 209	1500/0400	30° 04.92S	167° 59.9E
Aug12/Aug11	PO6W 205	0845/2145	30° 04.82S	169° 59.82E
Aug12/Aug12	PO6W 204	1300/0130	30° 05.07S	179° 29.94E
Aug13/Aug12	PO6W 199	0830/2100	30° 04.98S	172° 29.92E
Aug13/Aug13	PO6W 198	1350/0120	30° 05.06S	172° 59.95E
Aug14/Aug14	PO6W X14	1300/0100	30° 00.50S	176° 00.69E
Aug15/Aug14	PO6W 190	0930/2130	31° 05.06S	177° 32.25E
Aug15/Aug15	PO6C 181	1130/2330	32° 30.15S	179° 34.98W
Aug16/	XXXXX	1100/2300	31° 56.04S	177° 19.05W
Aug17/Aug18	PO6C-176	1230/0030	32° 30.05S	178° 00.03W
Aug18/Aug19	PO6C-173	1300/0100	32° 29.96S	176° 45.08W
Aug19/	PO6C 169	1200/2400	32° 30.10S	174° 50.13W
Aug20/Aug20	PO6C 166	1035/2235	32° 30.25S	173° 39.25W

Aug20/Aug21	PO6C 165	1450/0250	32° 29.95S	173° 10.39W
Aug21/	PO6C 161	1140/2240	32° 30.11S	171° 35.07W
Aug22/	PO6C X15	0910/2010	32° 30.13S	170° 00.13W
Aug22/Aug23	PO6C 156	1400/0100	32° 30.02S	169° 30.23W
Aug23/	PO6C 153	0900/2000	32° 30.11S	168° 00.92W
Aug23/	PO6C 152	1300/2400	32° 30.15S	167° 29.97W
Aug26/	PO6C 146	0930/2030	32° 30.05S	163° 50.12W
Aug26/	PO6C 145	1300/2400	32° 29.94S	163° 10.03W
Aug27/	PO6C 140	1310/0010	32° 29.72S	160° 29.62W
Aug28/	PO6C 137	1035/2135	32° 30.04S	158° 09.95W
Aug28/	PO6C 136	1400/0100	32° 29.73S	157° 19.98W
Aug30/	PO6C 129	1130/2230	32° 29.92S	151° 29.62W
Aug31/	PO6C 126	0900/2000	32° 29.98S	148° 59.98W
Aug31/Sep01	PO6C 125	1430/0130	32° 30.13S	148° 09.99W
Sep01/	PO6C 122	0945/2045	32° 29.97S	145° 39.81W
Sep01/Sep02	PO6C 121	1400/0100	32° 30.35S	144° 49.87W

Station# PO6C-165

ID#	DEPTH	CHLOR	PHAEO
264049	0	0.287	0.024
264050	10	0.364	0.007
264051	50	0.292	0.042
264052	100	0.184	0.049
264053	150	0.026	0.035
264054	200	0.009	0.035

Station# PO6C-148

ID#	DEPTH	CHLOR	PHAEO
264108	0	0.176	0.023
264102	10	0.153	0.018
264103	50	0.152	0.023
264104	100	0.157	0.024
264105	150	0.031	0.037
264106	200	0.008	0.006

Station# PO6C-132

ID#	DEPTH	CHLOR	PHAEO
264155	0	0.103	0.006
264156	10	0.103	0.004
264157	50	0.1	0.01
264158	100	0.11	0.011
264159	150	0.09	0.026
264160	200	0.031	0.026

Station# PO6C-162

ID#	DEPTH	CHLOR	PHAEO
264056	0	0.245	0
264057	10	0.242	0
264058	50	0.216	0.015
264059	100	0.154	0.019
264060	150	0.021	0.017
264061	200	0.009	0.008

Station# PO6C-146

ID#	DEPTH	CHLOR	PHAEO
264110	0	0.124	0.02
264111	10	0.132	0.026
264112	50	0.134	0.033
264113	100	0.136	0.024
264114	150	0.048	0.034
264115	200	0.013	0.006

Station# PO6C-130

ID#	DEPTH	CHLOR	PHAEO
264162	0	0.095	0.004
264163	10	0.093	0.003
264164	50	0.093	0.002
264165	100	0.095	0.004
264166	150	0.093	0.026
264167	200	0.001	0.038

Station# PO6C-161

ID#	DEPTH	CHLOR	PHAEO
264062	0	0.229	0
264063	10	0.214	0
264064	50	0.243	0
264065	100	0.197	0.012
264066	150	0.028	0.021
264067	200	0.011	0.009

Station# PO6C-145

ID#	DEPTH	CHLOR	PHAEO
264116	0	0.132	0.014
264117	10	0.119	0.006
264118	50	0.134	0.013
264119	100	0.077	0.03
264120	150	0.031	0.014
264121	200	0.004	0.006

Station# PO6C-129

ID#	DEPTH	CHLOR	PHAEO
264168	0	0.103	0
264170	10	0.094	0
264171	50	0.105	0.001
264172	100	0.11	0.008
264173	150	0.106	0.006
264174	200	0.04	0.021

Station# PO6C-X15

ID#	DEPTH	CHLOR	PHAEO
264069	0	0.245	0
264070	10	0.205	0
264071	50	0.199	0.031
264072	100	0.042	0.023
264073	150	0.014	0.013
264074	200	0.003	0.006

Station# PO6C-142

ID#	DEPTH	CHLOR	PHAEO
264123	0	0.155	0.019
264124	10	0.152	0.009
264125	50	0.161	0.016
264126	100	0.082	0.03
264127	150	0.061	0.058
264128	200	0.012	0.009

Station# PO6C-126

ID#	DEPTH	CHLOR	PHAEO
264176	5	0.107	0
264177	10	0.098	0.003
264178	50	0.101	0.005
264179	100	0.127	0.005
264180	150	0.079	0.017
264181	200	0.029	0.026

Station# PO6C-156

ID#	DEPTH	CHLOR	PHAEO
264075	0	0.161	0.027
264076	10	0.176	0.009
264077	50	0.192	0.051
264078	100	0.094	0.034
264079	150	0.025	0.021
264080	200	0.006	0.007

Station# PO6C-140

ID#	DEPTH	CHLOR	PHAEO
264129	0	0.151	0.028
264130	10	0.161	0
264131	50	0.154	0.01
264132	100	0.141	0.046
264133	150	0.019	0.011
264134	200	0.003	0.002

Station# PO6C-125

ID#	DEPTH	CHLOR	PHAEO
264182	0	0.071	0
264183	10	0.065	0
264184	50	0.072	0
264185	100	0.096	0
264186	150	0.092	0.032
264187	200	0.028	0.013

Station# PO6C-153

ID#	DEPTH	CHLOR	PHAEO
264082	0	0.211	0.001
264083	10	0.191	0
264084	50	0.206	0
264085	100	0.174	0.012
264086	150	0.031	0.014
264087	200	0.015	0.012

Station# PO6C-137

ID#	DEPTH	CHLOR	PHAEO
264136	0	0.157	0.022
264137	10	0.158	0.019
264138	50	0.156	0.019
264139	100	0.167	0.006
264140	150	0.031	0.019
264141	200	0.003	0.003

Station# PO6C-122

ID#	DEPTH	CHLOR	PHAEO
264189	0	0.074	0
264190	10	0.076	0
264191	50	0.077	0
264192	100	0.128	0.036
264193	150	0.099	0.036
264194	200	0.028	0.007

Station# PO6C-152

ID#	DEPTH	CHLOR	PHAEO
264088	0	0.138	0
264089	10	0.124	0.001
264090	50	0.174	0.01
264091	100	0.159	0.052
264092	150	0.028	0.015
264093	200	0.006	0.006

Station# PO6C-149

ID#	DEPTH	CHLOR	PHAEO
264088	5	0.184	0.024
264089	10	0.178	0.022
264090	50	0.169	0.029
264091	100	0.121	0.03
264092	150	0.026	0.015
264093	200	0.007	0.008

Station# PO6C-136

ID#	DEPTH	CHLOR	PHAEO
264142	0	0.088	0.005
264143	10	0.082	0.009
264144	50	0.111	0.017
264145	100	0.071	0.032
264146	150	0.017	0.011
264147	200	0.003	0.003

Station# PO6C-133

ID#	DEPTH	CHLOR	PHAEO
264149	5	0.1	0.002
264150	10	0.099	0
264151	50	0.118	0.008
264152	100	0.131	0.015
264153	150	0.072	0.063
264154	200	0.024	0.014

Station# PO6C-121

ID#	DEPTH	CHLOR	PHAEO
264195	0	0.06	0
264196	10	0.057	0
264197	50	0.064	0
264198	100	0.136	0.019
264199	150	0.08	0.053
264200	200	0.018	0.004

Annex 2

Fig. 1

Raw data from Ocean Optics instruments(12th August)

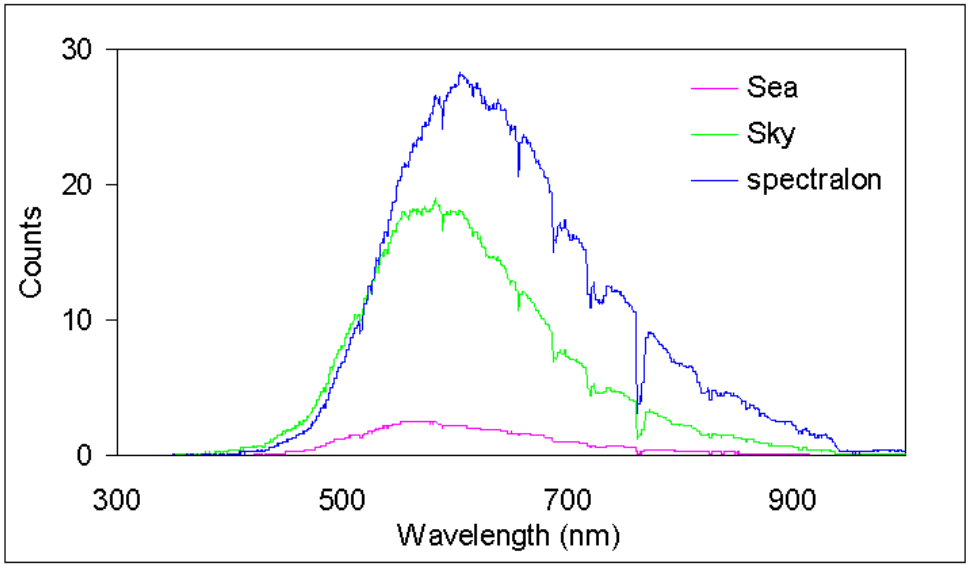


Fig. 2

Reflectance calculated using from raw data from Ocean Optics instruments(12th August)

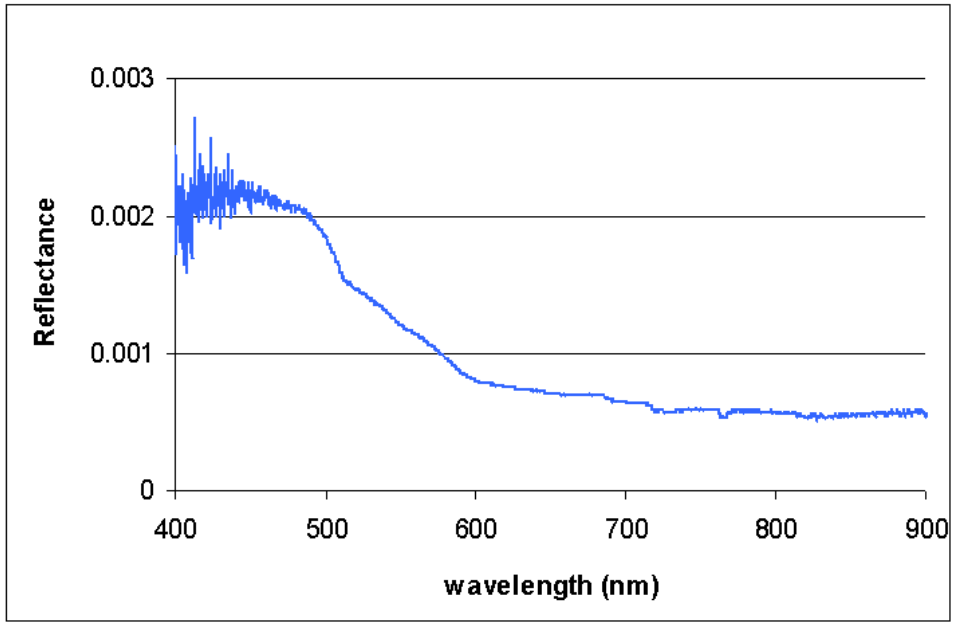


Fig. 3

Data from CTD instrument. There is the fluorescence in green, the temperature in blue and oxygen in pink.