doi : 10.17596/0003663

Cruise Report

BEGLE2003

MR03-K04 LEG.3

Oct. 19- Nov. 2, 2003

Valparaiso – Santos

BLANK

Cruise Report Contents

1. Preface

This volume includes the preliminary report of the MR03-K04 leg.3 cruise carried out by R/V MIRAI in the Chilean marginal area and Magellan Strait in 2003. The leg.3 cruise is a part of the program BEAGLE (Blue Earth Global Ocean Experiment), which is a whole round cruise of the Southern hemisphere and developed by JAMESTEC / POGO-IOCCG. The expedition started in Brisbane (Australia) to Tahiti (leg 1), and then to Valparaiso - Chile (leg 2) where started this leg 3 with destination Santos (Brazil). Main purpose of the leg. 3 is to reconstruct the glacial-interglacial change of paleo environment in the Chilean marginal area. We could collect sediment samples at fore stations (including sediment cores at the extra station in the Magellan Strait) and could successfully finish Bio–optical, Under way, Geological, Geophysical, Meteorological, Shipboard ADCP, Satellite and Atmospheric observations in the inside the Chilean Exclusive Economic Zone. On behalf of the scientists on board, I thank all Chilean authorities; Chilean Navy, the Ministry of Foreign Affair for allowing us to work inside the EEZ. During the process of application for the permission, many people in the Concepcion University in Chile and the Ministries of Foreign Affair and Education, Culture, Sports, Science and Technology of Japan have helped us significantly. Without their help, the cruise would have never been realized.

The cruise has been completed almost of what we planed. I really appreciate captain Akamine, and crew members for their hard works on board the ship. Finally, I would like to thank Chilean Pilots for their best advices about coring points and roots for safety navigation in the Patagonian channels.

MR03-K04 leg. 3 Cruise Chief Scientist
Naomi Harada
Japan Marine Science and Technology Center

2. Outline of the MR03-K04 leg. 3

2.1 Cruise summary

Naomi Harada
Japan Marine Science and Technology Center (JAMSTEC)

An area of the Chilean marginal area is characterized by high productivity due to coastal upwelling and cold sea surface water due to Humboldt Current, which is the largest eastern boundary current in the global oceans. At the subsurface water depth, low oxygen concentration zone presents along with Gunther Undercurrent from 20˚ to 45˚S, and Antarctic Intermediate Water, which has high oxygen, low nutrients and salinity presents at the depths 500–800m in the southern latitude from 35 ˚S. Thus, the Chilean marginal area has been recognized as a key area for biogeochemical cycle of carbon in the global oceans not only during the modern time but also over the past geological period. Despite its importance, there have been few systematic surveys to cover the temporal and spatial variation of biogeochemical processes in the area. Main goal of this cruise is to realize the historical change of the biological pump, sea surface water temperature and ventilation speed of the intermediate water during the past geological era, and to clarify the bio-optical dynamics in the surface water in the present time.

Based on the above-mentioned purpose, a cruise was planed to focus on the area along the Chilean marginal area and Magellan Strait.

R/V MIRAI left Valparaiso, Chile on Oct. 19, 2003 for the cruise and arrived at Santos, Brazil on Nov. 2. During its 15 days of the cruise, we have occupied 4stations for sediment core sampling and 12 stations for bio-optical observations. In the meantime, meteorological measurements, sea surface gravity measurement, surface three components magnetometer measurement, plankton sampling, underway measurement of chemical properties in sea water as well as temperature and salinity, satellite, and atmospheric observations such as aerosol and particulate carbon have been carried out continuously. Details of the observations are described in the following chapters.

2.2 Cruise Log

Naomi Harada (Japan Marine Science and Technology Center)

Table 2-2-1 Cruise log

UTC		Stn	Cast	Position		Unc	Equipment	Commentts
Date	Time			Latitude S	Longitude W	Depth (m)		
10.19	1800							Surface water pump on
10.20	800	1					Multinarrow beam	Site survey start
10.20	945	1		36 13.34	73 41.00	1017	Multinarrow beam	Site survey finish
10.20	1007	1	1	36 13.08	73 40.92	1017	Piston corer	Opelation start
10.20	1030	1	1	36 13.08	73 40.92	1017	Piston corer	Center wire set up
10.20	1037	1	1	36 13.08	73 40.92	1017	Piston corer	Pilot at water surface
10.20	1042	1	1	36 13.13	73 40.87	1015	Piston corer	Piston at water surface
10.20	1043	1	1	36 13.13	73 40.87	1015	Piston corer	Wire out start (Wire speed: 1.0m/s)
10.20	1048	1	1	36 13.13	73 40.87	1015	Piston corer	Swell-compensator on
10.20	1102	1	1	36 13.13	73 40.87	1015	Piston corer	Wire out stop (3min)
10.20	1105	1	1	36 13.13	73 40.87	1015	Piston corer	Wire out restart (Wire speed: 0.3m/s)
10.20	1110	1	1	36 13.34	73 41.00	1023	Piston corer	Piston reach at sea floor (Tension: 2.4ton)
10.20	1112	1	1	36 13.34	73 41.00	1023	Piston corer	Piston leave for sea floor (Tension: ??)
10.20	1126	1	1	36 13.34	73 41.00	1023	Piston corer	Swell-compensator off (Wire speed:0.8m/s)
10.20	1140	1	1	36 13.36	73 40.98	1023	Piston corer	Pilot at water surface
10.20	1200	1		36 13.00	73 41.00	1023		Solar light measurement
10.20	1206	1	1	36 13.26	73 40.82	1018	Piston corer	Piston at water surface
10.20	1325	1	1	36 13.00	73 40.63	1005	Gravity corer	Opelation start
10.20	1340	1	1	36 13.07	73 40.77	1005	Gravity corer	Wire out start
10.20	1344	1	1	36 13.07	73 40.77	1005	Gravity corer	Pilot at water surface
10.20	1350	1	1	36 13.14	73 40.84	1005	Gravity corer	Gravity at water surface (Wire speed: 0.8m/s)
10.20	-	1	1	36 13.14	73 40.84	1005	Gravity corer	Swell-compensator on (Wire speed:1.0m/s)
10.20	1410	1	1	36 13.14	73 40.84	1005	Gravity corer	Wire out stop (3min)
10.20	1413	1	1	36 13.14	73 40.84	1005	Gravity corer	Wire out restart (Wire speed: 0.3m/s)
10.20	1420	1	1	36 13.34	73 41.00	1024	Gravity corer	Gravity reach at sea floor (Tension: 0.9ton)
10.20	1422	1	1	36 13.34	73 41.00	1024	Gravity corer	Gravity leave for sea floor (Wire speed: 0.3m/s, Tension:1.5ton)
10.20	1436	1	1	36 13.34	73 40.99	1024	Gravity corer	Swell-compensator off (Wire speed:0.8m/s)
10.20	1445	1	1	36 13.20	73 40.92	1021	Gravity corer	Pilot at water surface
10.20	1453	1	1	36 13.19	73 40.93	1017	Gravity corer	Gravity at water surface
10.20	1456	1	1				Gravity corer	Failure (no sediment was catched)
10.20	1512	1	1	36 13.12	73 40.94	1018	Multiple corer	Opelation start
10.20	1514	1	1	36 13.13	73 40.95	1019	Multiple corer	Wire out start (Wire speed: 0.8m/s)
10.20	1516	1	1	36 13.13	73 40.95	1020	Multiple corer	Multiplu at water surface
10.20	1529	1	1	36 13.13	73 40.95	1019	Multiple corer	Swell-compensator on (Wire speed:1.0m/s)
10.20	1534	1	1	36 13.13	73 40.95	1023	Multiple corer	Wire out stop (3min)
10.20	1537	1	1	36 13.13	73 40.95	1023	Multiple corer	Wire out restart (Wire speed: 0.3m/s)

UTC				Position		Unc		
Date	Time	Stn	Cast	Latitude S	Longitude W	Depth (m)	Equipment	Commentts
10.20	1544	1	1	36 13.00	73 41.00	1022	Multiple corer	Multiple reach at sea floor (Tension:1.2-1.3ton)
10.20	1546	1	1	36 13.00	73 41.00	1024	Multiple corer	Multiple leave for sea floor (Wire speed: 0.3m/s, Tension:1.6ton)
10.20	1559	1	1	36 13.00	73 41.00	1024	Multiple corer	Swell-compensator off (Wire speed:1.0m/s)
10.20	1607	1	1	36 13.25	73 40.87	1015	Multiple corer	Multiplu at water surface
10.20	1627	1	1	36 13.22	73 40.77	1015		Solar light measurement
10.20	1634	1	2	36 13.25	73 40.76	1015	Gravity corer	Opelation start
10.20	1644	1	2	36 13.25	73 40.76	1015	Gravity corer	Wire out start
10.20	1645	1	2	36 13.10	73 40.92	1016	Gravity corer	Pilot at water surface
10.20	1648	1	2	36 13.13	73 40.92	1016	Gravity corer	Gravity at water surface (Wire speed: 0.8m/s)
10.20	1653	1	2	36 13.13	73 40.92	1016	Gravity corer	Swell-compensator on (Wire speed:1.0m/s)
10.20	1708	1	2	36 13.13	73 40.92	1016	Gravity corer	Wire out stop (3min)
10.20	1711	1	2	36 13.13	73 40.92	1016	Gravity corer	Wire out restart (Wire speed: 0.3m/s)
10.20	1718	1	2	36 13.34	73 40.99	1024	Gravity corer	Gravity reach at sea floor (Tension: 0.9ton)
10.20	1720	1	2	36 13.34	73 40.99	1024	Gravity corer	Gravity leave for sea floor (Wire speed: 0.3m/s, Tension:1.7ton)
10.20	1734	1	2	36 13.34	73 40.99	1024	Gravity corer	Swell-compensator off (Wire speed:0.8m/s)
10.20	1741	1	2	36 13.35	73 40.89	1024	Gravity corer	Pilot at water surface
10.20	1748	1	2	36 13.33	73 40.83	1024	Gravity corer	Gravity at water surface
10.20	1753	1	2				Gravity corer	Failure (no sediment was catched)
10.21	910	2					Multinarrow beam	Site survey start
10.21	945	2		39 45.45	74 10.00	1064	Multinarrow beam	Site survey finish
10.21	1330	2	1	39 59.69	74 25.08	1064	Piston corer	Opelation start
10.21	1335	2	1	39 59.69	74 25.08	1064	Piston corer	Center wire set up
10.21	1355	2	1	39 59.69	74 25.08	1064	Piston corer	Pilot at water surface
10.21	1400	2	1	39 59.08	74 25.04	1061	Piston corer	Piston at water surface
10.21	1400	2	1	39 59.08	74 25.04	1061	Piston corer	Wire out start (Wire speed: 1.0m/s)
10.21	1405	2		39 59.86	74 25.08	1061		Bucket water sampling
10.21	1408	2	1	39 59.08	74 25.04	1061	Piston corer	Swell-compensator on
10.21	1421	2	1	39 59.08	74 25.04	1065	Piston corer	Wire out stop (3min)
10.21	1424	2	1	39 59.08	74 25.04	1065	Piston corer	Wire out restart (Wire speed: 0.3m/s)
10.21	1429	2	1	39 59.96	74 25.16	1064	Piston corer	Piston reach at sea floor (Tension: 2ton)
10.21	1430	2	1	39 59.96	74 25.16	1065	Piston corer	Piston leave for sea floor (Tension: 4ton)
10.21	1445	2	1	39 59.96	74 25.16	1064	Piston corer	Swell-compensator off (Wire speed:0.8m/s)
10.21	1456	2	1	40 00.00	74 25.16	1064	Piston corer	Pilot at water surface
10.21	1519	2	1	40 00.00	74 25.16	1023	Piston corer	Piston at water surface
10.21	1540	2	1	39 59.90	74 24.95	1066	Gravity corer	Opelation start
10.21	1542	2	1	39 59.90	74 24.95	1066	Gravity corer	Wire out start
10.21	1543	2	1	39 59.90	74 24.95	1066	Gravity corer	Pilot at water surface
10.21	1548	2	1	39 59.91	74 24.95	1066	Gravity corer	Gravity at water surface (Wire speed: 0.8m/s)
10.21	1553	2	1	39 59.91	74 24.95	1066	Gravity corer	Swell-compensator on (Wire speed:1.0m/s)
10.21	1610	2	1	39 59.91	74 24.95	1066	Gravity corer	Wire out stop (3min)
10.21	1612	2	1	39 59.91	74 24.95	1066	Gravity corer	Wire out restart (Wire speed: 0.3m/s)
10.21	1616	2	1	39 59.98	74 25.19	1064	Gravity corer	Gravity reach at sea floor (Tension: 0.9ton)

UTC		Stn	Cast	Position				Unc	Equipment	Commentts
Date	Time			Latitude S		Longitude W		Depth (m)		
10.21	1619	2	1	39	59.98	74	25.17	1064	Gravity corer	Gravity leave for sea floor (Wire speed: 0.3m/s, Tension:3.0ton)
10.21	1634	2	1	39	59.98	74	25.17	1064	Gravity corer	Swell-compensator off (Wire speed:0.8m/s)
10.21	1639	2	1	40	00.04	74	24.86	1064	Gravity corer	Pilot at water surface
10.21	1649	2	1	39	59.92	74	24.72	1064	Gravity corer	Gravity at water surface
10.21	1800	2	1	39	59.82	74	24.83	1066	Multiple corer	Opelation start
10.21	1803	2	1	39	59.82	74	24.84	1067	Multiple corer	Wire out start (Wire speed: 0.8m/s)
10.21	1805	2	1	39	59.82	74	24.84	1067	Multiple corer	Multiplu at water surface
10.21	1818	2	1	39	59.82	74	24.84	1067	Multiple corer	Swell-compensator on (Wire speed:1.0m/s)
10.21	1825	2	1	39	59.82	74	24.84	1067	Multiple corer	Wire out stop (3min)
10.21	1828	2	1	39	59.82	74	24.84	1067	Multiple corer	Wire out restart (Wire speed: 0.3m/s)
10.21	1834	2	1	39	59.98	74	25.18	1066	Multiple corer	Multiple reach at sea floor (Tension:1.3ton)
10.21	1835	2	1	39	59.98	74	25.18	1066	Multiple corer	Multiple leave for sea floor (Wire speed: 0.3m/s, Tension:2.0ton)
10.21	1849	2	1	39	59.98	74	25.18	1066	Multiple corer	Swell-compensator off (Wire speed:1.0m/s)
10.21	1858	2	1	40	00.18	74	25.51	1079	Multiple corer	Multiplu at water surface
10.24	554	3							Multinarrow beam	Site survey start
10.24	920	3		52	52	74	1.00	560	Multinarrow beam	Site survey finish
10.24	1305	3	1	52	52.05	74	05.00	560	Multiple corer	Opelation start
10.24	1306	3	1	52	52.05	74	05.00	560	Multiple corer	Wire out start (Wire speed: 0.8m/s)
10.24	1307	3	1	52	52.05	74	05.00	558	Multiple corer	Multiplu at water surface
10.24	1308	3		52	52.05	74	05.00	558		Bucket water sampling
10.24	1318	3	1	52	52.05	74	05.00	558	Multiple corer	Wire out stop (3min)
10.24	1322	3	1	52	52.05	74	05.00	561	Multiple corer	Swell-compensator on, Wire out restart (Wire speed:0.3m/s)
10.24	1326	3		52	51.99	74	04.98	558		Solar light measurement
10.24	1328	3	1	52	51.99	74	05.02	558	Multiple corer	Multiple reach at sea floor (Tension:0.9ton)
10.24	1330	3	1	52	51.99	74	05.02	560	Multiple corer	Multiple leave for sea floor (Wire speed: 0.3m/s, Tension:1.1ton)
10.24	1335	3	1	52	51.99	74	05.02	560	Multiple corer	Swell-compensator off (Wire speed:0.8m/s)
10.24	1342	3	1	52	52.05	74	04.95	560	Multiple corer	Multiplu at water surface
10.24	1354	3	1	52	52.02	74	04.94	561	Piston corer	Opelation start
10.24	1403	3	1	52	52.02	74	04.94	561	Piston corer	Center wire set up
10.24	1416	3	1	52	52.02	74	04.94	561	Piston corer	Pilot at water surface
10.24	1421	3	1	52	52.02	74	05.07	559	Piston corer	Piston at water surface
10.24	1422	3	1	52	52.02	74	05.07	559	Piston corer	Wire out start (Wire speed: 1.0m/s)
10.24	1430	3	1	52	52.02	74	05.07	559	Piston corer	Swell-compensator on
10.24	1435	3	1	52	52.02	74	05.07	559	Piston corer	Wire out stop (3min)
10.24	1438	3	1	52	52.02	74	05.07	559	Piston corer	Wire out restart (Wire speed: 0.3m/s)
10.24	1429	3	1	52	52.00	74	05.07	562	Piston corer	Piston reach at sea floor (Tension: 1.4ton)
10.24	1443	3	1	52	52.00	74	05.03	559	Piston corer	Piston leave for sea floor (Tension: 2.8ton)
10.24	1449	3	1	52	52.00	74	05.03	559	Piston corer	Swell-compensator off (Wire speed:0.8m/s)
10.24	1501	3	1	52	52.02	74	05.26	560	Piston corer	Pilot at water surface
10.24	1510	3	1	52	52.02	74	05.26	560	Piston corer	Piston at water surface

UTC		Stn	Cast	Position		Unc	Equipment	Commentts
Date	Time			Latitude S	Longitude W	Depth (m)		
10.25	418	4					Multinarrow beam	Site survey start
10.25	940	4		53 34.26	70 40.49	470	Multinarrow beam	Site survey finish
10.25	1053	4	1	53 34.26	70 40.49	468	Multiple corer	Opelation start
10.25	1054	4	1	53 34.16	70 40.23	468	Multiple corer	Wire out start (Wire speed: 0.8m/s)
10.25	1055	4	1	53 34.16	70 40.23	468	Multiple corer	Multiplu at water surface
10.25	1100	4		53 34.16	70 40.23	468		Bucket water sampling
10.25	1105	4	1	53 34.16	70 40.23	468	Multiple corer	Wire out stop (3min)
10.25	1108	4	1	53 34.16	70 40.23	468	Multiple corer	Wire out restart (Wire speed: 0.3m/s)
10.25	1114	4	1	53 34.26	70 40.48	469	Multiple corer	Multiple reach at sea floor (Tension:0.8ton)
10.25	1115	4	1	53 34.27	70 40.46	468	Multiple corer	Multiple leave for sea floor (Wire speed: 0.3m/s, Tension:0.9ton)
10.25	1120	4		53 34.27	70 40.50	469		Solar light measurement
10.25	1126	4	1	53 34.30	70 40.52	470	Multiple corer	Multiplu at water surface
10.25	1248	4	1	53 34.30	70 40.52	470	Piston corer	Opelation start
10.25	1304	4	1	53 34.30	70 40.52	470	Piston corer	Center wire set up
10.25	1312	4	1	53 34.30	70 40.52	470	Piston corer	Pilot at water surface
10.25	1317	4	1	53 34.29	70 40.48	469	Piston corer	Piston at water surface
10.25	1318	4	1	53 34.29	70 40.48	469	Piston corer	Wire out start (Wire speed: 0.8m/s)
10.25	1326	4	1	53 34.29	70 40.48	469	Piston corer	Wire out stop (3min)
10.25	1329	4	1	53 34.29	70 40.48	469	Piston corer	Wire out restart (Wire speed: 0.3m/s)
10.25	1334	4	1	53 34.29	70 40.49	468	Piston corer	Piston reach at sea floor (Tension: 1.5ton)
10.25	1337	4	1	53 34.25	70 40.52	466	Piston corer	Piston leave for sea floor (Tension: 3.1ton)
10.25	1350	4	1	53 34.22	70 40.49	471	Piston corer	Pilot at water surface
10.25	1357	4	1	53 34.22	70 40.49	471	Piston corer	Piston at water surface
10.25	1445	4	1	53 34.31	70 40.34	472	Gravity corer	Opelation start
10.25	1454	4	1	53 34.31	70 40.34	472	Gravity corer	Wire out start
10.25	1456	4	1	53 34.31	70 40.34	472	Gravity corer	Pilot at water surface
10.25	1459	4	1	53 34.31	70 40.34	472	Gravity corer	Gravity at water surface (Wire speed: 0.8m/s)
10.25	1508	4	1	53 34.31	70 40.34	472	Gravity corer	Wire out stop (3min)
10.25	1511	4	1	53 34.31	70 40.34	472	Gravity corer	Wire out restart (Wire speed: 0.2m/s)
10.25	1518	4	1	53 34.26	70 40.56	467	Gravity corer	Gravity reach at sea floor (Tension: 1ton)
10.25	1520	4	1	53 34.26	70 40.51	471	Gravity corer	Gravity leave for sea floor (Wire speed: 0.2m/s, Tension:2.2ton)
10.25	1532	4	1	53 34.11	70 40.60	467	Gravity corer	Pilot at water surface
10.25	1543	4	1	53 33.96	70 40.79	470	Gravity corer	Gravity at water surface
10.26	0							Surface water pump off

2.3 Cruise Track

Wataru Tokunaga (Global Ocean development, Inc.)

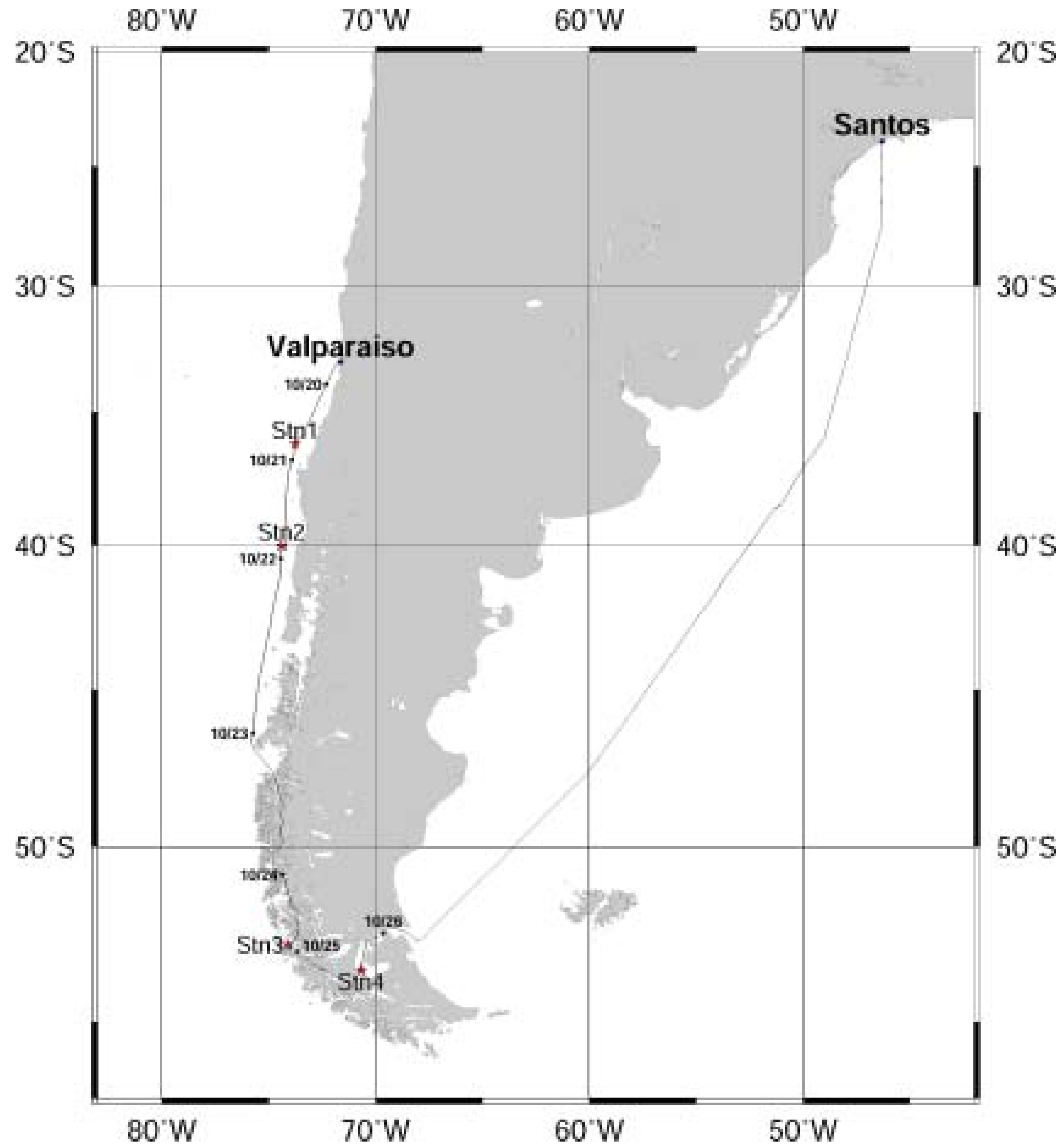


Fig. 2-3-1 Cruise track

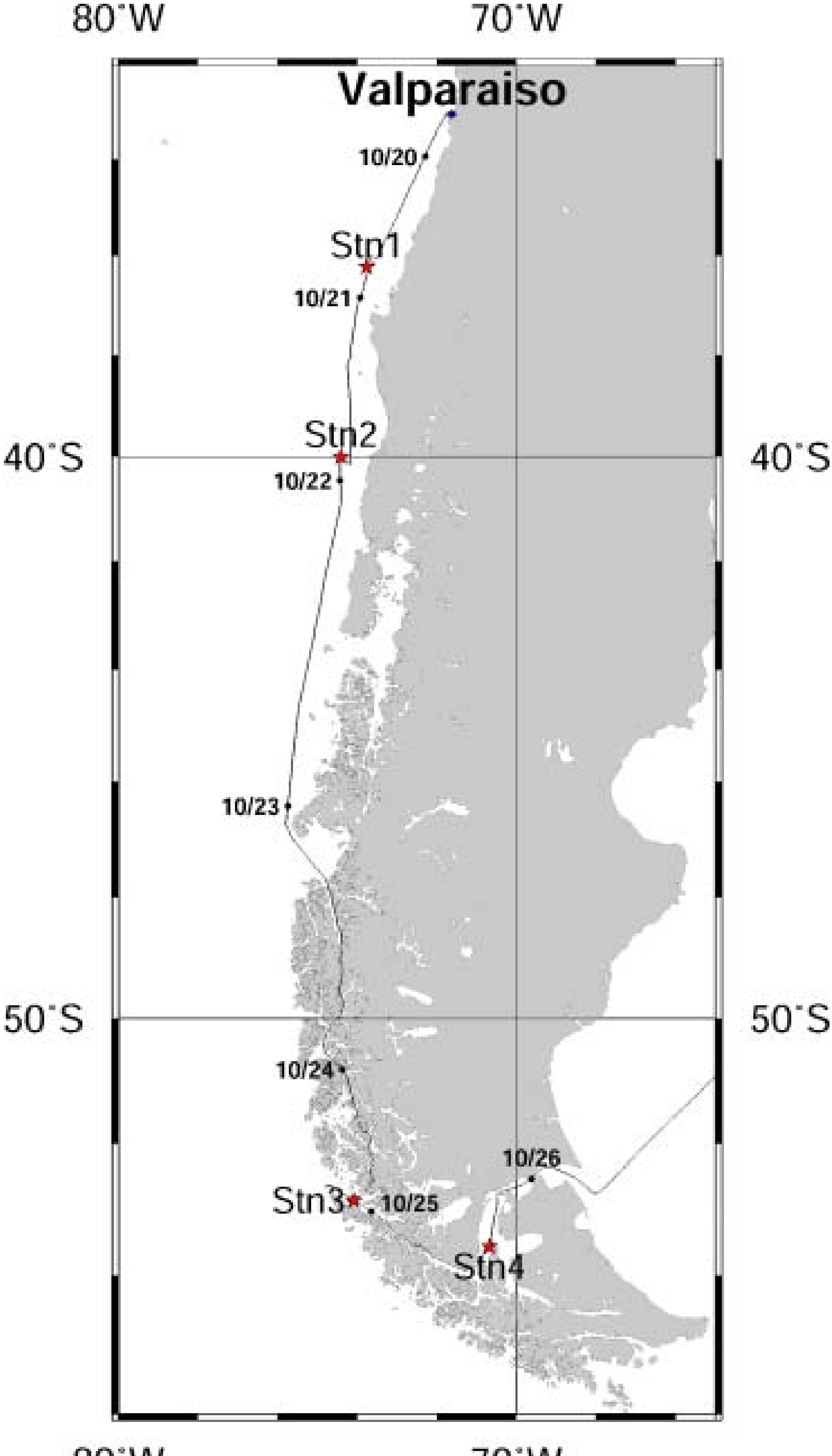


Fig. 2-3-2 Sediment Coring Sites

2.4 List of participants

Name	Affiliation	Address	Tel Fax E-mail
Naomi HARADA	Japan Marine Science & Technology Center (JAMSEC)	2-15 Natsushima-cho Yokosuka 237-0061, Japan	
Naokazu AHAGON	JAMSTEC	690 Kitasekine Sekine Mutsu 035-0022, Japan	
Shuichi WATANABE	JAMSTEC	2-15 Natsushima-cho Yokosuka 237-0061, Japan	
Toshiaki MISHIMA	JAMSTEC	2-15 Natsushima-cho Yokosuka 237-0061, Japan	
Mitsuo MURATA	JAMSTEC	2-15 Natsushima-cho Yokosuka 237-0061, Japan	
Yoshihiro ASAHARA	Nagoya University	Furo-cho Chikusaku Nagoya Aichi 464-8602,Japan	
Yutaka WATANABE	Hokkaido University	N10,W5 Kitaku Sapporo 060-0810, Japan	
Kota KATSUKI	Kyushu University	6-10-1 Hakozaki Higashi-ku Fukuoka 812-8581, Japan	
Hirohide KANKE	Nagoya University	Furo-cho Chikusaku Nagoya Aichi 464-8601,Japan	
Carina B. LANGE	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 7 Dept. Oceanografia Universided de Concepcion Cacilla 162-C Concepcion, Chile	
Silvio PANTOJA	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 5 Dept. Oceanografia Universided de Concepcion Cacilla 160-C Concepcion, Chile	

Name	Affiliation	Address	Tel Fax E-mail
Margarita E. MARCHANT	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 8 Dept. Oceanografia Universided de Concepcion Cacilla 163-C Concepcion, Chile	
Alejandro J. AUIRA.SANTIS	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 6 Dept. Oceanografia Universided de Concepcion Cacilla 161-C Concepcion, Chile	
Julio SEPULUEDA	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 6 Dept. Oceanografia Universided de Concepcion Cacilla 161-C Concepcion, Chile	
Raul I. TAPIA	University of Concepcion Copas-Center (UDEC COPAS CENTER)	Cabina 7 Dept. Oceanografia Universided de Concepcion Cacilla 162-C Concepcion, Chile	
Anna Bronwen CURRIE	Ministry of Fisheries and Marine Resources	912, Swakopmund Namibia	
Kathleen Rhona PEARD	Luderitz Marine Research	357, Luederitz Namibia	
Vivian LUTZ	Institute Nacional de Investigation y Desarrollo Pesquero	Pasep Victoria Ocampo 1 Mar del Plate, B7602HSA Argentina	
Gustavo MARTINEZ	Universidad de la Republica Oriental del Uruguay Seccion Oceanologia	Unidad de Proyectos y Sistemas de Informacion Direccion Nacional de Recursos Acuaticos. Constituyente 1497. CP 11200. Montevideo. Uruguay.	
Luis Americo CONTI	Oceanographic Institute University of Sao Paulo	University of Saopaulo Pca do Oceanografico, 191 Brazil	
Ana Ines DOGLIOTTI	Institudo de Astronomia y Fisica del Espacio	Instituto De Astronomia Y Fisica Del Espacio (IAFE) Conicet Pabellon Iafe Ciudad Universitaria, Buenos Aires (1428) C.C. 67-Sucursal 28-Argentina	

Name	Affiliation	Address	Tel Fax E-mail
Ryo KIMURA	Global Ocean Development Inc. (GODI)	13-8 Kamiookanishi 1-chome Konan-ku Yokohama 233-0002 Japan	
Norio NAGAHAMA	GODI	13-8 Kamiookanishi 1-chome Konan-ku Yokohama 233-0002 Japan	
Wataru TOKUNAGA	GODI	13-8 Kamiookanishi 1-chome Konan-ku Yokohama 233-0002 Japan	
Yutaka MATSUURA	Marine Works Japan Ltd. (MWJ)	Live Pier Kanazawahakkei 2F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Rena MAEDA	MWJ	Live Pier Kanazawahakkei 3F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Yuusuke SATO	MWJ	Live Pier Kanazawahakkei 2F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Tamami UENO	MWJ	Live Pier Kanazawahakkei 2F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Mikio KITADA	MWJ	Live Pier Kanazawahakkei 2F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Kenichiro SATO	MWJ	Live Pier Kanazawahakkei 3F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Tomoko MIYASHITA	MWJ	Live Pier Kanazawahakkei 3F 1-1-7 Mutsuura Kanagawa-ku Yokohama 236-0031, Japan	
Tomoaki KANAI	JAMSTEC	2-15 Natsushima-cho Yokosuka 237-0061, Japan	
Tsuyoshi KOUGO	JAMSTEC	2-15 Natsushima-cho Yokosuka 237-0061, Japan	

3. Observation

3-1 Meteorological observation

3-1-1 Surface Meteorological Observation

Wataru Tokunaga	(Global Ocean Development Inc.)
Norio Nagahama	(GODI)
Ryo Kimura	(GODI)
Not on-board:	
Kunio Yoneyama	(JAMSTEC) Principal Investigator
R. Michael Reynolds	(Brookhaven National Laboratory, USA)

(1) Objectives

The surface meteorological parameters are observed as a basic dataset of the meteorology. These parameters bring us the information about the temporal variation of the meteorological condition surrounding the ship.

(2) Methods

The surface meteorological parameters were observed throughout the MR03-K04 leg3 cruise from the departure of Valparaiso on 17 Oct 2003 to arrival of Santos on 2 Nov 2003.

At this cruise, we used two systems for the surface meteorological observation.

1. Mirai meteorological observation system
2. Shipboard Oceanographic and Atmospheric Radiation (SOAR) System

(2-1) Mirai meteorological observation system

Instruments of Mirai meteorological system (SMET) are listed in Table 3-1-1.1 and measured parameters are listed in Table 3-1-1.2. Data was collected and processed by KOAC-7800 weather data processor made by Koshin-Denki, Japan. The data set has 6-second averaged.

(2-2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

SOAR system designed by BNL consists of major 3 parts.

1. Portable Radiation Package (PRP) designed by BNL – short and long wave downward radiation.
2. Zeno meteorological system designed by BNL – wind, air temperature, relative humidity, pressure, and rainfall measurement.
3. Scientific Computer System (SCS) designed by NOAA (National Oceanic and Atmospheric Administration, USA)- centralized data acquisition and logging of all data sets.

SCS recorded PRP data every 6 seconds, Zeno/met data every 10 seconds. Instruments and their locations are listed in Table 3-1-1.3 and measured parameters are listed in Table 3-1-1.4.

(3) Preliminary results

Figure 3-1-1.1 shows the time series of the following parameters from the departure of Valparaiso to 26 Oct 2003; Wind (SOAR), air temperature (SOAR), sea surface temperature (EPCS), relative humidity (SOAR), precipitation (SOAR), short/long wave radiation (SOAR), pressure (SOAR) and significant wave height (SMET).

(4) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division. Corrected data sets will also be available from K. Yoneyama of JAMSTEC.

Table 3-1-1.1 Instruments and installations of Mirai meteorological system

Sensors	Type	Manufacturer	Location (altitude from surface)
Anemometer	KE-500	Koshin Denki, Japan	foremast (24m)
Thermometer	HMP45A	Vaisala, Finland	compass deck (21m)
	with 43408 Gill aspirated radiation shield (R.M. Young)		
	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet -5m) SST
Barometer	F-451	Yokogawa, Japan	weather observation room captain deck (13m)
Rain gauge	50202	R. M. Young, USA	compass deck (19m)
Optical rain gauge	ORG-115DR	Osi, USA	compass deck (19m)
Radiometer (short wave)	MS-801	Eiko Seiki, Japan	radar mast (28m)
Radiometer (long wave)	MS-202	Eiko Seiki, Japan	radar mast (28m)
Wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10m)

Table 3-1-1.2 Parameters of Mirai meteorological observation system

	Parmeter	Units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	Ship's speed	knot	Mirai log, DS-30 Furuno
4	Ship's heading	degree	Mirai gyro, TG-6000, Tokimec
5	Relative wind speed	m/s	6sec./10min. averaged
6	Relative wind direction	degree	6sec./10min. averaged
7	True wind speed	m/s	6sec./10min. averaged
8	True wind direction	degree	6sec./10min. averaged
9	Barometric pressure	hPa	adjusted to sea surface level 6sec. averaged
10	Air temperature (starboard side)	degC	6sec. averaged
11	Air temperature (port side)	degC	6sec. averaged
12	Dewpoint temperature (starboard side)	degC	6sec. averaged

13	Dewpoint temperature (port side)	degC	6sec. averaged
14	Relative humidity (starboard side)	%	6sec. averaged
15	Relative humidity (port side)	%	6sec. averaged
16	Sea surface temperature	degC	6sec. averaged
17	Rain rate (optical rain gauge)	mm/hr	hourly accumulation
18	Rain rate (capacitive rain gauge)	mm/hr	hourly accumulation
19	Down welling shortwave radiation	W/m^2	6sec. averaged
20	Down welling infra-red radiation	W/m^2	6sec. averaged
21	Significant wave height (fore)	m	hourly
22	Significant wave height (aft)	m	hourly
23	Significant wave period	second	hourly
24	Significant wave period	second	hourly

Table 3-1-1.3 Instrument and installation locations of SOAR system

Sensors (altitude from surface)	Type	Manufacturer	Location
Zeno/Met			
Anemometer	05106	R.M. Young, USA	foremast (25m)
Tair/RH	HMP45A	Vaisala, Finland	foremast (24m)
	with 43408 Gill aspirated radiation shield (R.M. Young)		
Barometer	61201	R.M. Young, USA	foremast (24m)
	with 61002 Gill pressure port (R.M. Young)		
Rain gauge	50202	R. M. Young, USA	foremast (24m)
Optical rain gauge	ORG-815DA	Osi, USA	foremast (24m)
PRP			
Radiometer (short wave)	PSP	Eiko Seiki, Japan	foremast (25m)
Radiometer (long wave)	PIR	Eiko Seiki, Japan	foremast (25m)
Fast rotating shadowband radiometer		Yankee, USA	foremast (25m)

Table 3-1-1.4 Parameters of SOAR system

	Parmeter	Units	Remarks
1	Latitude	degree	
2	Longitude	degree	
3	Sog	knot	
4	Cog	degree	
5	Relative wind speed	m/s	
6	Relative wind direction	degree	
7	Barometric pressure	hPa	
8	Air temperature	degC	
9	Relative humidity	%	
10	Rain rate (optical rain gauge)	mm/hr	reset at 50mm
11	Precipitation (capacitive rain gauge)	mm	
12	Down welling shortwave radiation	W/m^2	
13	Down welling infra-red radiation	W/m^2	
14	Defuse irradiance	W/m^2	

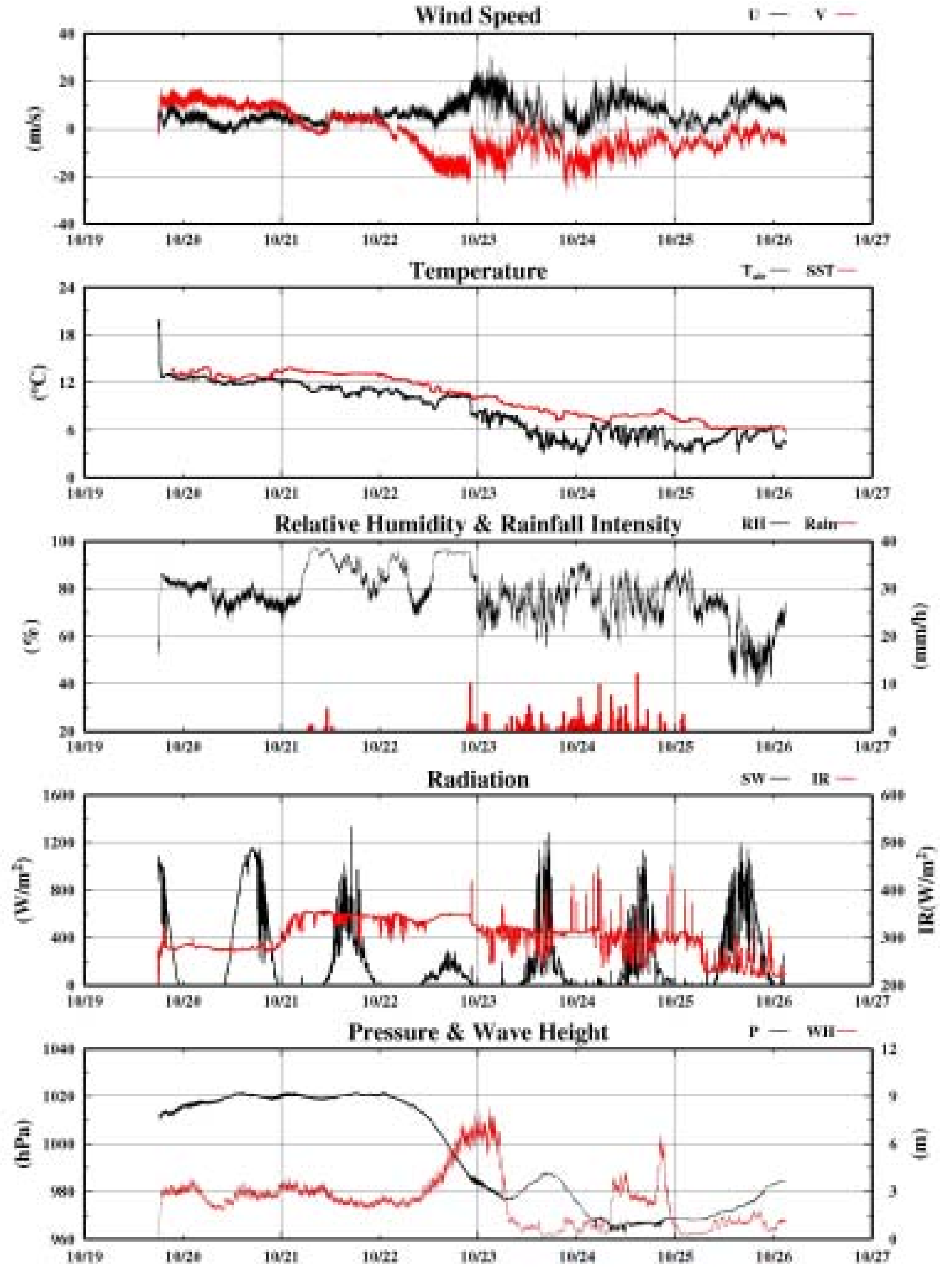


Fig3-1-1.1 Time series of surface meteorological parameters during the cruise.

3-1-2 Ceilometer Observation

Wataru Tokunaga	(GODI)
Norio Nagahama	(GODI)
Ryo Kimura	(GODI)
Not on-board:	
Kunio Yoneyama	(JAMSTEC) Principal Investigator

(1) Objectives

The information of cloud base height and the liquid water amount around cloud base is important to understand the process on formation of the cloud. As one of the methods to measure them, the ceilometer observation was carried out.

(2) Parameters

1. Cloud base height [m].
2. Backscatter profile, sensitivity and range normalized at 30 m resolution.
3. Estimated cloud amount [oktas] and height [m]; Sky Condition Algorithm.

(3) Methods

We measured cloud base height and backscatter profile using ceilometer (CT-25K, VAISALA, Finland) throughout the MR03-K04 leg3 cruise from the departure of Valparaiso on 17 Oct 2003 to 26 Oct 0300UTC.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode
Transmitting wavelength:	905±5 mm at 25 degC
Transmitting average power:	8.9 mW
Repetition rate:	5.57 kHz
Detector:	Silicon avalanche photodiode (APD) Responsibility at 905 nm: 65 A/W
Measurement range:	0 ~ 7.5 km
Resolution:	50 ft in full range
Sampling rate:	60 sec
Sky Condition	0, 1, 3, 5, 7, 8 oktas (9: Vertical Visibility) (0: Sky Clear, 1:Few, 3:Scattered, 5-7: Broken, 8: Overcast)

On the archive dataset, cloud base height and backscatter profile are recorded with the resolution of 30 m (100 ft).

(4) Preliminary results

The figure 3-1-2.1 shows the time series of the first, second and third lowest cloud base height.

(5) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division.

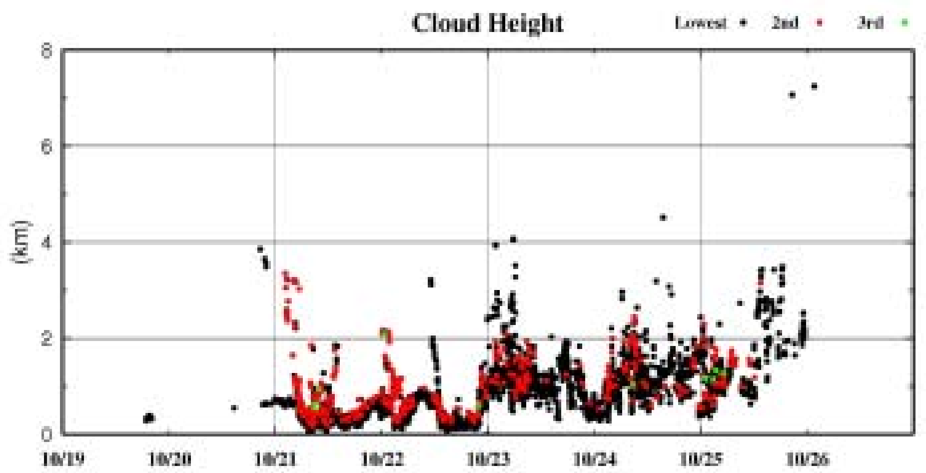


Figure 3-1-2.1 1st, 2nd and 3rd lowest cloud base height during the cruise.

3-2 Geological / geophysical observation

3-2-1 Multi-narrow beam observation

Wataru Tokunaga	(GODI)
Norio Nagahama	(GODI)
Ryo Kimura	(GODI)
Naomi Harada	(JAMSTEC) : Principal investigator
Naokazu Ahagon	(JAMSTEC)
Not on-board:	
Toshiya Fujiwara	(JAMSTEC)

(1) Introduction

A Multi Narrow Beam Echo Sounding system (MNBES), SEABEAM 2112.004 (SeaBeam Instruments Inc.) is equipped on R/V MIRAI. The main system of "SeaBeam 2100", 12 kHz system, provides swath bathymetry data. Sub Bottom Profiler (SBP) subsystem is an add-on option to the "SEABEAM 2100". SBP collects vertical sub-bottom profile information.

The capital objective of MNBES is site survey so that we have gathered necessary bathymetric and sub-sediment information around the core sampling point. Another objective is collecting continuous bathymetry data along ship's track to make a contribution to geological and geophysical investigations and global datasets.

(2) Data Acquisition

The "SEABEAM 2100" on R/V MIRAI was used for bathymetry mapping during MR03-K04 Leg3 cruise from 19 October 2003 to 26 October 2003. For primary data quality management, applying proper sound velocity profile is the most important. Sound velocity profiles were calculated using temperature data from XBT and salinity data from EPCS by the equation in Mackenzie (1981). Variations of sound velocity on the surface of transducer have a large influence on depth, especially side beams, so that this system has Surface Sound Velocimeter, which measuring sound velocity in the surface intake water continuously.

Obviously low quality data was flagged automatically by real-time data screening function of the system.

System configuration and performance;

SEABEAM 2112.004 (12kHz system);

Frequency:	12 kHz
Transmit beam width:	2 degree
Transmit power:	20 kW
Transmit pulse length:	3 to 20 msec.

Depth range:	100 to 11,000 m
Beam spacing:	1 degree athwart ship
Swath width:	150 degree (max)
	120 degree to 4,500 m
	100 degree to 6,000 m
	90 degree to 11,000 m
Depth accuracy:	Within < 0.5% of depth or +/-1m, whichever is greater, over the entire swath. (Nadir beam has greater accuracy; typically within < 0.2% of depth or +/-1m, whichever is greater)

Sub-Bottom Profiler (4kHz system);

Frequency:	4 kHz
Transmit beam width:	5 degree
Sweep:	5 to 100 msec
Depth Penetration:	As much as 75 m (varies with bottom composition)
Resolution of sediments:	Under most condition within < tens-of-centimeters range (Dependent upon depth and sediment type)

(3) Preliminary Results

The survey was performed at the Stns. 1, 2, 3 and 4, sediment core sampling sites. The results of the survey are shown in Figures 3-2-1-1 to 4.

(4) Data Archives

Data obtained during this cruise will be submitted to the JAMSTEC Data Management Division as archives.

(5) Remarks

1. Underway pinging was stopped when MIRAI navigated in shallower than 100 m water depth.
2. GPS receiver sometimes lost position when the number of satellites decreased or HDOP increased. The periods of losing the position are as follows;

(UTC)	
10/20	19:18
10/23	07:22, 07:37 - 07:39, 18:56, 19:04
10/24	08:09, 18:48 - 18:56, 16:17, 18:44, 18:49 - 18:57

Site PC-1

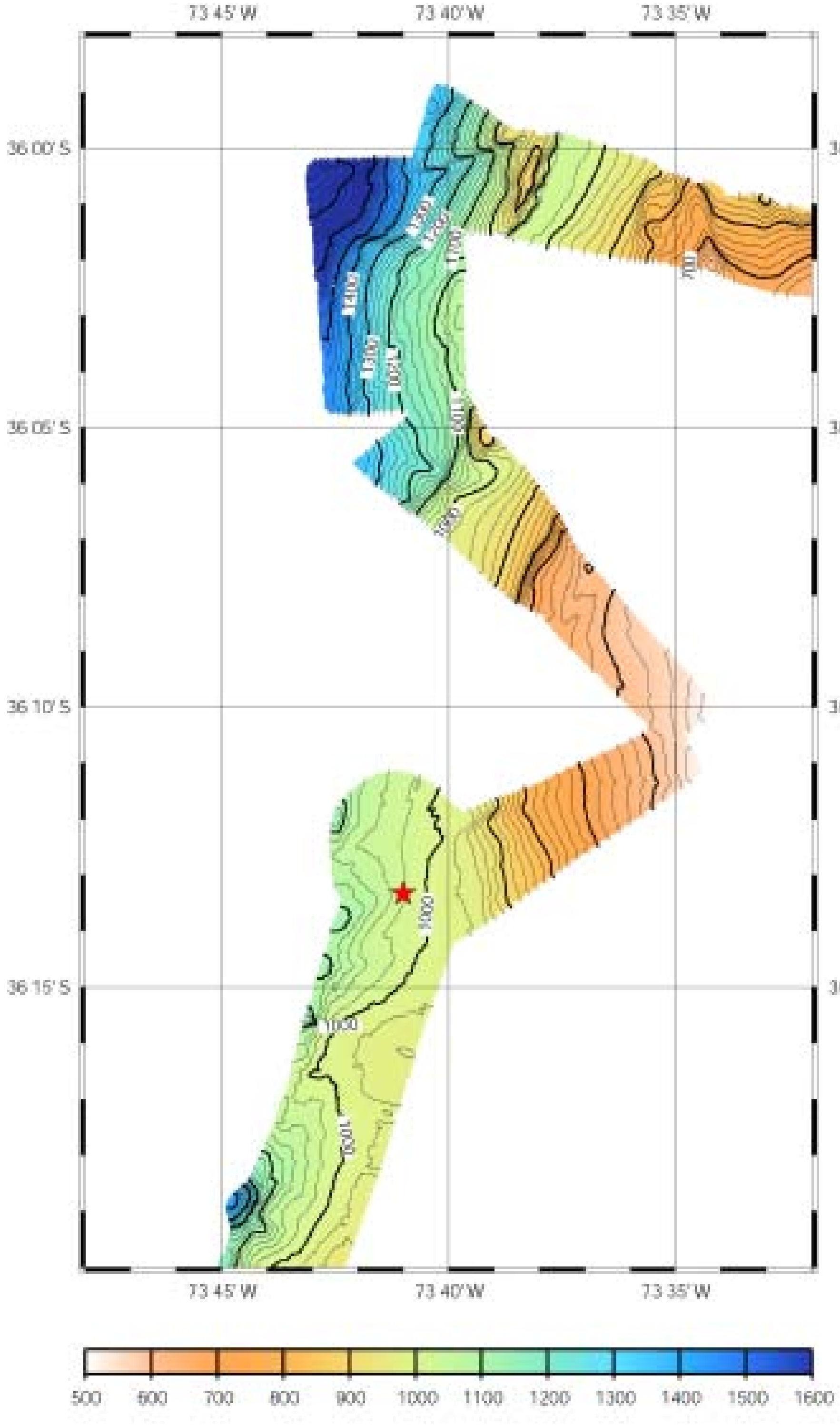


Fig.3-2-1-1 The result of site survey at PC-1

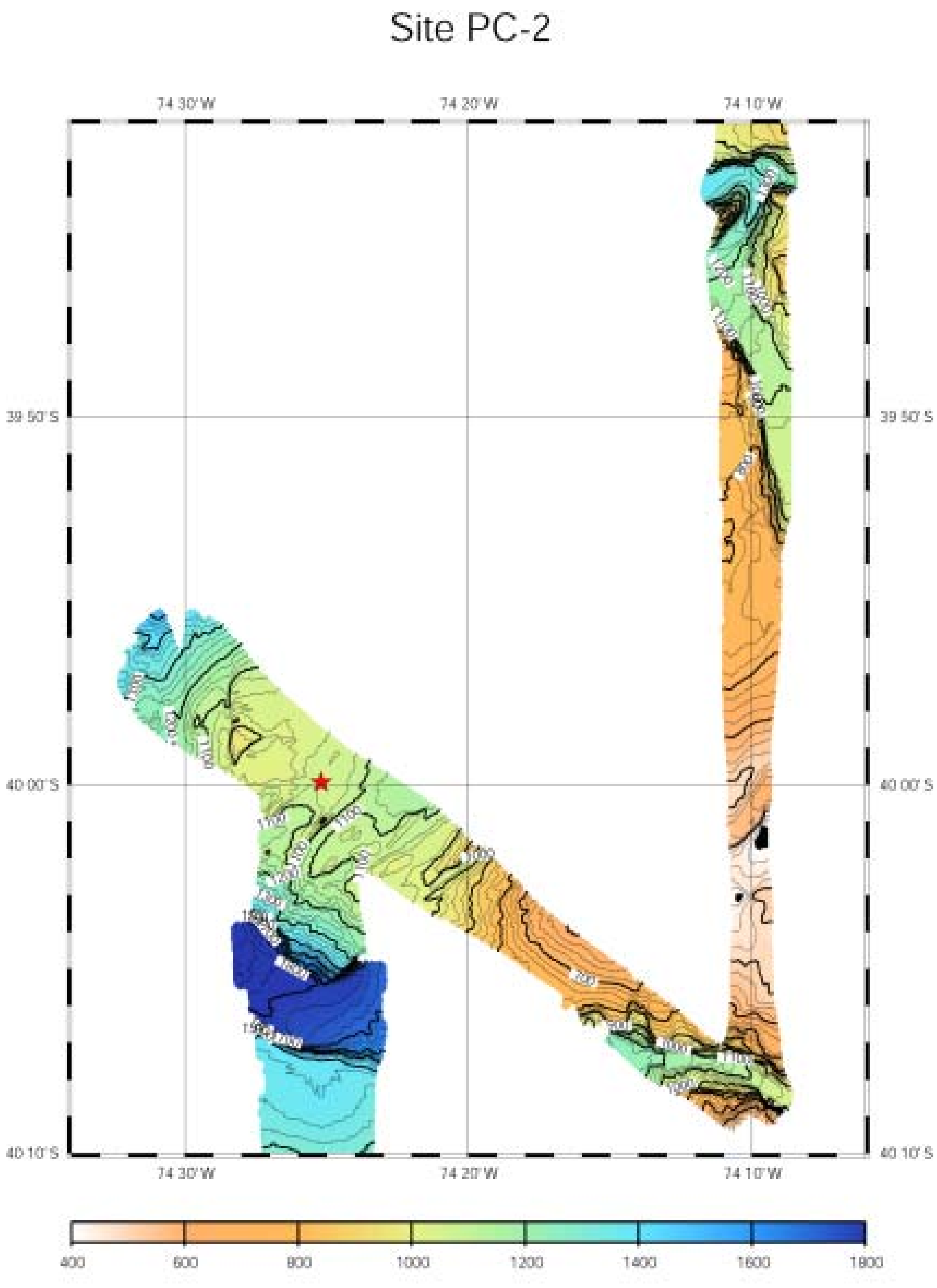


Fig.3-2-1-2 The result of site survey at PC-2

Site PC-3

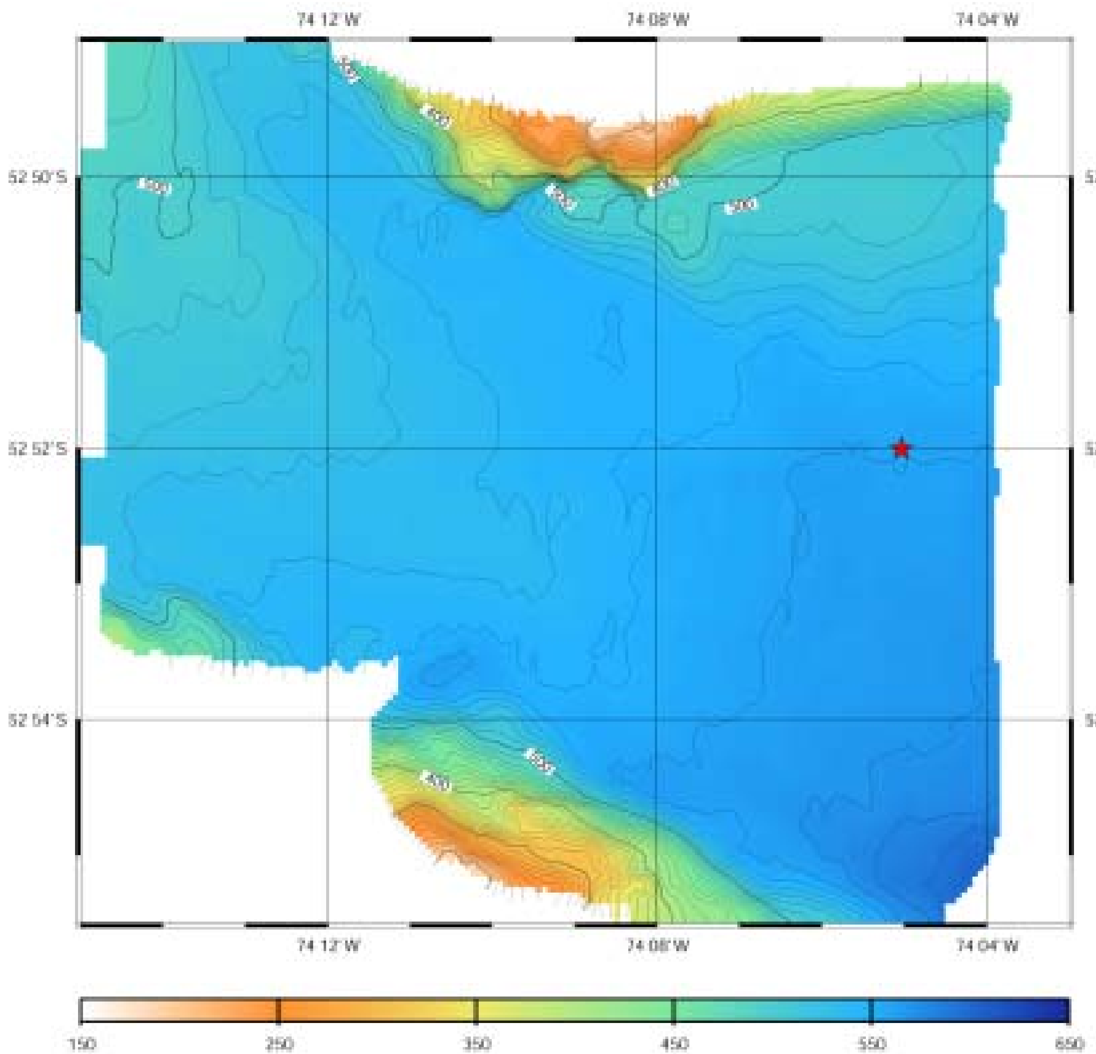


Fig.3-2-1-3 The result of site survey at PC-3

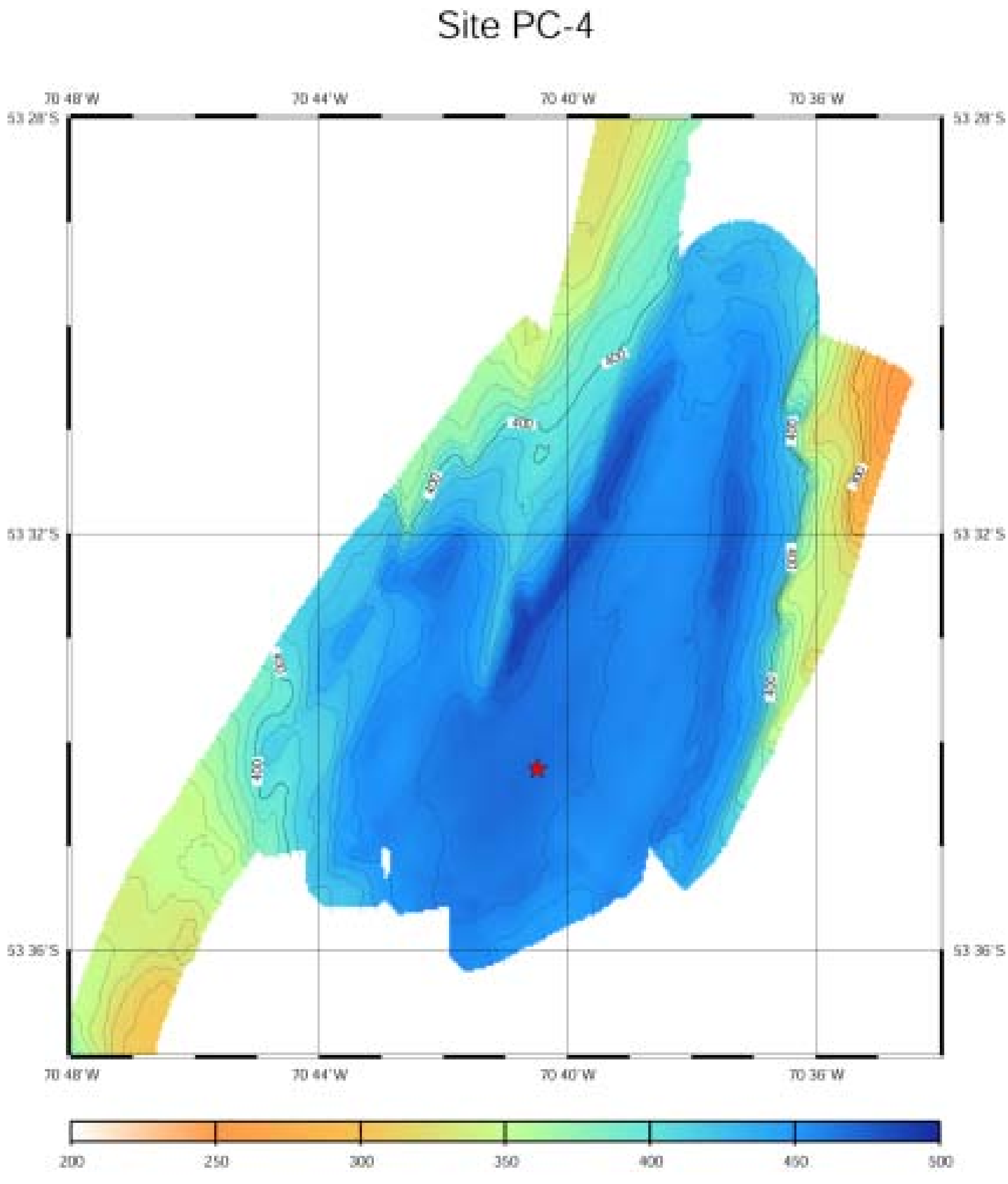


Fig.3-2-1-4 The result of site survey at PC-4

3-2-2 Sea surface gravity measurement

Wataru Tokunaga (GODI)
Norio Nagahama (GODI)
Ryo Kimura (GODI)
Not on-board:
Toshiya Fujiwara (JAMSTEC)

(1) Introduction

The difference of local gravity is an important parameter in geophysics and geodesy. We collected gravity data at the sea surface during the MR03-K04 Leg3 cruise from 19 October 2003 to 26 October 2003.

(2) Parameters

Relative Gravity [mGal]

(3) Data Acquisition

We have measured relative gravity using LaCoste and Romberg air-sea gravity meter S-116 (LaCosat and Romberg Gravity Meters, Inc.) during this cruise. To convert the relative gravity to absolute one, we measured gravity, using portable gravity meter (Scintrex gravity meter CG-3M), at Valparaiso Port and Santos Port as reference points.

(4) Preliminary Results

Table 3-2-2-1 Absolute gravity

No.	Date	U.T.C.	Port	Absolute Gravity [mGal]	Sea Level [cm]	Draft [cm]	Gravity at Sensor *1 [mGal]	L&R *2 Gravity [mGal]
#1	Oct/19	17:28	Valparaiso	979619.29	350	638	979620.42	11916.7
#2	Nov/6	09:44	Santos	978829.84	298	648	978830.81	11127.6

*1: Gravity at Sensor = Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.0431
*2: LaCoste and Romberg air-sea gravity meter S-116

Differential	G at sensor	L&R value
No.2 - No.1	-789.61 mGal ---(a)	-789.1 mGal ---(b)
L&R drift value (b)-(a)	0.51 mGal	17.68 days
Daily drift ratio	**0.029 mGal/day**	

(5) Data Archives

Gravity data obtained during this cruise will be submitted to the JAMSTEC Data Management Division, and archived there.

(6) Remarks

The periods of losing position are as follows;

(UTC)

10/20 19:18

10/23 07:22, 07:37 - 07:39, 18:56, 19:04

10/24 08:09, 18:48 - 18:56, 16:17, 18:44, 18:49 - 18:57

3-2-3 Surface three components magnetometer

Wataru Tokunaga (GODI)
Norio Nagahama (GODI)
Ryo Kimura (GODI)
Not on-board:
Toshiya Fujiwara (JAMSTEC)

(1) Introduction

Measurements of magnetic force on the sea are required for the geophysical investigations of marine magnetic anomaly caused by magnetization in upper crustal structure. We measured geomagnetic field using a three-component magnetometer during the MR03-K04 Leg3 cruise from 19 October 2003 to 26 October 2003.

(2) Parameters

Three-component magnetic force [nT]
Ship's attitude [1/100 deg]

(3) Method Data Acquisition

A sensor of three-component fluxgate magnetometer is set on the top of foremast. Sampling is controlled by 1pps (pulse per second) standard clock of GPS signals. Every one-second record is composed of navigation information, 8 Hz three-component of magnetic force, and VRU (Vertical Reference Unit) data.

(4) Preliminary Results

The results will be published after primary processing.

(5) Data Archives

Magnetic force data obtained during this cruise will be submitted to the JAMSTEC Data Management Division, and archived there.

(6) Remarks

The periods of losing position are as follows;

(UTC)	
10/20	19:18
10/23	07:22, 07:37 - 07:39, 18:56, 19:04
10/24	08:09, 18:48 - 18:56, 16:17, 18:44, 18:49 - 18:57

3-3 Sediment

Naomi Harada (Japan Marine Science and Technology Center)

Past variation and changes in the thermohaline circulation and biogeochemical cycle recorded in marine sediment provide important information to predict the future global climatic change. Since a large part of southern hemisphere is occupied by ocean, southern ocean significantly influences to climatic change of southern hemisphere.

We decide two themes; “carbon cycle” and “phase lag or synchronization of the sea surface environment between southern and northern hemispheres, which are most important things in paleoceanography. We make hypothesis for each theme and verify it. Based on the results, we define the past environmental change in the whole southern hemisphere since the last deglacial period, and would like to make use of constructing a paleo climate prediction model.

Carbon cycle

According to the vertical profile of pCO_2 of bubbles in the Vostok ice core, pCO_2 in the air during the last glacial maximum (LGM) was very low, 220~200ppm. The truth mechanism brought the low pCO_2 has not come out, although it is easily expected that the pattern of ice distribution between land and ocean, and biogeochemical cycle in ocean during the LGM were different with those in Holocene. There are several hypotheses as follows; 1) carbon fixation ability of phytoplankton increased in the LGM because of progress in efficiency of nutrient utilization and/or change of assemblages of phytoplankton, 2) primary production increased in the LGM because of the increase of dust supply such as iron, 3) release of CO_2 from surface of the southern ocean decreased because of expansion of sea ice area.

We will use sediment cores at the off Chile for estimation of sea ice expansion. If sea ice area were expanded in the southern ocean during the LGM rather than Holocene, polar front located at 40~50˚S in the modern south Pacific would migrate to northern latitude. We will collect three piston cores between 30˚ and 60˚S and will estimate paleo sea surface temperature by $\delta^{18}O$ and alkenone methods to realize the variation of north-south migration of polar front.

We will also analyze opal and organic carbon contents, biomarker such as alkenones, and stable isotopic ratio of carbon and nitrogen of bulk organic matter to understand how much amount of the primary production and efficiency of nutrient utilization of phytoplankton changed in the termination period from the last glacial to Holocene. Furthermore, we will measure Cd/Ca ratio of planktonic and benthic foraminifera as a nutrient proxy and will estimate the difference of nutrient concentration between surface and deep water to understand the glacial-interglacial variation of nutrient cycle in the southern ocean. In order to estimate the intensity of wind and how much amount of dust supply changed through the geological period, metal isotopic ratios such as Rb-Sr, Sm-Nd and Lu-Hf originated from dust will be measured.

Climate linkages between Northern and Southern Hemispheres

The bipolar seesawing climate change in sub-Milankovitch to millennium time scales has been hypothesized by researchers (e.g., Broecker, 1998), based on climate reconstructions from both ice-sheet and deep-sea sediment records. However, there is no clear consensus on the interhemispheric climate linkage yet. Indeed, some researchers argued synchronicity of interhemispheric climate change in same time scales. In addition, there are many common oceanographic characteristics between Chilean marginal area and the northwestern North Pacific such as the presence of strong boundary current (Humboldt Current for the former eastern boundary current, and Kuroshio Current for the latter western boundary current), Intermediate water (Antarctic Intermediate Water for the former, and North Pacific Intermediate water for the latter). This study is also expected to clarify how link the change of intensity of the boundary current and intermediate water in the northern hemisphere with those in the southern hemisphere.

We will analyze $\delta^{13}C$ and micro metal such as Mg, Cd in multi species of planktonic foraminifers ^{14}C age of planktonic and benthic foraminifera, and alkenone SST within high time resolution by using sediments from the off Chile region. These data provide us time-series data on ocean surface environments to resolve sub-Milankovitch to millennium scale climate changes in the Southern Hemisphere.

Based on the above-mentioned goal geochemical and micropaleontological measurements are planed by using the sediment cores in the Chilean marginal area and Magellan Strait throughout the late Quaternary period (ca 20ka) as follows; (1) the sea surface temperature, (2) north and south migrations of frontal zones, (3) the paleo flux of biogenic particles, (4) intermediate water ventilation, (5) paleo distribution of nutrients in the deep-water, (6) how far the ice rafted debris (IRD) were transported from the Antarctic region to the Chilean marginal area, (7) how much amount of IRD were transported. Furthermore, paleomagnetic study is carried out to determine the geological age and to understand the relationship between the magnetic field and paleo-environmental change.

3-3-1 Sampling location

Naomi Harada (Japan Marine Science and Technology Center)

Total four piston, two gravity and four multiple cores were collected in the Chilean marginal sea and Magellan Strait (Table 1 and see Figs.3-2-1-1 to 4). The PC-01 and MC-01 were collected at the southwestern off Valparaiso, Chile (36˚13'S, 73˚41'W, water depth 1023m). The PC-02, the GC-01 and the MC-02 were collected at the southern from PC-01 (39˚59'S, 74˚25'W, water depth 1064m). The PC-03 and the MC-03 were collected at the mouth of Magellan Strait in the Pacific side (52˚52'S, 74˚05'W, water depth 560m). The PC-04, the GC-02 and the MC-04 were collected in the Magellan Strait (53˚34'S, 70˚40'W, water depth 470m).

Table 3-3-1-1 Summary of sediment cores during the Cruise MR03-K04 leg.3

Core	Date	Equipment	Latitude (˚S)	Longitude (˚W)	Water depth (m)	Cored length including flow-in (cm)
PC-01	Oct. 20	Piston corer	36-13.34	73-41.00	1023	766
MC-01	Oct. 20	Multiple corer	36-13.00	73-41.00	1022	-
PC-02	Oct. 21	Piston corer	39-59.96	74-25.16	1064	791
GC-01	Oct. 21	Gravity corer	39-59.98	74-25.19	1064	268
MC-02	Oct. 21	Multiple corer	39-59.98	74-25.18	1066	-
MC-03	Oct. 24	Multiple corer	52-51.99	74-05.02	558	-
PC-03	Oct. 24	Piston corer	52-52.00	74-05.07	562	964
MC-04	Oct. 25	Multiple corer	53-34.26	70-40.48	469	-
PC-04	Oct. 25	Piston corer	53-34.29	70-40.49	468	1851
GC-02	Oct. 25	Gravity corer	53-34.26	70-40.56	467	308

3-3-2 Equipments and sampling procedures

Naomi Harada (Japan Marine Science and Technology Center)

(1) Multiple core sampler

A Multiple core sampler produced by Rigosha Co. was used for taking the surface sediment. This core sampler consists of a main body of 620kg-weight and 8 sub-core samplers (I.D. 73mm and length of 60cm).

(2) 20m-long piston core sampler

Piston core sampler consists of a 1500kg-weight, a total 20m-long duralumin pipe (5m x 4), and a pilot core sampler. The inner diameter of duralumin pipe is 80mm. The acrylic resin inner pipe was also used. We used a multiple core sampler “Ashura” equipped with an 80kg-weight and three sub-cores of 60cm in length and 73mm I.D. for a pilot core sampler.

(3) Gravity core sampler

Gravity core sampler consists of a 500kg-weight, a total 7m-long stainless pipe (1m x 7), and a pilot core sampler. The acrylic resin inner pipe was also used. The U-ing type corer equipped with an 80kg-weight and a pipe of about 1m-long was used as a trigger.

(4) Site survey

Site survey is very significant to determine the coring position. The site survey was carried out with the 12kHz SEA BEAM 2100 Multibeam Bathymetric Survey System in order to take a sea-bottom topographic. Survey area at every site will be a quadrilateral in the range of about 30 minutes.

(5) Positioning System

Global positioning system (GPS) of WGS84 was used to determine a geographic position.

(6) Sampling Procedures

The multiple core was sliced in 1 or 2 cm each which depended on researcher. These multiple sub-cores will be utilized for onshore analysis in Table 3-3-2-1.

Table 3-3-2-1 Multiple core sample-shearing scheme

Core No.	Analytical item	Person in charge
#1	MSCL, Color, Soft-X, Description, Paleomag/Isotopes, Radiolarian, Archive	JAMSTEC, Takahashi K.
#2	Compound specific C analysis	Uchida M.
#3	Compound specific N analysis	Pantoja S.
#4	Living (stained) Benthic Forams	Marchant M.
#5	Opal, Radionuclides, Diatoms, Coccolith	Carina L.
#6	Allocated for Concepcion	Concepcion
#7	Alkenone, TOC, TN	Harada N.
#8	Archive	JAMSTEC

When inner tube was installed in the piston corer, the core sample in the acrylic resin inner pipe was cut into 1m-long each with a hand sow. When inner tube was not used, the duralumin tube was marked and the sediment sample in the duralumin tube was cut into 1m in length each with a rotary band sow. The 1m-long sediment section was pushed out with a core pusher. The edge of each section was capped with a urethane board, and marked with colored tapes, white to identify the top of section and red for the bottom. For gravity core, halved and 1 m–long acrylic resin inner tubes are installed in the outer, and sediment was cut in 1 m each pulling the inner tube from the outer tube

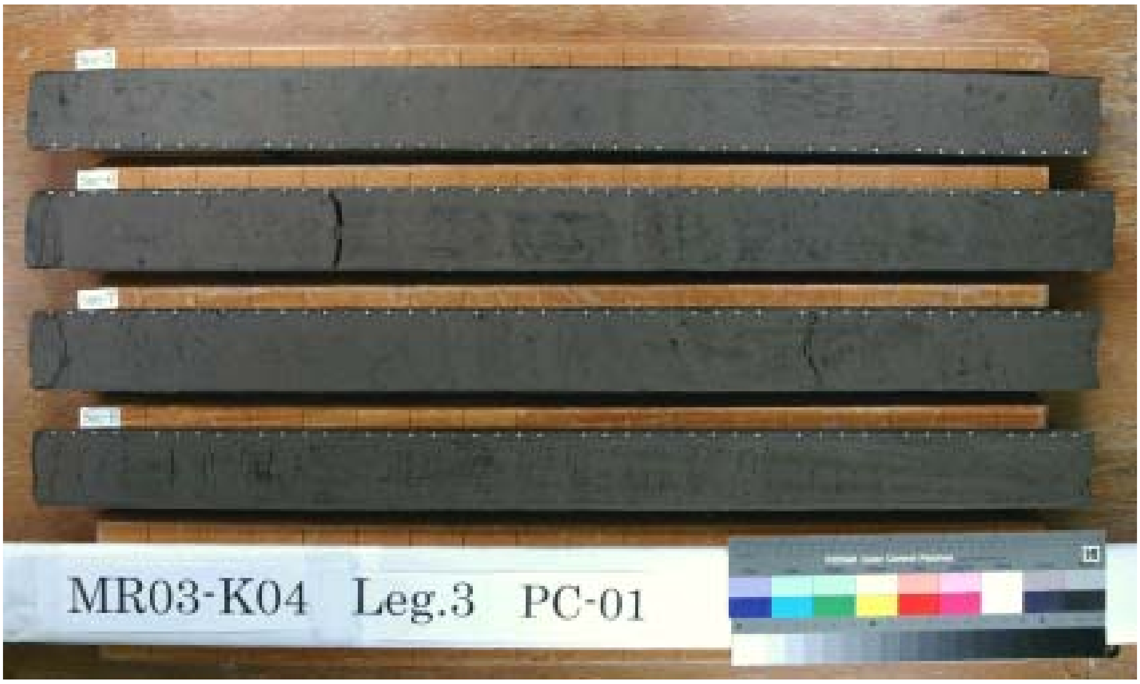
After carrying the sections into the laboratory, whole-round sections were measured the length and run trough the multisensor core logger (MSCL). The MSCL includes the gamma-ray attenuation porosity evaluator (GRAPE), the P-wave logger, and a volume magnetic susceptibility meter. After the MSCL analysis, each section was split lengthwise into working and archives halves with a stainless wire (In the case of acrylic inner tube, the acrylic resin tube and sediment was split into two halves with a core splitter.). After splitting, working and archive halves of each section was designated and the length of the core in each section and the core-catcher sample were measured to the nearest centimeter again.

Archive halves of cores were first scraped across to expose a smooth, fresh surface, then were described visually. Visual core description summarized in the visual core description forms with core color in standard Munsell notation. This analysis was followed by the determination of the archive halves using Minolta CM-2002 color refractometer. The cores were photographed (pictures 3-3-2-1~19). After that process, slab samples of 1cm thick were taken for soft X-ray analysis using a plastic case of 20 cm-long and 3cm-wide. The sub-sample photographed by soft X-ray is going to store as archives. Then halves were sub-sampled for compound specific stable carbon isotopic ratio analysis and radiocarbon measurement and compound specific $\delta^{15}N$. Microfossil assemblage such as diatom, foraminifera, and coccolithophorid are also going to be analyzed. The archive pieces (plastic case) were transferred to 4˚C storage aboard the R/V MIRAI.

The working halves of the core were continuously sub-sampled for on shore analysis. The sub-sample for water content analysis was taken 2cm each using plastic containers of 22.5mm x 22.5mm x 22.5mm (ca.7cc). These plastic cube samples were also used for paleo-magnetic analysis and organic geochemical analysis such as total carbon, organic carbon, total nitrogen. The sub-sample for $\delta^{18}O$, ^{13}C and ^{14}C, of planktonic foraminifera and benthic foraminifera, and trace metal (Cd/Ca, Mg/Ca) analyses of those microfossils were taken by using plastic syringe. The sediment materials were completely sub-sampled for, alkenone, sterol, hydrocarbon, and fatty acid by using glass bottle, radiolarian assemblage using plastic bags and, radiogenic isotopes of trace metal elements such as $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, and $^{176}Hf/^{177}Hf$ ratios using plastic bag or plastic container.

Regarding the gravity core, archive halves of core were described visually and sub-sampled for microfossil assemblage of diatom, foraminifera, and coccolithophorid, and compound specific stable nitrogen isotopic ratio analysis. The working halves were also sub-sampled for soft-X ray, compound specific stable carbon isotopic ratio and radiocarbon, radiolarian assemblage, paleo-magnetic analysis, $\delta^{18}O$, ^{13}C, ^{14}C, and trace metal (Cd/Ca, Mg/Ca) analyses of planktonic foraminifera and benthic foraminifera, and radiogenic isotopes of trace metal elements such as $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{176}Hf/^{177}Hf$ ratios

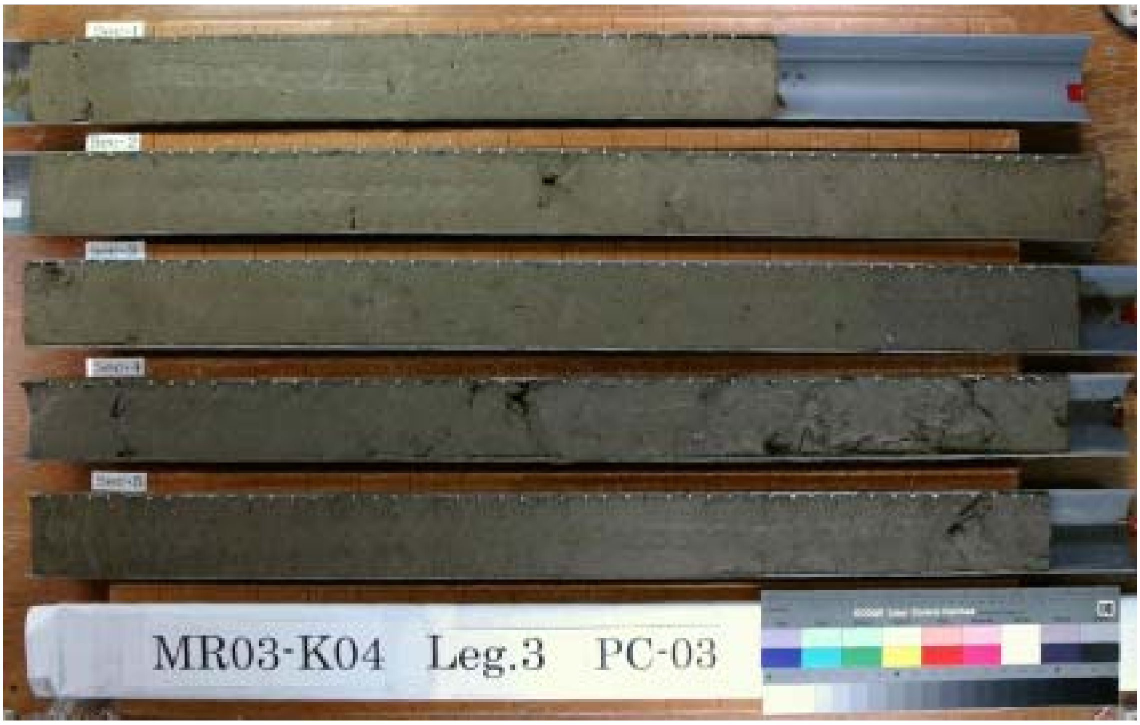
Picture 3-3-2-1 PC-01 Sec.1-4



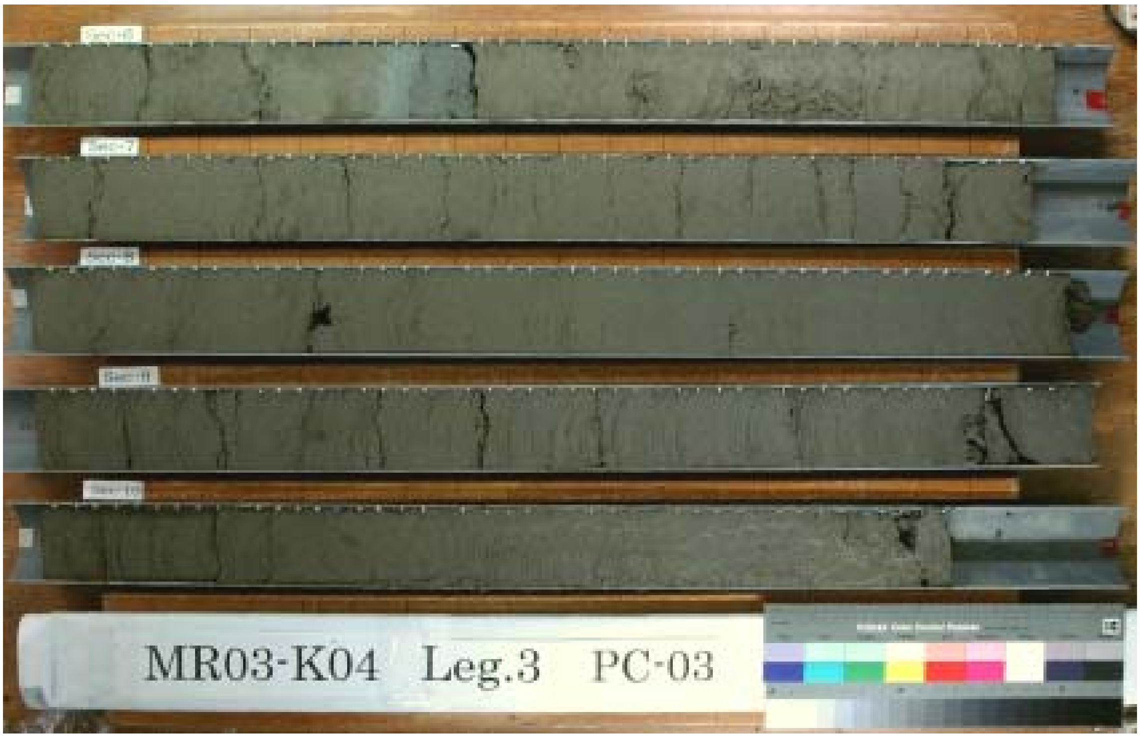
Picture 3-3-2-2 PC-01 Sec.5-8

Picture 3-3-2-3 PC-02 Sec.1-4

Picture 3-3-2-4 PC-02 Sec.5-8

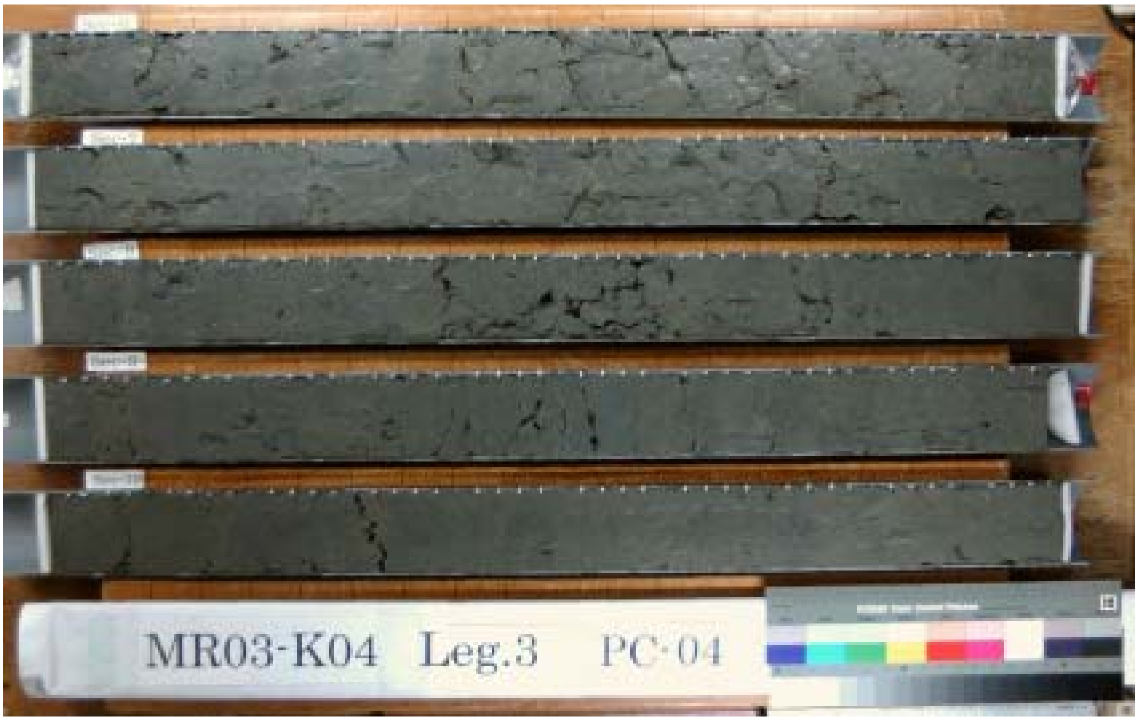


Picture 3-3-2-5 PC-03 Sec.1-5



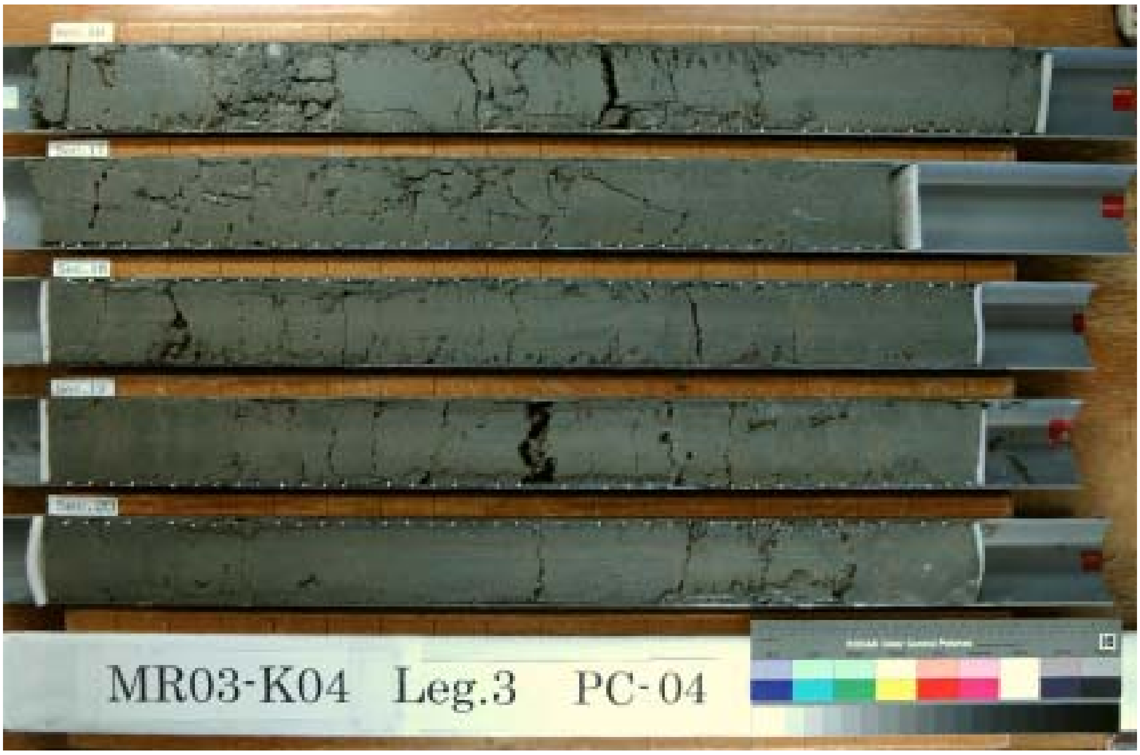
Picture 3-3-2-6 PC-03 Sec.6-10

Picture 3-3-2-7 PC-04 Sec.1-5



Picture 3-3-2-8 PC-04 Sec.6-10

Picture 3-3-2-9 PC04 Sec.11-16



Picture 3-3-2-10 PC-04 Sec.16-20

Picture 3-3-2-11 GC-01 Sec.1-3

Picture 3-3-2-12 GC-01 C.C.

Picture 3-3-2-13 GC-02 Sec.1-3

Picture 3-3-2-14 GC-02 C.C.

Picture 3-3-2-15 MC-01 HAND-1

Picture 3-3-2-16 MC-02 HAND-1

Picture 3-3-2-17 MC-03 HAND-8

Picture 3-3-2-18 MC-04 HAND-1

Picture 3-3-2-19 PL-01 HAND-1

3-3-3 Visual Core Description

Naokazu Ahagon†, Carina B. Lange‡, Margarita E. Marchant‡, Silvio Pantoja‡, Raul I. Tappa‡, and Alejandro J.A. Santis‡

† Mutsu Inst. Oceanography, Japan Marine Science and Technology Center

‡ University of Concepción, Chile

(1) Methods

Split surface of archive half section was scraped for exposing fresh surface by glass or stainless-steel plate and then lithological and sedimentological features were described using handwritten visual core description (VCD) sheets. In the MR03-K04 Leg.3, the ODP-style nomenclature for lithological description (e.g., Mazzullo *et al*., 1988) was adopted with some modifications. Sediment classification scheme used here was similar with that of Shepard's ternary diagram for Sand-Silt-Clay component system with modifier. However, in case of the sediment consisted of mixture of an almost equal amount of each component, we described as "mud" for convenience. For example, the mixed sediment, which consisted of 30%Sand-30%Silt-30%Caly and 10%Nannofossil, is named as "Nannofossil-bearing mud". Results from smear slides, microfossil observations, and soft X-ray radiographs were combined to construct summarized lithologic columns.

(2) Results

In general, the sediments at all sites are composed of homogenous fine-grained hemipelagic sediments with various degrees of bioturbation throughout. The sediments from Station 1 and 2 (MC-01, PC-01, MC-02, PC-02, and GC-01) are dominated by Clayey Silt–Silty Clay with varying amount of diatom and nannofossil. These are consistent with the lithology of site 1234 and 1233 of ODP Leg.202 (Mix et al., 2003). Sand content is highest at Station 3 (MC-03 and PC-03) in the Pacific inlet of Magellan Strait, while Clay content is highest at Station 4 (MC-04, PC-04, and GC-02) in Magellan Strait. All cores have a wide variety of microfossils, being Station 3 the most diverse. Station 4, on the other hand has little amount of foraminifers and high content of continental markers. These lithological and sedimentological features were summarized as graphic columns with short notes (Figure 3-3-3.1).

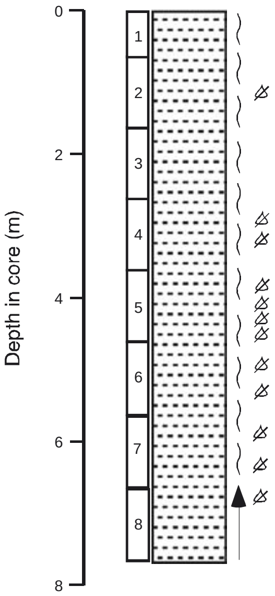
Digitized version of individual VCD sheets and scanned Soft-X images for constructing graphic columns are archived in Appendix in this volume.

References

Mazzullo, J.M., Meyer, A., and Kidd, R.B., 1988. New sediment classification scheme for the Ocean Drilling Program. *In* Mazzullo, J., and Graham, A.G. (Eds.), *Handbook for Shipboard Sedimentologists. ODP Tech. Note*, 8:45–67.

Mix, A.C., Tiedemann, R., J.M., Blum, P. *et al*., 2003. *Proc. ODP, Init. Repts.*, 202 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

PC-1



Major Lithology: Clayey Silt - Silty Clay

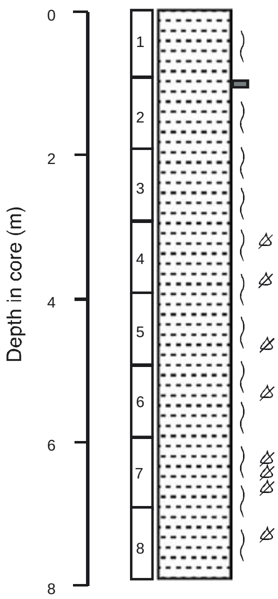
The sediment is composed of homogeneous clayey silt - silty clay with slight to moderate bioturbation throughout. Shell fragments are highly visible in sections 5, 6 and 7. Section 8 shows a typical flow-in structure throughout.

Length: 7.66 m

GC-St.1

Not recovered due to malfunction of bit valve.

PC-2

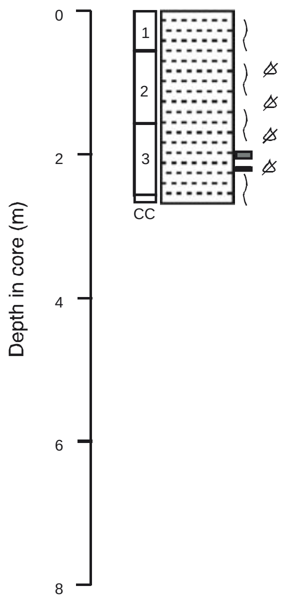


Major Lithology: Clayey Silt - Silty Clay

The sediment is composed of homogeneous clayey silt - silty clay with slight bioturbation throughout. Slight dark and coarser layer (12cm thick) at top of section 2 is observed. Shell fragments are visible in lower part of the core.

Length: 7.91 m

GC-1



Major Lithology: Clayey Silt - Silty Clay

The sediment is composed of homogeneous clayey silt - silty clay with slight bioturbation throughout. Slight dark and coarser layer (10cm thick) and thin lamination are observed at section 3.

Length: 2.68 m

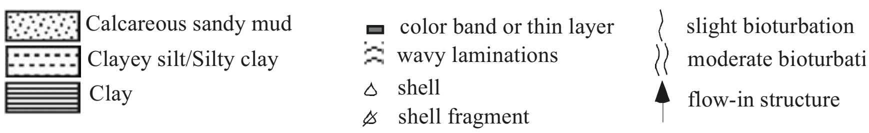
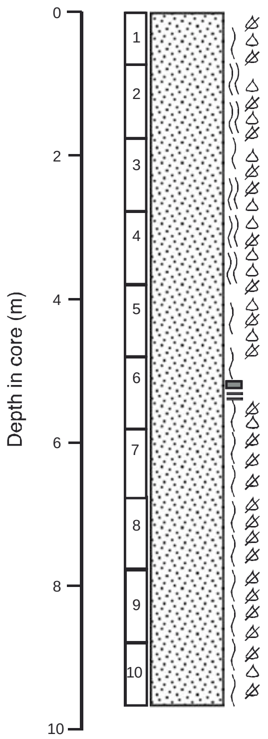


Figure 3-3-3.1. Lithological summary for sediment cores collected during MR03-K04 Leg.3. The major lithology is represented by graphic column. Numerals in the left side of graphic column indicate section numbers.

PC-3

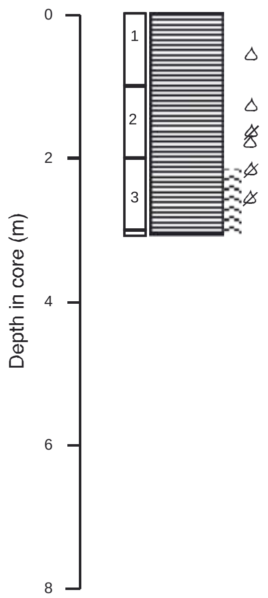


Major Lithology: Calcareous Sandy Mud

The sediment is composed of grayish olive to olive gray (5Y5/3-10Y4/2) calcareous sandy mud which contains abundant calcareous fossils such as foraminifers, pteropod, bivalve, echinoid, bryozoa etc. (see also *3-3-6* for details). Bioturbation throughout the core except the turbidite sand layers in section 6. The smell of H_2S is observed throughout.

Length: 9.64 m

GC-2

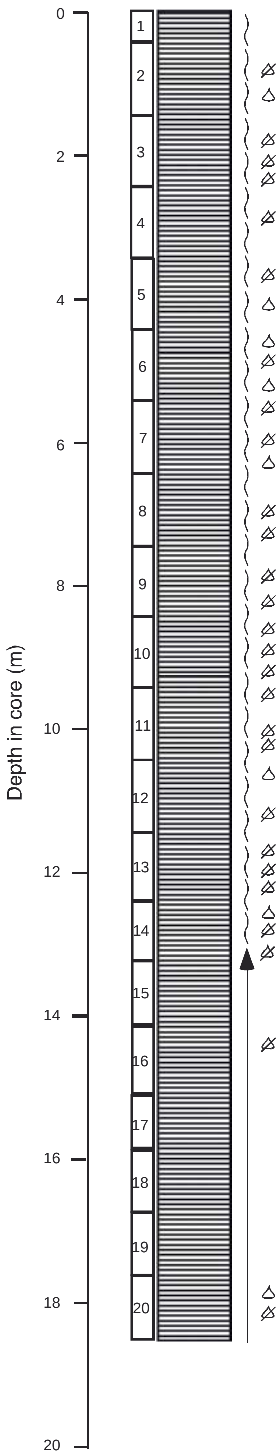


Major Lithology: Clay

The sediment is composed of olive gray (10Y4/2) homogeneous clay. The smell of H2S is observed troughout. A faint wavy color laminations with burrowing are observed in section 3.

Length: 3.08m

PC-4



Major Lithology: Clay

The sediment is composed of olive gray (10Y4/2), virtually structureless, homogeneous clay. Shell fragments and polychaete tubes are sporadically scattered throughout. Smell of H_2S is observed in the entire sections.

The sediment was slightly disturbed and extended during on-deck process because of expansion of inherent gas in sediment pore water, especially in the lower sections. Soft-X images indicate that the flow-in or expansion structures occurred below the mid of sec.14.

Length: 18.51 m

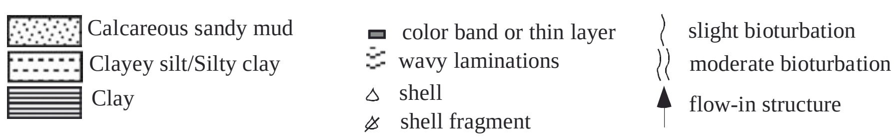


Figure 3-3-3.1. *(Continued)*

3-3-4 Color reflectance

Lruis A. Conti (University of Sao Paulo)
Matsuura Yutaka (Marine Works Japan Ltd., MWJ)
Tamami Ueno (MWJ)
Rena Maeda (MWJ)
Yuusuke Sato (MWJ)

(1) Introduction

The most common use of color measurements in split-cores is the acquisition of reflectance parameters what indicates several characteristics of the sediments such as litology, oxidation rate, concentrations of carbonates, organic matter and certain inorganic compounds. It is also frequently used to correlate different corers.

There are different systems to quantify the color reflectance for soil and sediment measurements, the most common is the L*a*b* system, also referred to as the CIELAB system. It can be visualized as a cylindrical coordinate system in witch the axis of the cylinder is the lightness (variable L*) ranging from 0% to 100% (black to white) and the radii are the chromatic (variables a* and b*). Variable a* is the green (negative) to red (positive) axis, and variable b* is the blue (negative) to yellow (positive). Other system derived from L*a*b* system is known as MUNSEL notation that give color parameters in terms of L*, V (value) and C (chroma). Despite can be used as secondary parameter to analyze sediment color the MUNSELL system has many disadvantages, it is a procedure that this is neither high objective nor can the data be analyzed quantitatively.

It was used, in this leg, for measure the color reflectance parameters a Minolta Photospectrometer CM-2002 using 400 to 700 nm in wavelengths. This is a compact and hand-held instrument in which specifications can be found in Blum (1997)[1] and can measure spectral reflectance of sediment surface with a scope of 8 mm diameter. To ensure accuracy, the CM-2002 was used with a double-beam feedback system, monitoring the illumination on the specimen at the time of measurement and automatically compensating for any changes in the intensity or spectral distribution of the light.

---

[1] Bloom, P. – 1997- Reflectance, Spectrophotometry and colorimetry. PP. Handbook.

After split the cores sections in two parts (A and B), both parts were measured and marked each 2 cm. A crystal polyethylene wrap (saran wrap) covered the two them and the part A was reserved to color measurements and photography while the part b was directed to sub sampling.

After turn on the “Minolta Photospectrometer CM-2002” it was necessary to make two calibrations: “the zero calibration” and “white calibration”. The first one is performed to compensate for the effects of stray light owning to flare characteristics. In addiction, zero calibration may also compensate variations on the ambient, as temperature and humidity. It was performed using a “zero calibration box” (Minolta CM-2002 standard accessories). The white calibration sets the maximum reflectance to 100%. Each time the camera is switched on and after zero calibration, white calibration was performed. After the regular calibration and white calibration (used in each core measure), the process of measure starts, getting one measure in each 2 cm of the core. The data was storage on a laptop. (picture 3-3-4-1).

After each core section measure, the data was saved and exported to a ascii file, that could be loaded by any worksheet software as MS Excel.

Picture –3-3-4-1 color measurements

(2) Preliminary results

The data and graphics of the color measurements are shown on the Figs 3-3-4-1~14 and Table 3-3-4-1~11 in Appendix.

The first outstanding result obtained is relative to the core correlation. Since the piston cores (PC) 2 and 4 and Gravity cores (GC) 1 and 2 respectively were obtained at the same position, the color parameters could indicates how much sediment was lost on the top of piston corer. Unusually, there are about 1 to 1.5 meters of lost on the top of piston corer due to compaction and high penetration of the piston core on the process of sampling. Comparing the pattern of the color distribution between the piston corer and the gravity corer the lost of material can be predicted.

This process produced very good results on the correlation between PC-2 and GC-1, as it is possible to see in Fig. 3-3-4-1. The Relative position of color differences features could be compared, and it was concluded that there was a lost of the first 1.36 meters of the piston corer. On the case of comparison between PC-4 and GC-2 this relation was not so clear. This happened due the fact that both PC-4 and GC-2 presented a chaotic distribution of stains of darker material all long the core, and also due to the irregularities of the measure surface on PC-4. That condition made the of the color parameters change very much in a few centimeters of sampling as it possible to see in graphics PC-4 and GC-2 in the Figs 3-3-4-8, 9, 12 and 13.

Other basic and very useful characteristic in color measures is the relation between the L* parameter (or gray level) and carbonates contents in sediment. Despite this relation was not direct, could give a semi-quantitative relation. Thus, it is possible to observe the basic pattern of carbonate contents change following the behavior of the curves shown on the first graphics of each page of Figs. 3-3-4-2, 4, 6, 8, 10 and 12.

It can be observed in the PC-1 a clear trend of increasing the values of L* from top until the depth of 3m where the parameter value reach 53 and start do decline until the depth of 4.5m and then became stable around the value of 43, with a higher peak of 52 near 6.5 m depth. In PC-2 and PC-3, the general trend is more stable, with an exception of a lower value peak in PC-2 on the depth of 1 meter. In the case of PC-4 it can be observed a general trend of increasing values of L* toward the bottom of the core. The GC-1 and GC-2 presented a general.

Parameters a* and b* do not to seem to yield much characteristic information or cyclic variations. They are, however, sensitive to clay mineralogy, nannofossil content etc. Ratios such as a*/b* used in this work or parameters of the MUNSELL system, may distinguish this variations better than a* and b*. However, it was possible to note that peaks on value of a* and b* (and a*/b* ratio), witch may indicate changes on the lithology and specific compounds concentrations. The most clear example of that is a dramatic change on parameter a* (and b*) on the PC-1 between 1m and 2m of core depth. Variations of few centimeters can also be noted in the thinner peaks on the graphics and it reflect local variations on the core characteristics as can be seen on picture 3-3-4-2.

Picture 3-3-4-2 variations of litology on PC-2

As a suggestion for future data analysis, it could be done some statistical analysis using all parameters (i.e. temporal series analysis) or even work not with the data itself but with its first derivative. It was not possible develop this kind of studies due the absence of statistical software packages on the computers on board.

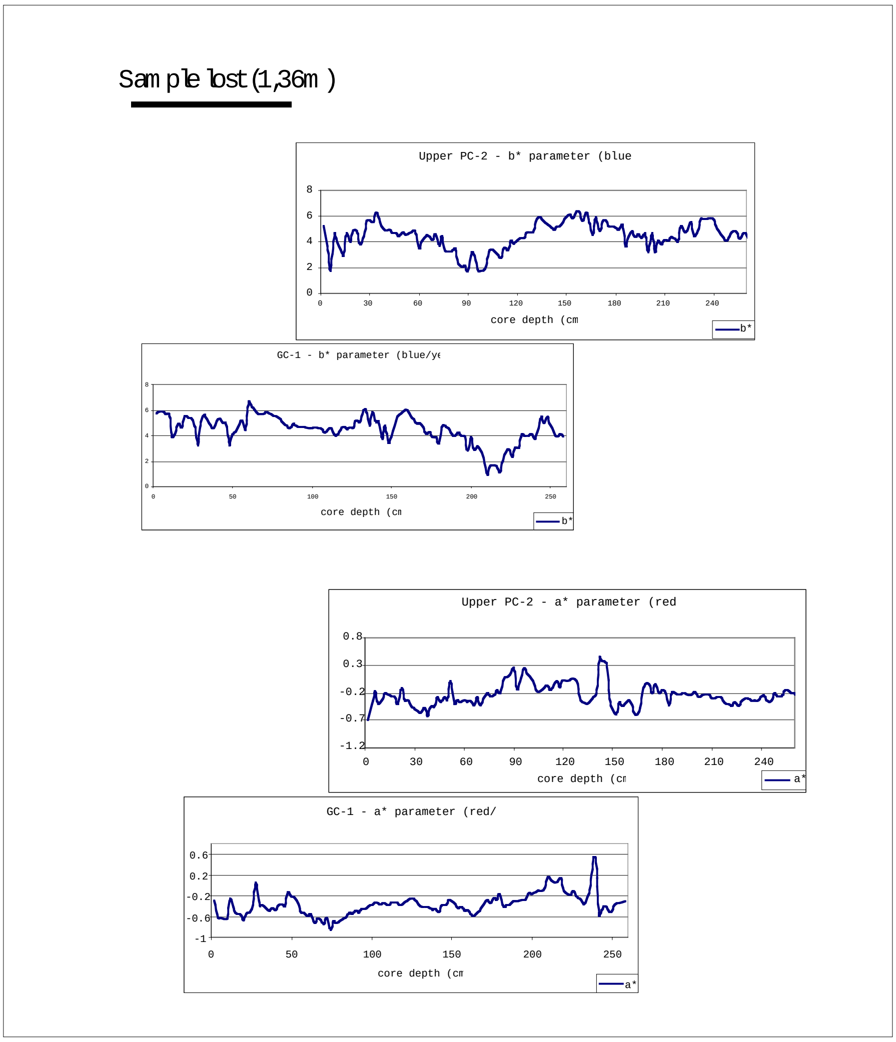


Fig. 3-3-4-1 The L*, a* and b* parameters showing coincidence between the top of PC-2 and GC-1, indicating the amount of lost of sediment on the piston core (~1.6m)

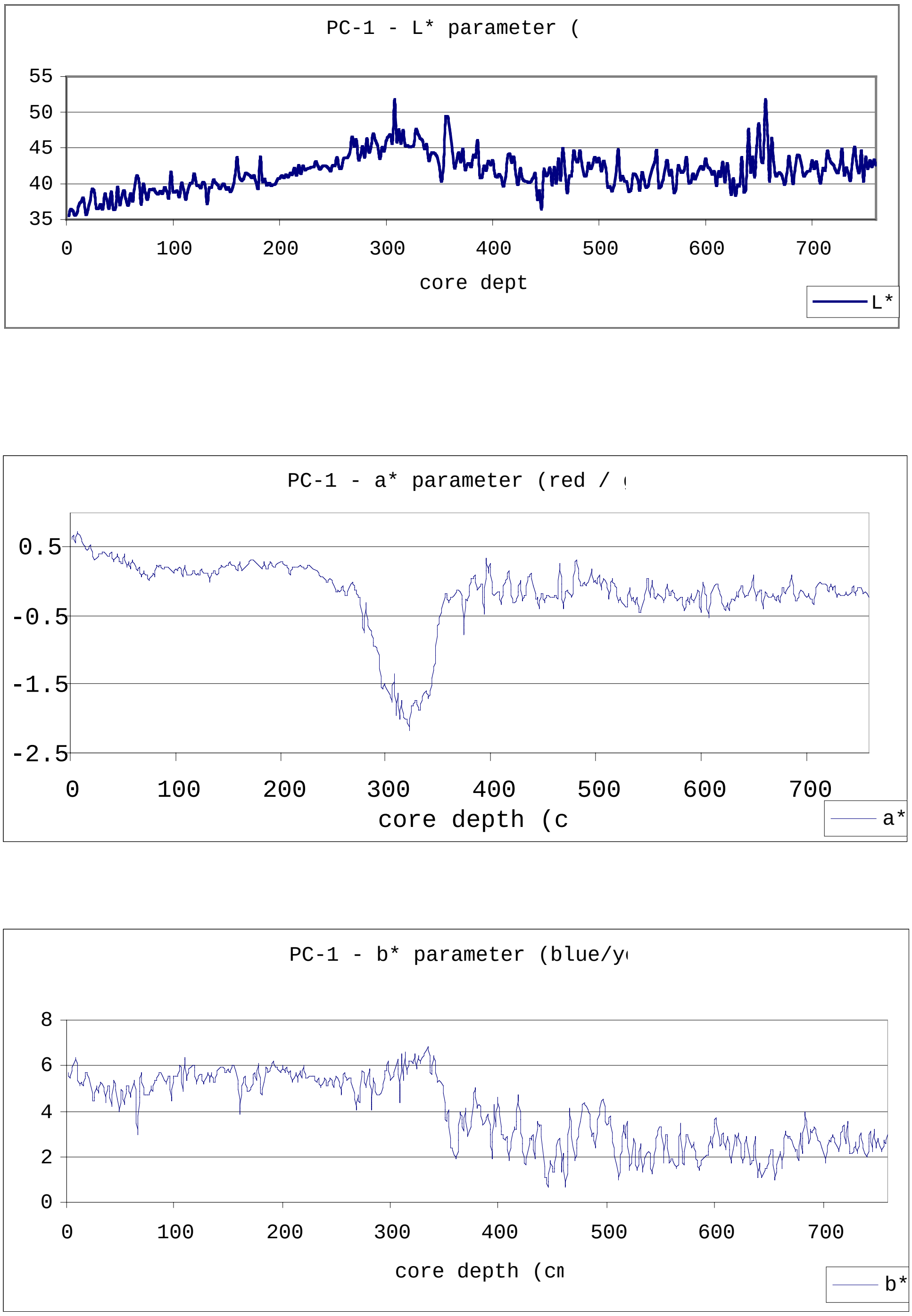
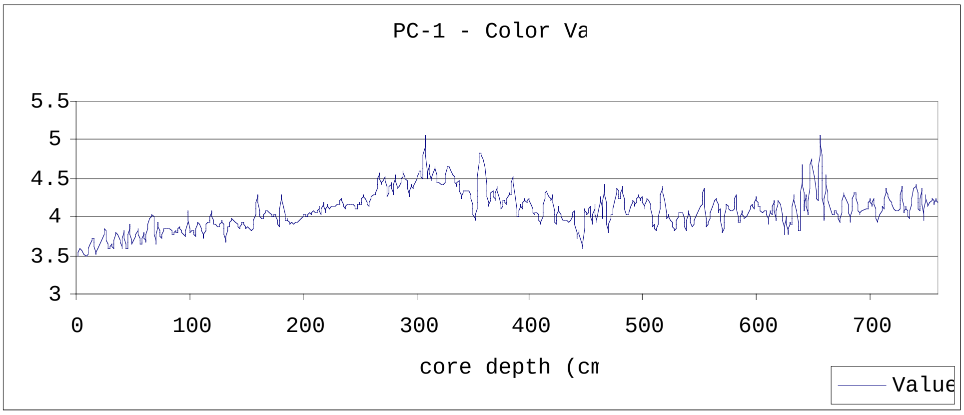
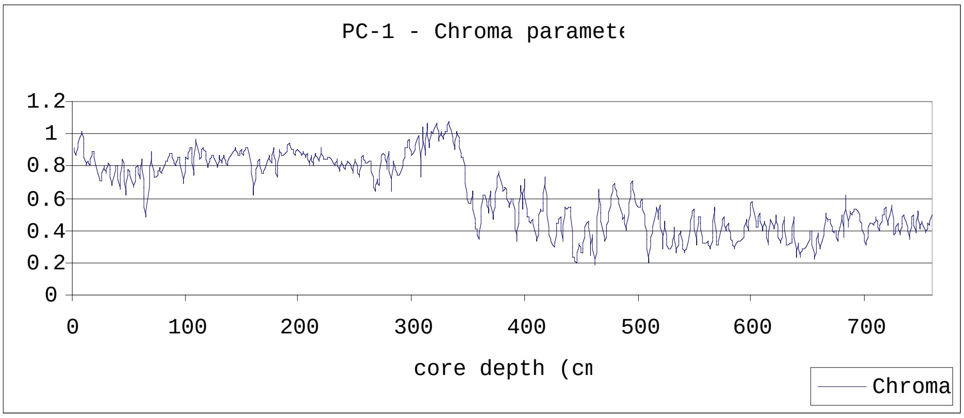


Fig. 3-3-4-2 L*, a*, and b* parameters of PC-1





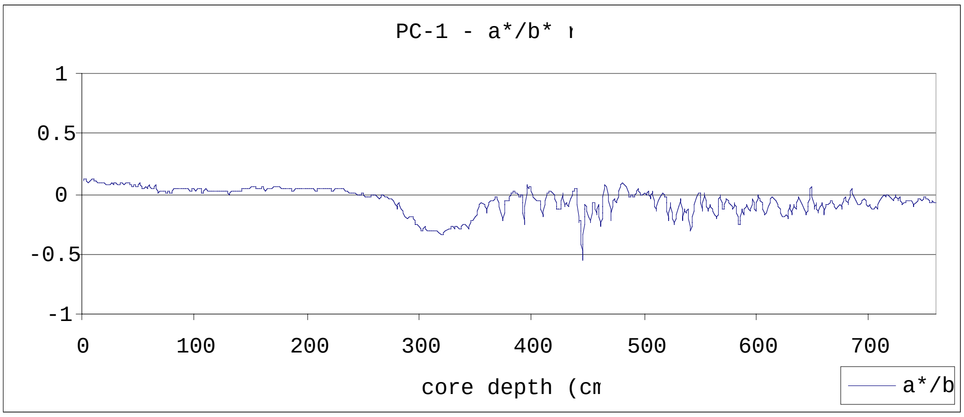
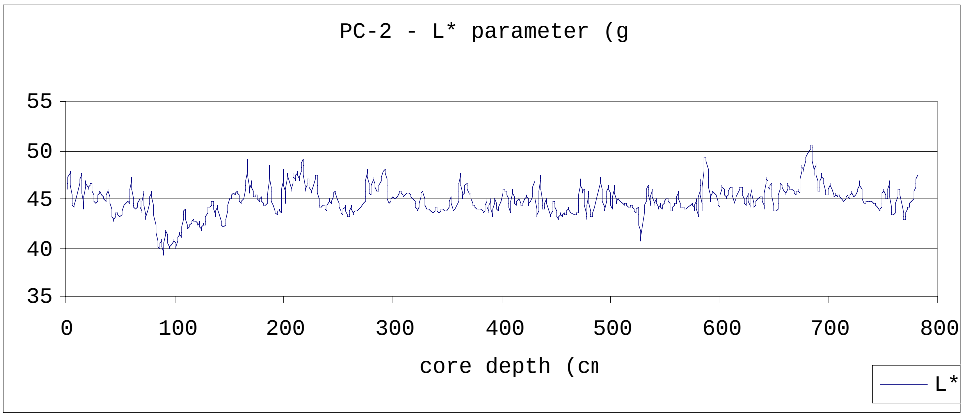
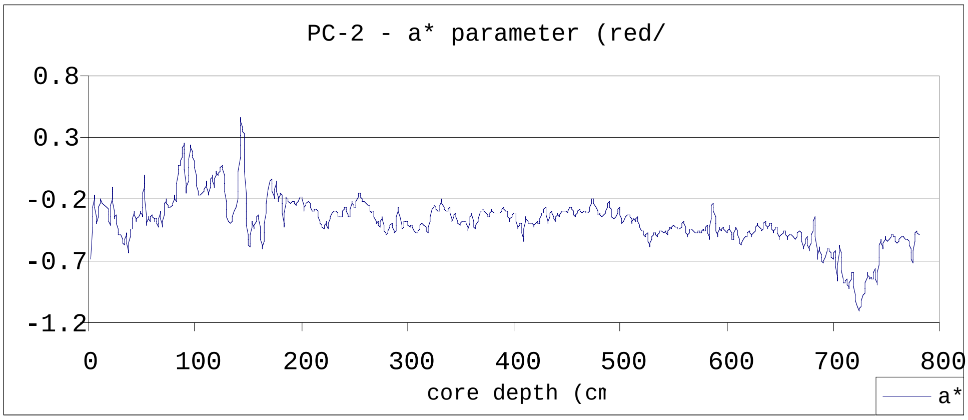


Fig. 3-3-4-3 Color parameters of PC-1





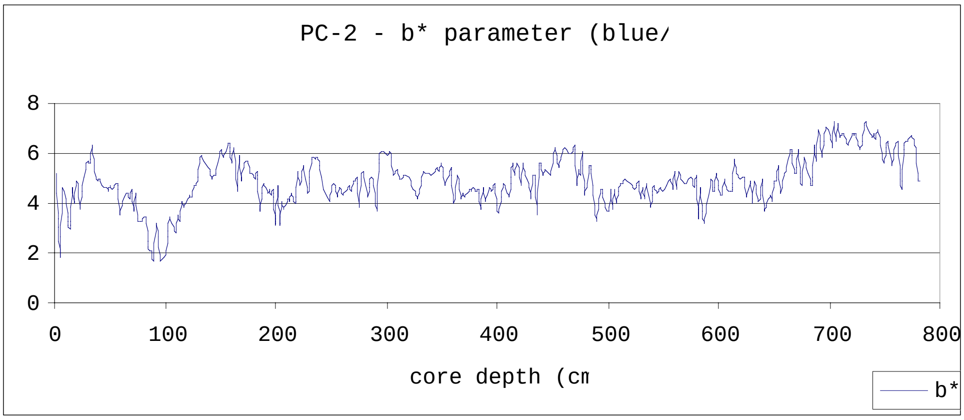
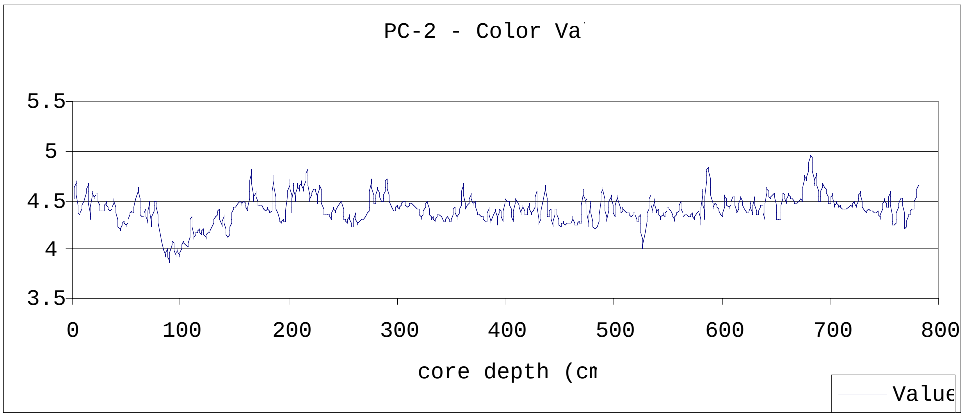
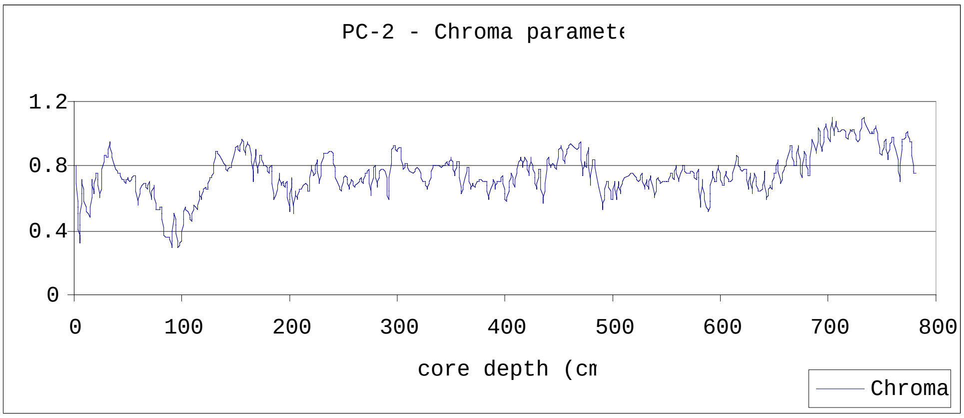


Fig. 3-3-4-4 L*, a* and b* parameter of PC-2





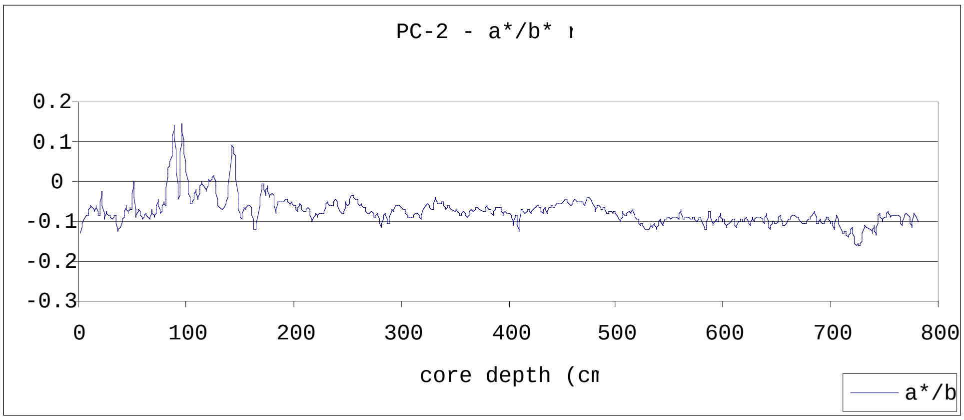
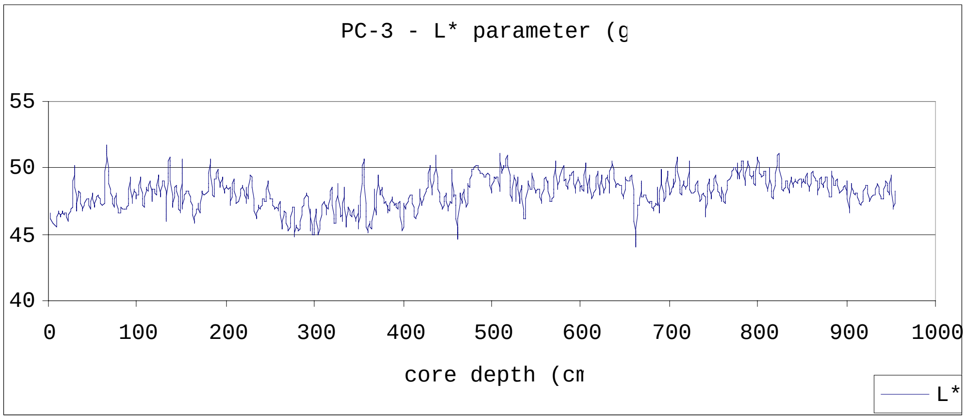
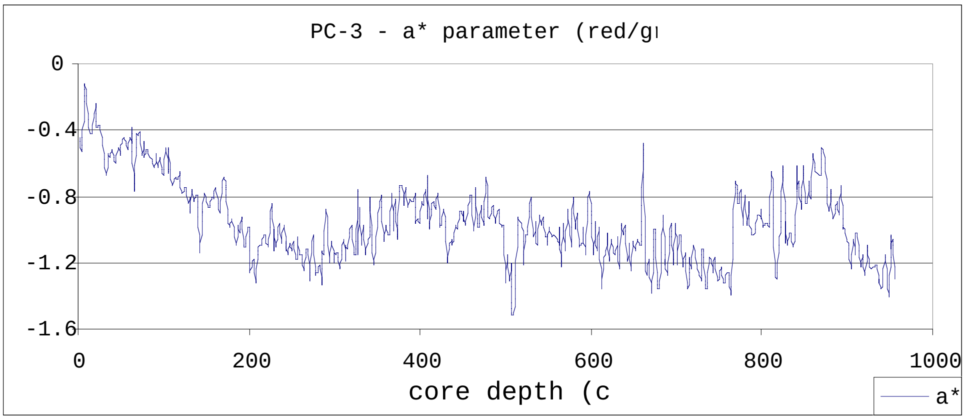


Fig. 3-3-4-5 Color parameters of PC-2





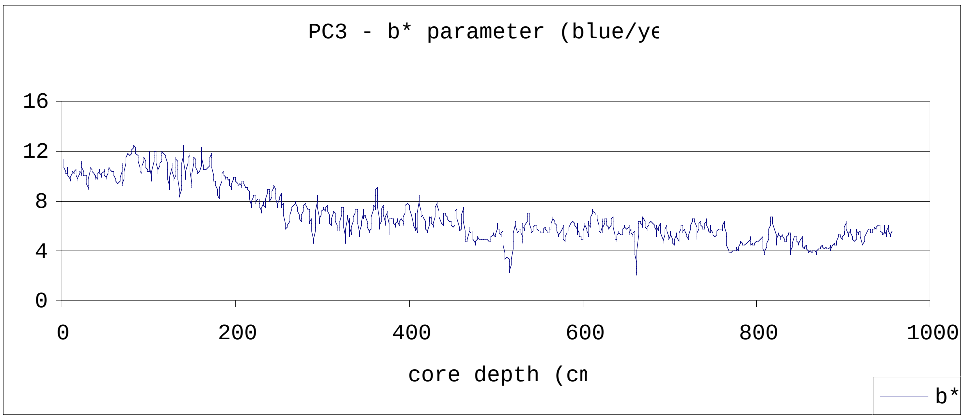


Fig. 3-3-4-6 L*, a* and b* parameters of PC-3

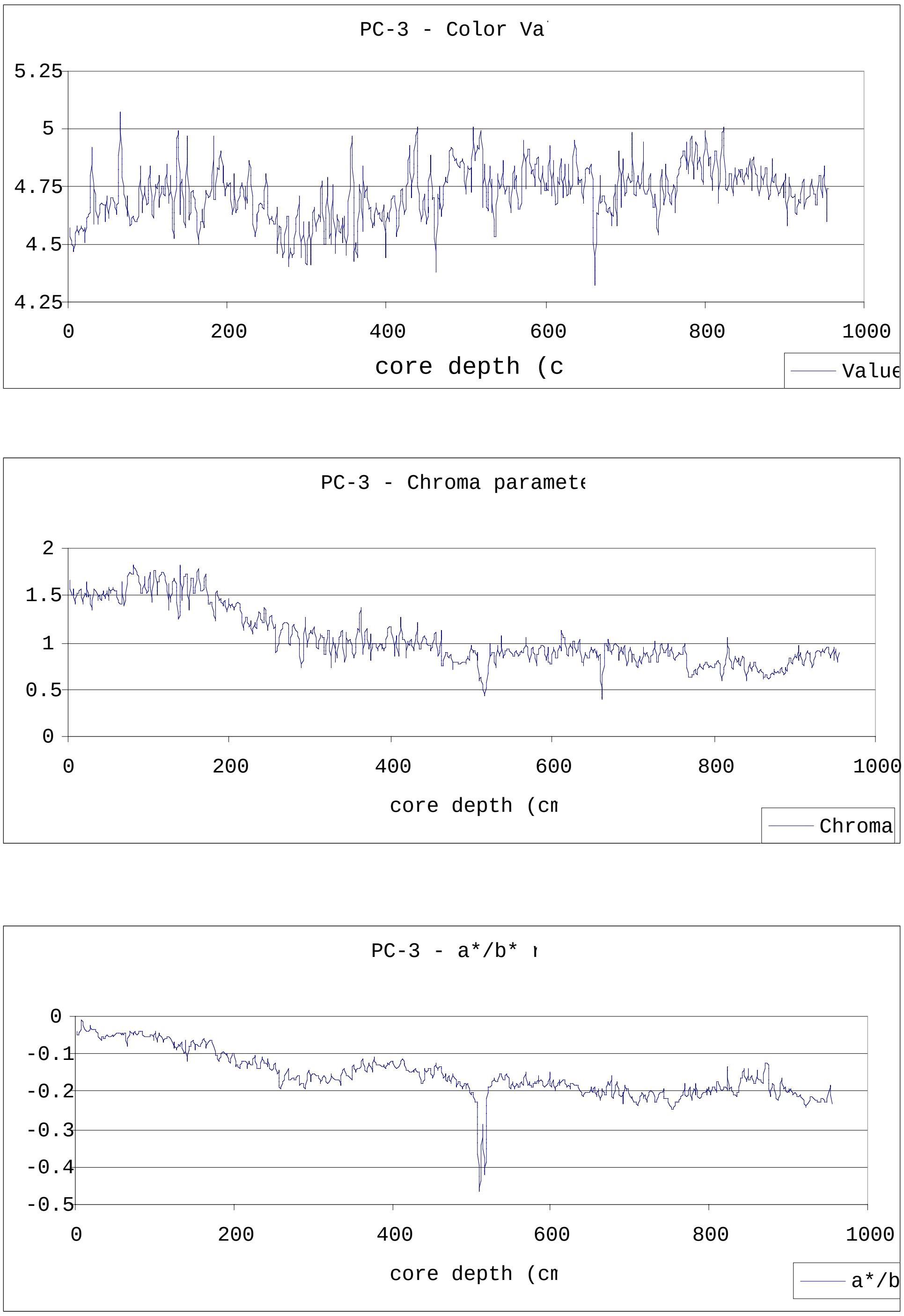


Fig. 3-3-4-7 Color parameters of PC-3

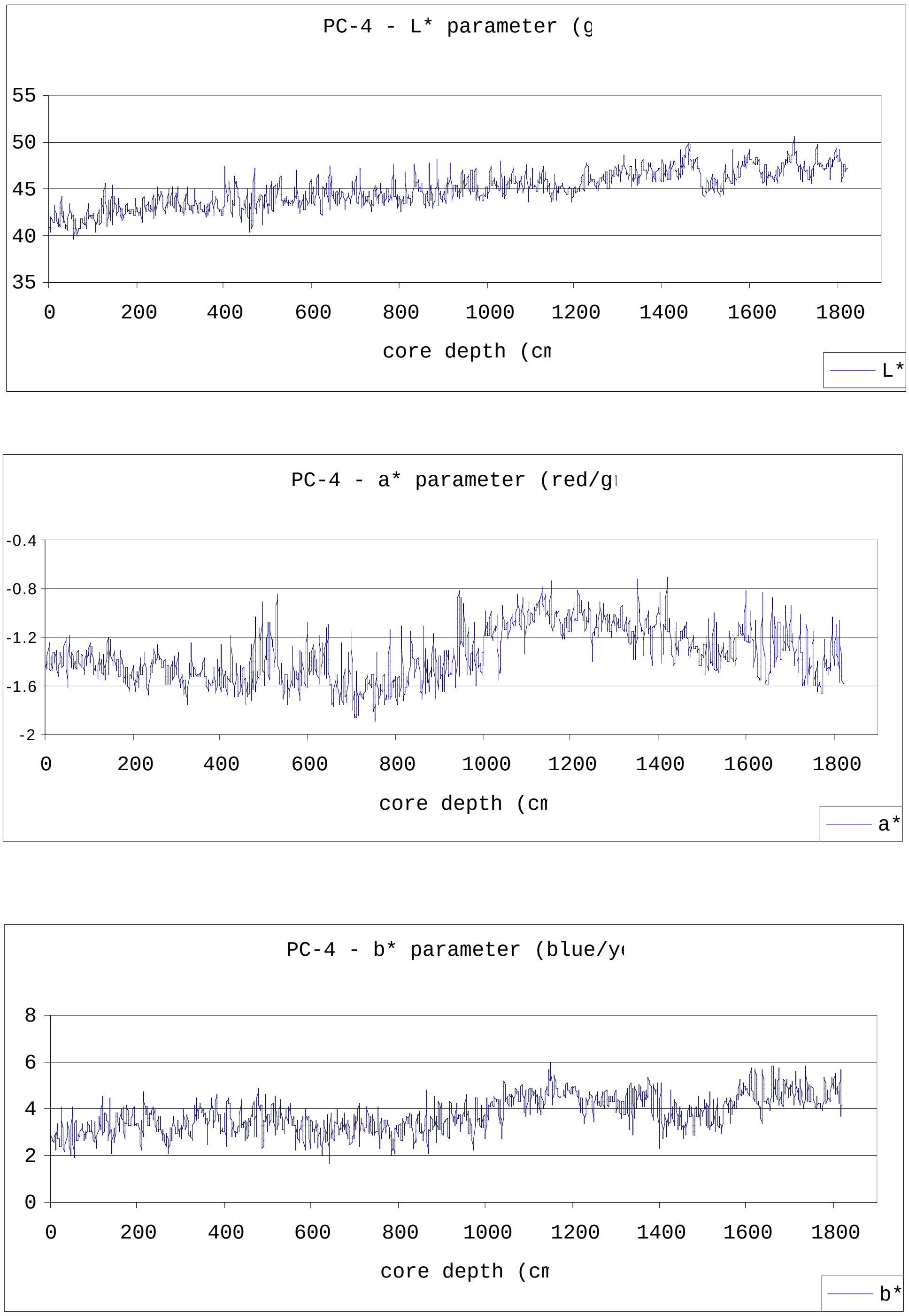
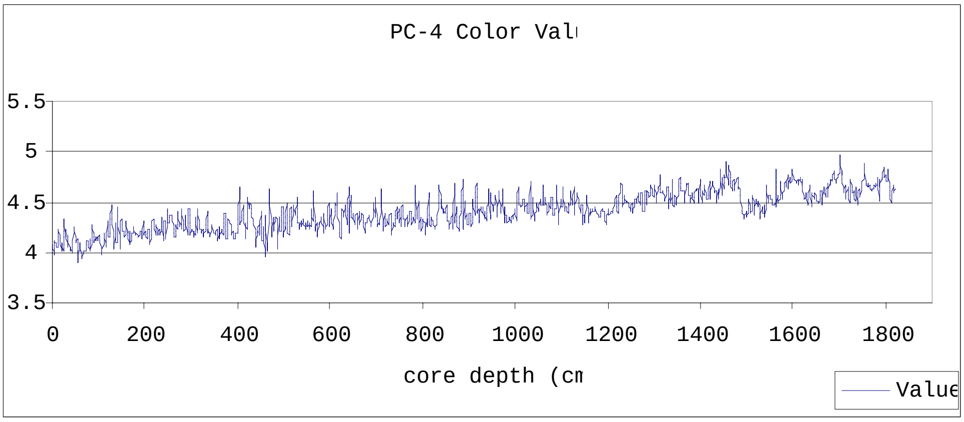
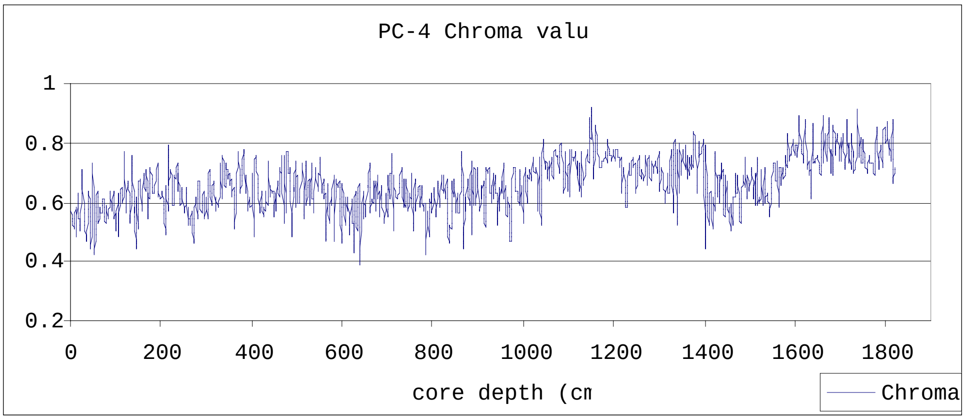


Fig. 3-3-4-8 L*, a* and b* parameters of PC-4





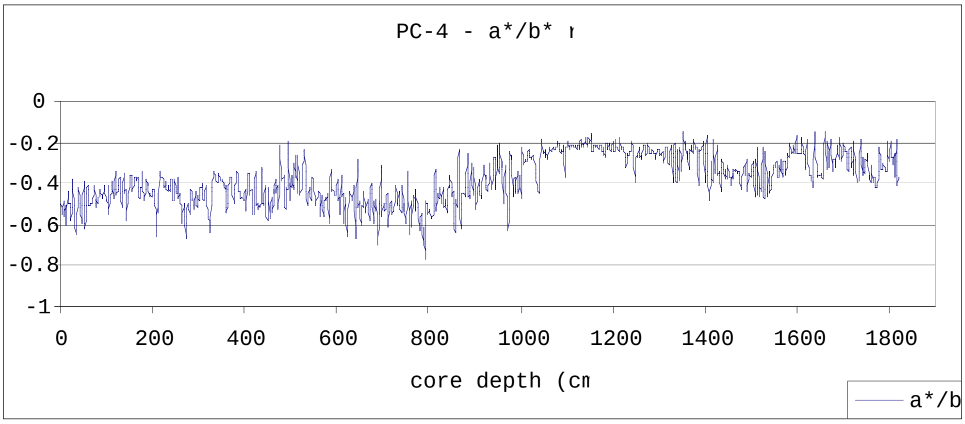


Fig. 3-3-4-9 Color parameters of PC-4

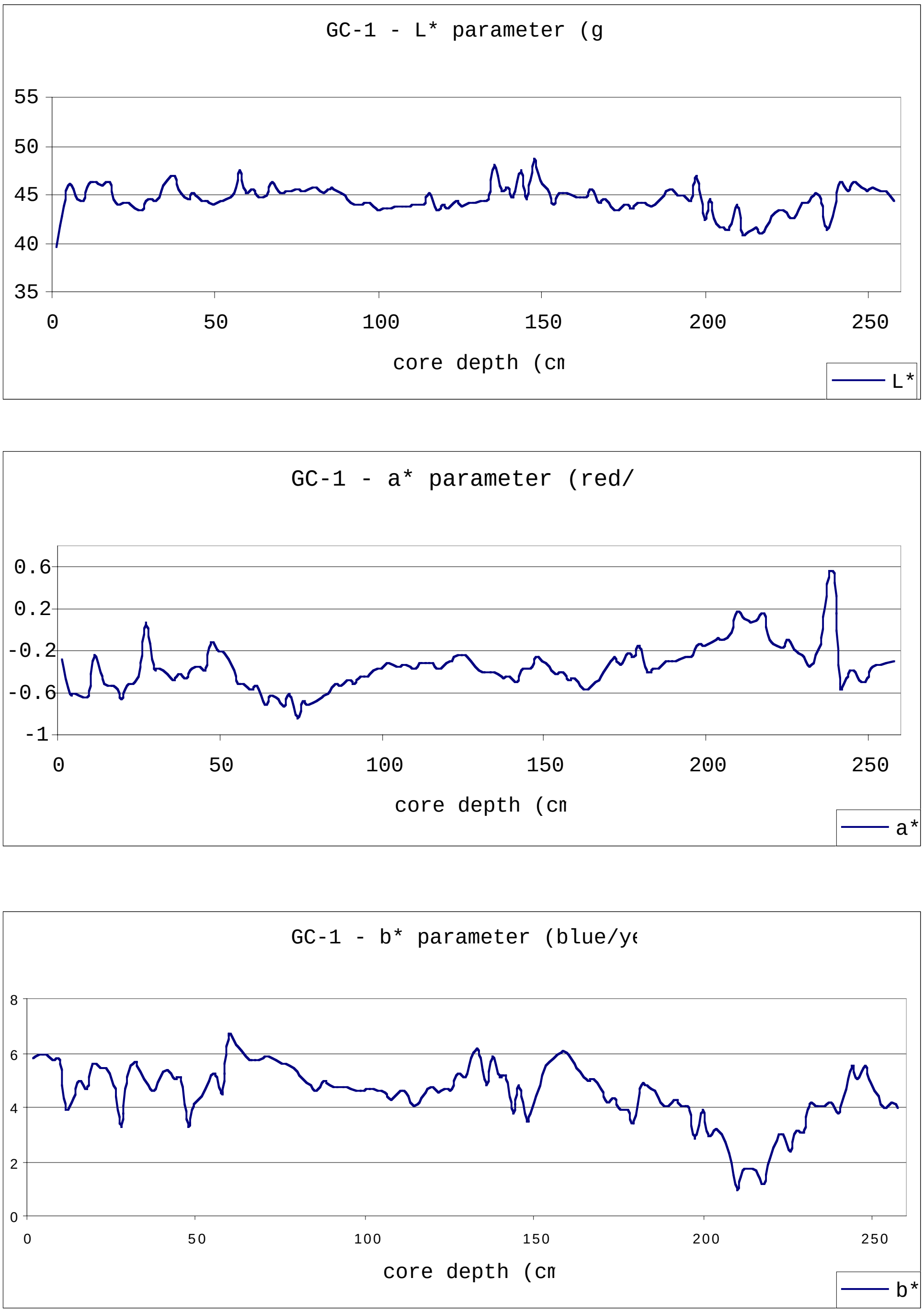


Fig. 3-3-4-10 L*, a*, and b* parameters of GC-1

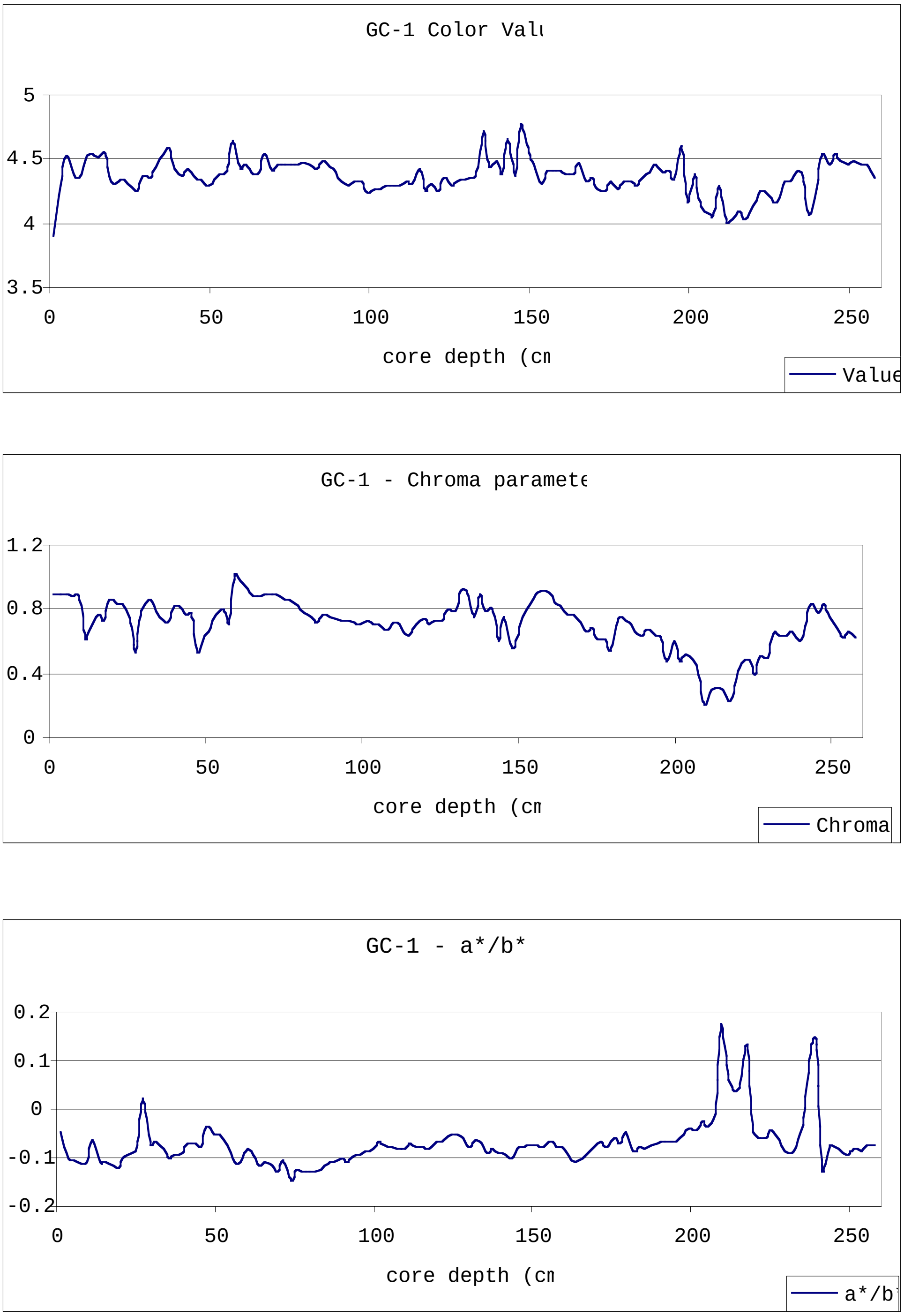
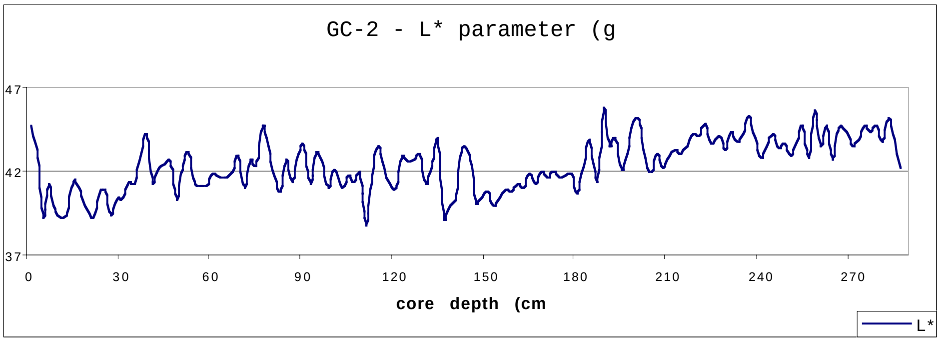
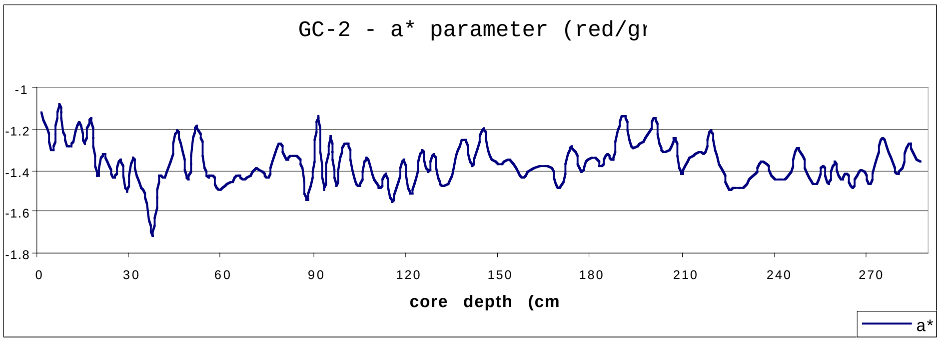


Fig. 3-3-4-11 Color parameters of GC-1





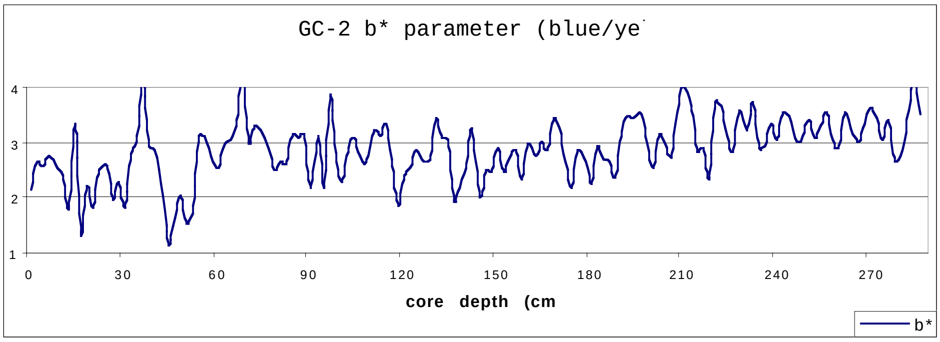
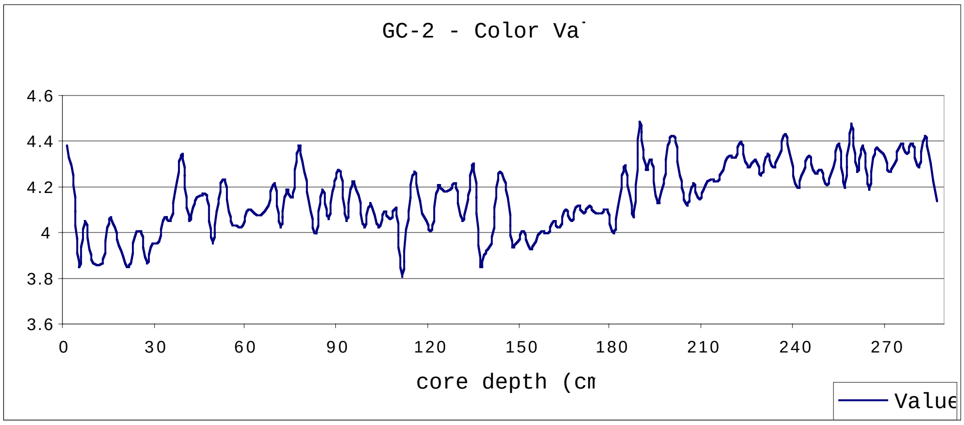
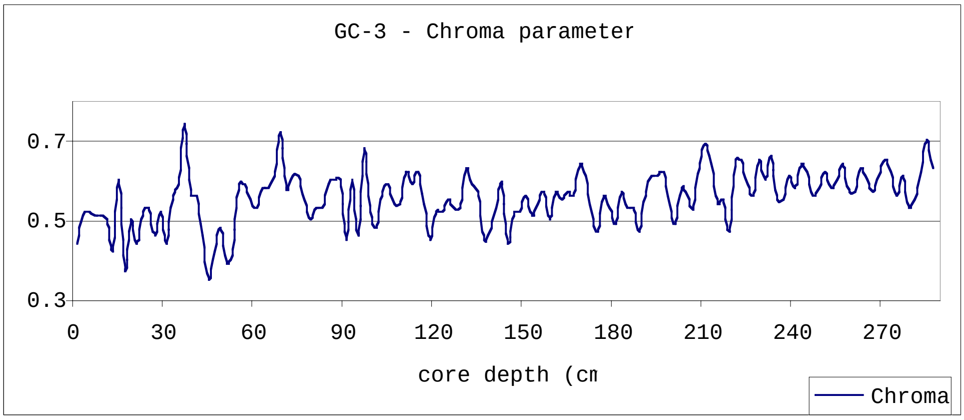


Fig. 3-3-4-12 L*, a* and b* parameters of GC-2





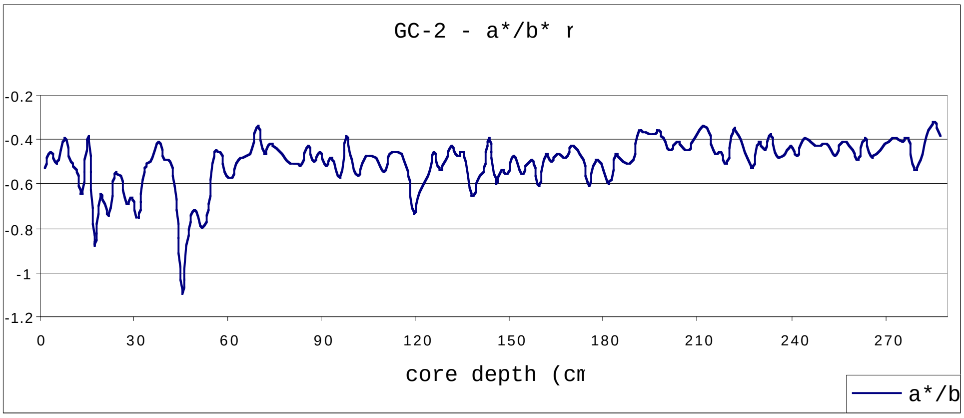


Fig. 3-3-4-13 Color parameters of GC-2

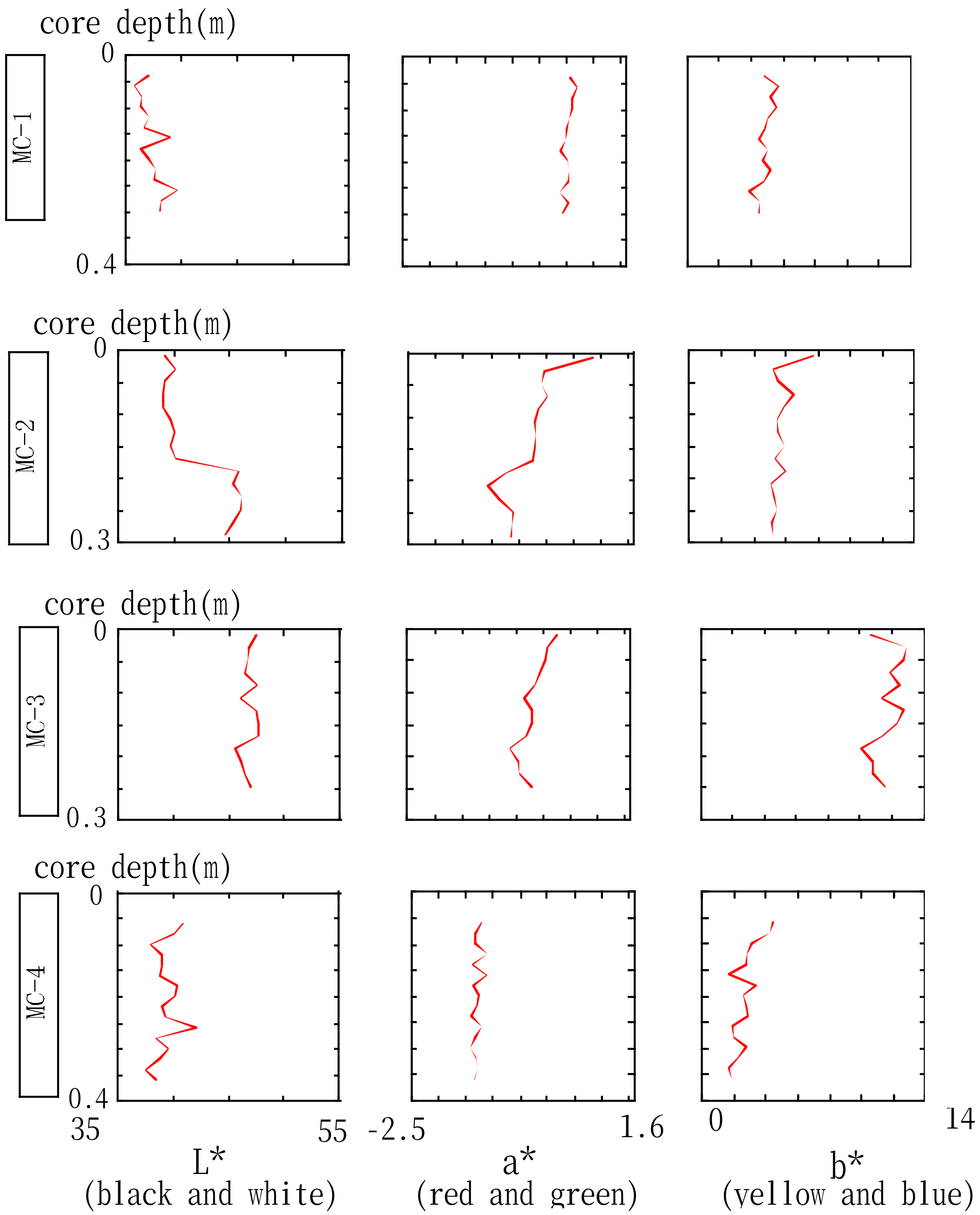


Fig. 3-3-4-14 L*, a* and b* parameters of MC-1~4

3-3-5 Multi-sensor core logging (MSCL)

Matsuura Yutaka (MWJ)
Yuusuke Sato (MWJ)
Rena Maeda (MWJ)
Tamami Ueno (MWJ)

Gamma-ray attenuation (GRA), P-wave velocity (PWV), and magnetic susceptibility (MS) were measured on whole-core sections with the onboard GEOTEK multi-sensor core logger (MSCL) to obtain primary data of wet bulk density, fractional porosity and magnetic susceptibility. The assumption that the inside of the liner included only sediments and water was applied to calculate wet bulk density and fractional porosity.

The principle of GRA is based on the facts that medium-energy gamma rays (0.1- 1 MeV) interact with the formation material mainly by Compton scattering, that the elements of most rock-forming minerals have similar Compton mass attenuation coefficients, and that the electron density measured can easily be related to the material bulk density. The 137 Ce source used transmits gamma rays at 660 KeV. A standard NaI scintillation detector is used in conjunction with a universal counter. GRA calibration assumes a two-phase system model for sediments and rocks, where the two phases are the minerals and the interstitial water. Aluminum has an attenuation coefficient similar to common minerals and can become as the mineral phase standard. Pure water is used as the interstitial-water phase standard. The actual standard consists of a telescoping aluminum rod (five elements of varying thickness) mounted in a piece of core liner and filled with distilled water. GRA measurement was carried on every 2-cm whole-core with 10 seconds counting. GRA data provide wet bulk density and fractional porosity for core thickness is constant (multiple core: 74mm, piston core: 80mm, gravity core: 120mm).

MS was measured using Bartington MS2C system within the MSCL. The main unit is the widely used, versatile MS2 susceptometer for rapid measurements with a number of sensors. The unit has a measuring range of 1 x 10-5 to 9999 x 10-5 (SI, volume specific). It has five front panel controls: on-off switch, sensitivity range switch, SI or cgs unit switch, zero button, measure button, and continuous measurement switch. The unit switch should always be on SI. The loop sensor for piston and multiple cores has an internal diameter of 100 mm. It operates at a frequency of 0.565 kHz and an alternating field (AF) intensity of 80 A/m (= 0.1 mT).

MS data measurement was carried on every 2-cm whole-core with 1 second. MS data is used mostly as a relative proxy indicator for changes in composition that can be linked to paleoclimatic controlled depositional processes.

(1) PC-01 and MC-01 (Fig. 3-3-5-1)

For data of P-wave velocity, fractional porosity, gamma density, and magnetic susceptibility, there is no correlation among the MC and the PL (pilot core) and the core top of piston core implies that the loss of a few ten-cm top of piston core. From the core top to a few ten-cm downward, drastic increasing of gamma density and drastic decreasing of fractional porosity are generally observed due to quick decreasing of water contents. Magnetic susceptibility gradually decreased from the 20cm to 1m. Very low magnetic susceptibility values were obtained in the interval from the 2.5 to 3.5m. P-wave velocity was also relatively higher in the interval from the 2.5 to 3.5m than those in the other depths. However, there was no relative characteristic in the visual description corresponding to the low magnetic susceptibility interval.

(2) PC-2, GC-1 and MC-2 (Figs 3-3-5-2 and 5)

Data of sections 1 and 2 of PC-2 and section 1 of GC-1 were not available because there are many tinny holes filled gases inside the sediment. According to the results from visual core description and color parameters, it is known that the top 1.6m of piston core was lost because of the impact when the corer attacked to the sea floor. However, the result from a comparison of the MSCL data between the PC-2 and the GC-1 did not show such a core top loss of piston core. Raw data of magnetic susceptibility and gamma ray attenuation are generally inversely correlated, and thus volumetric magnetic susceptibility and gamma bulk density are directly correlated to each other. Such patterns of profiles imply that high bulk density (low gamma ray attenuation) intervals are associated with high content of magnetic materials. The profiles of magnetic susceptibility, fractional porosity and gamma bulk density are stable the entire core without two spikes at the depths of 3.8 and 5.8m.

(3) PC-3 and MC-3 (Figs 3-3-5-3)

From the core top to a few ten-cm downward, drastic increasing of gamma density and drastic decreasing of magnetic susceptibility and fractional porosity are generally observed due to quick decreasing of water contents. Peaks and troughs of magnetic susceptibility show good correlation with that of gamma density. The patterns of profiles imply that high bulk density (low gamma ray attenuation) intervals are associated with high content of magnetic materials. Although no large spikes of magnetic susceptibility and gamma density were found in the profiles of top 5m, the frequency and amplitude of changes in magnetic susceptibility and gamma density were high at the depths deeper than 5m.

(4) PC-4, GC-2 and MC-4 (Fig. 3-3-5-4 and 6)

From the core top to a few ten-cm downward, drastic increasing of gamma density and drastic decreasing of magnetic susceptibility and fractional porosity are generally observed due to quick decreasing of water contents. Peaks and troughs of magnetic susceptibility show good correlation with that of gamma density. The patterns of profiles imply that high bulk density (low gamma ray attenuation) intervals are associated with high content of magnetic materials. The profiles of magnetic susceptibility and gamma density were stable in the top 4m, but the frequency and amplitude of changes in magnetic susceptibility and gamma density were high at the depths deeper than 4m.

3-3-6 Soft X-ray photographs analysis

Matsuura Yutaka (MWJ)
Yuusuke Sato (MWJ)
Rena Maeda (MWJ)
Tamami Ueno (MWJ)

Soft X-ray photographs were taken to observe sedimentary structures of the cores using the onboard device SOFTEX PRO-TEST 150. The total 278 sediment samples were collected from the cores with the original plastic cases (200x3x7mm). The X-ray photographs through the plastic cases were taken under a standard condition that is practically known (50kVp, 2mA, in 200 seconds). All the photographs were developed in negatives during the cruise. The negative films were printed on photo paper. These photo papers were scanned and were preserved as electric files (see appendix).

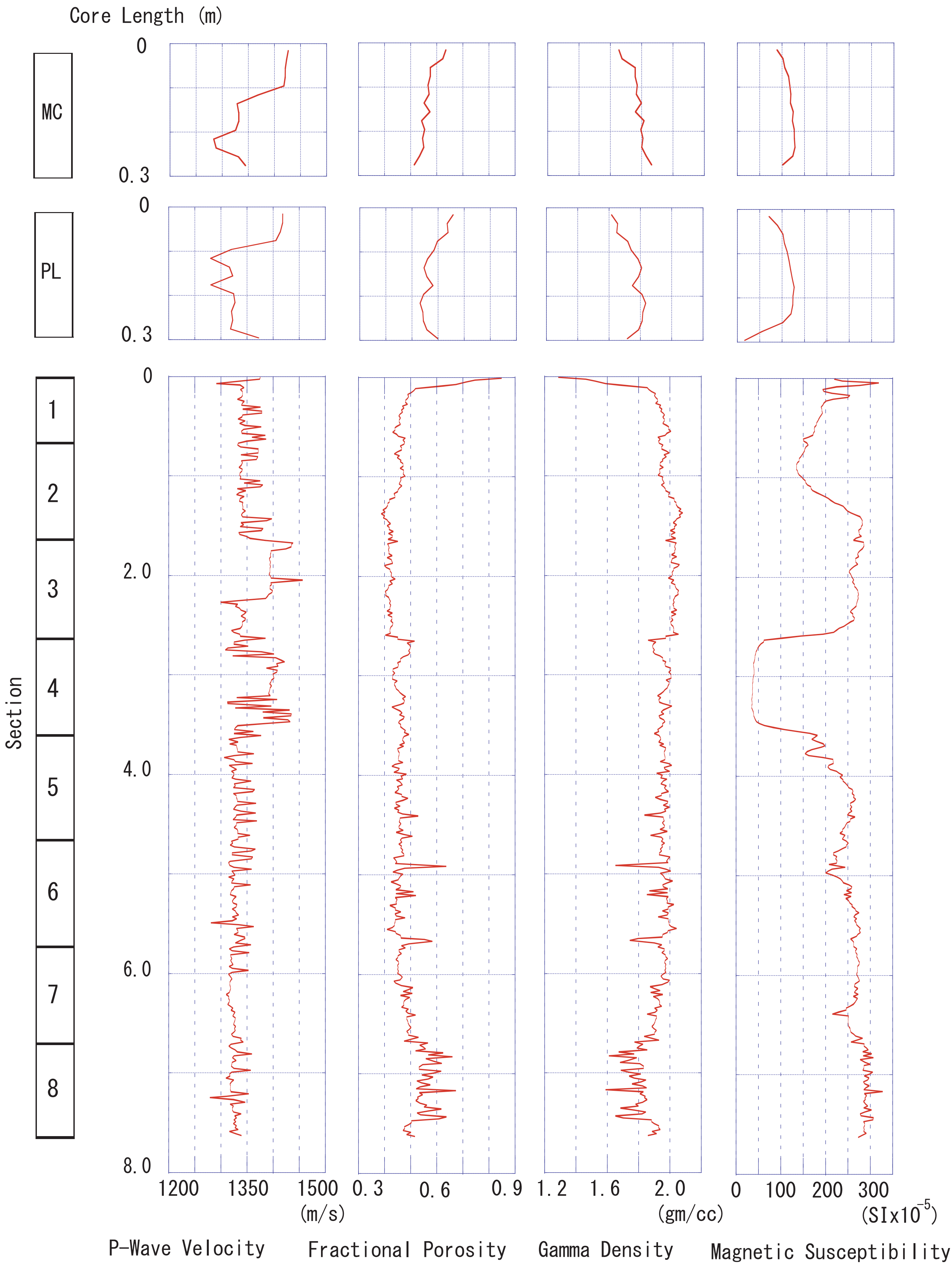


Fig.3-3-5-1 MSCL data of PC-1,PL-1 and MC-1

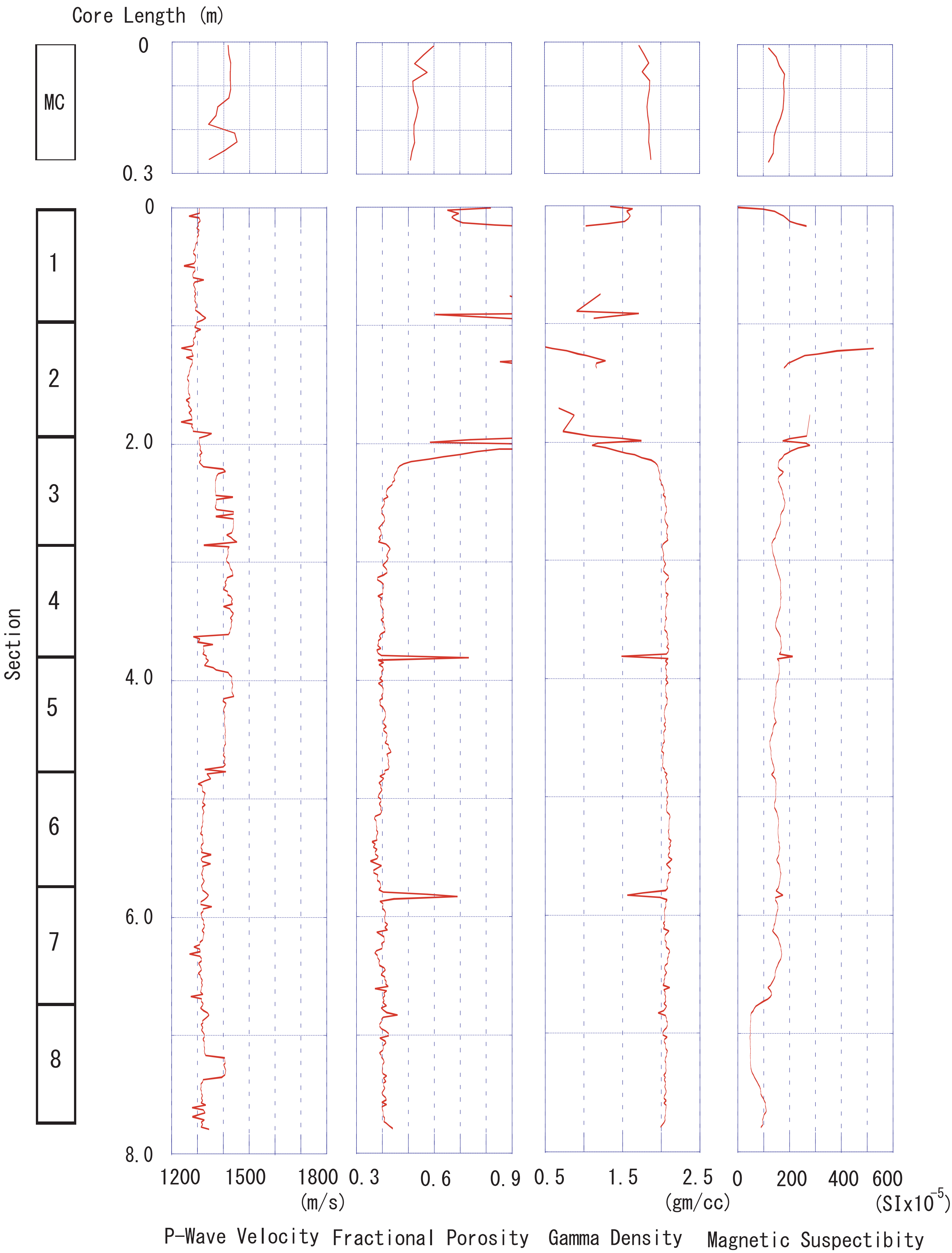


Fig. 3-3-5-2 MSCL data of PC-2 and MC-2

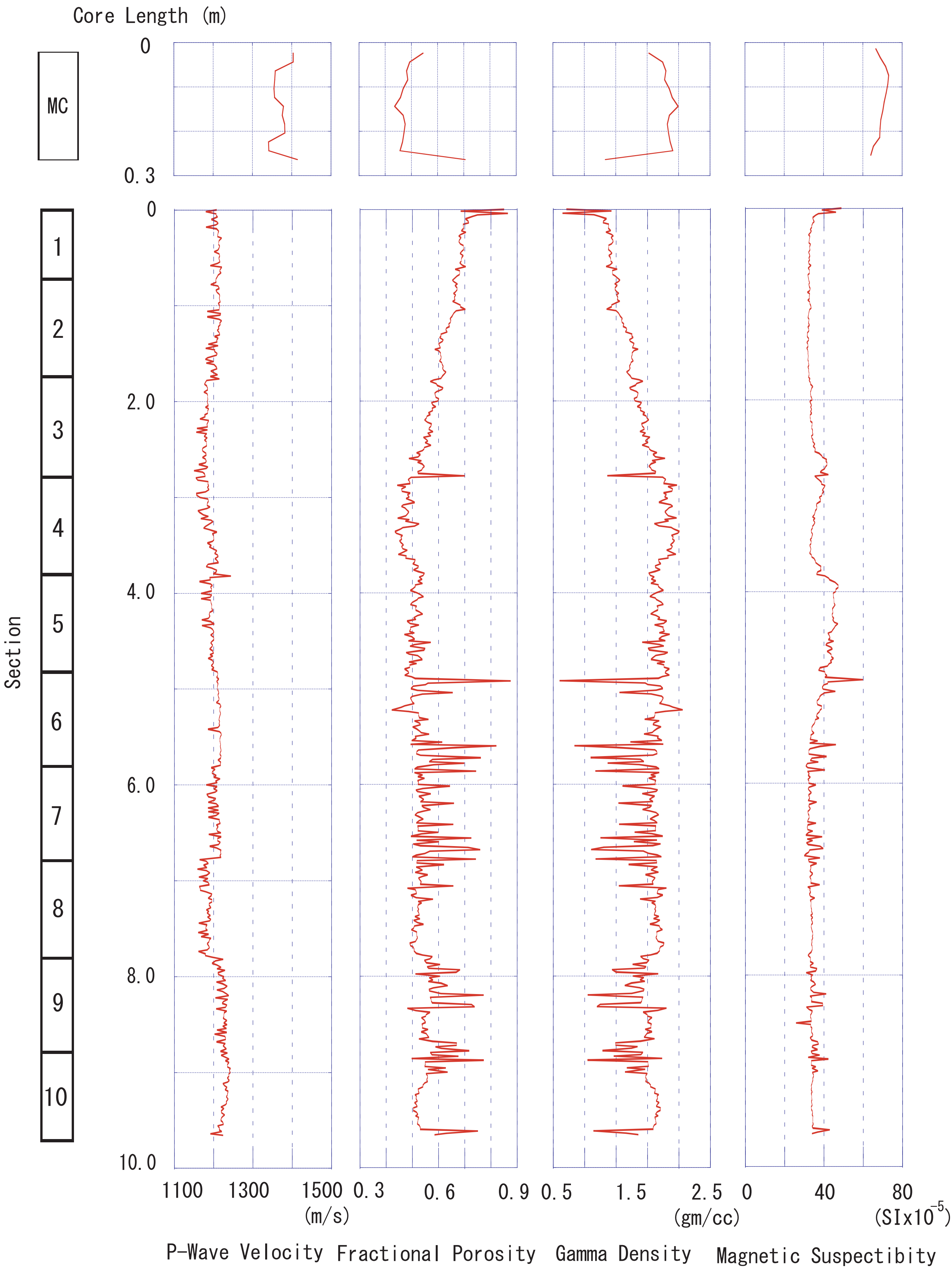


Fig. 3-3-5-3 MSCL data of PC-3 and MC-3

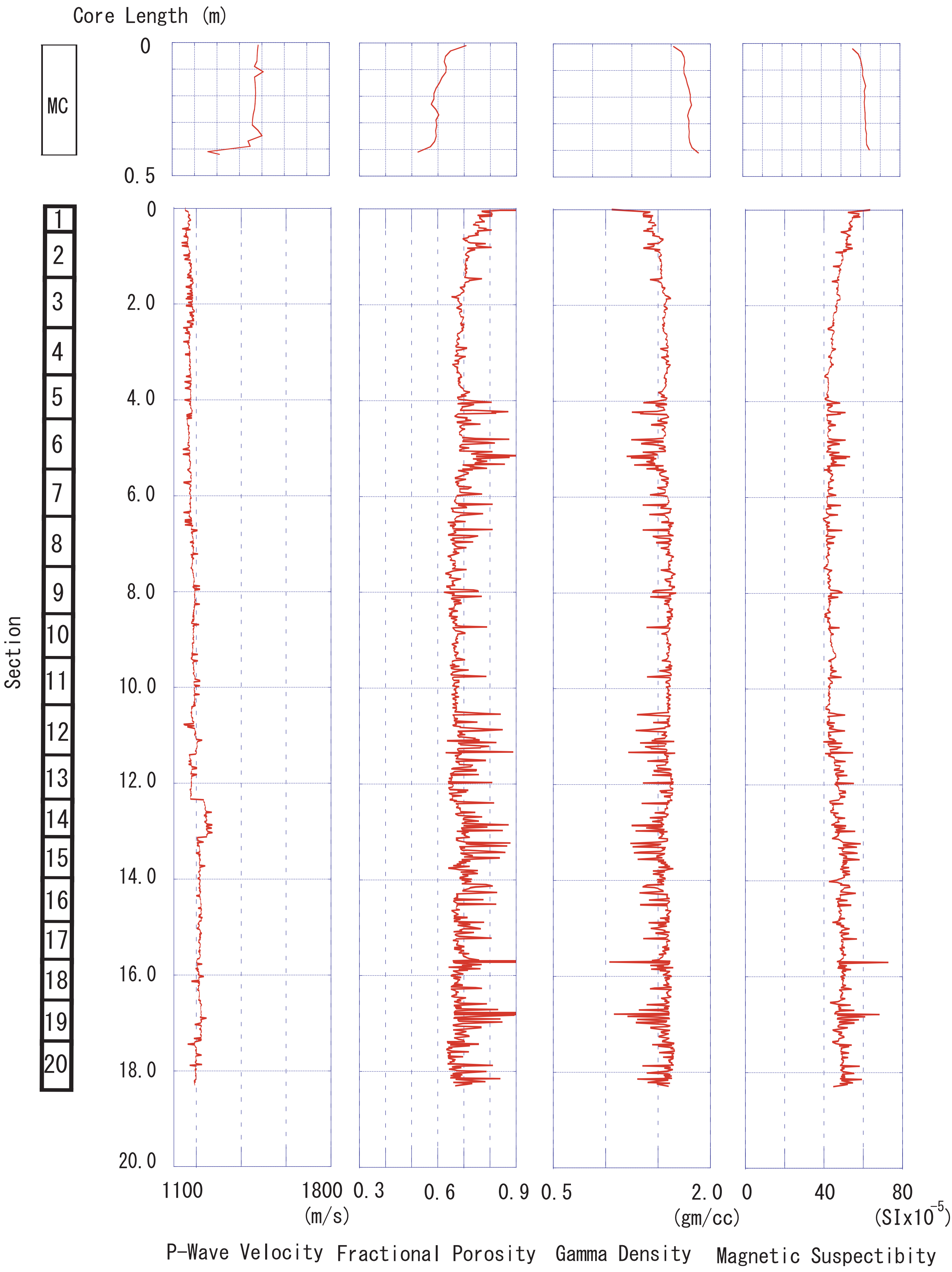


Fig.3-3-5-4 MSCL data of PC-4 and MC-4

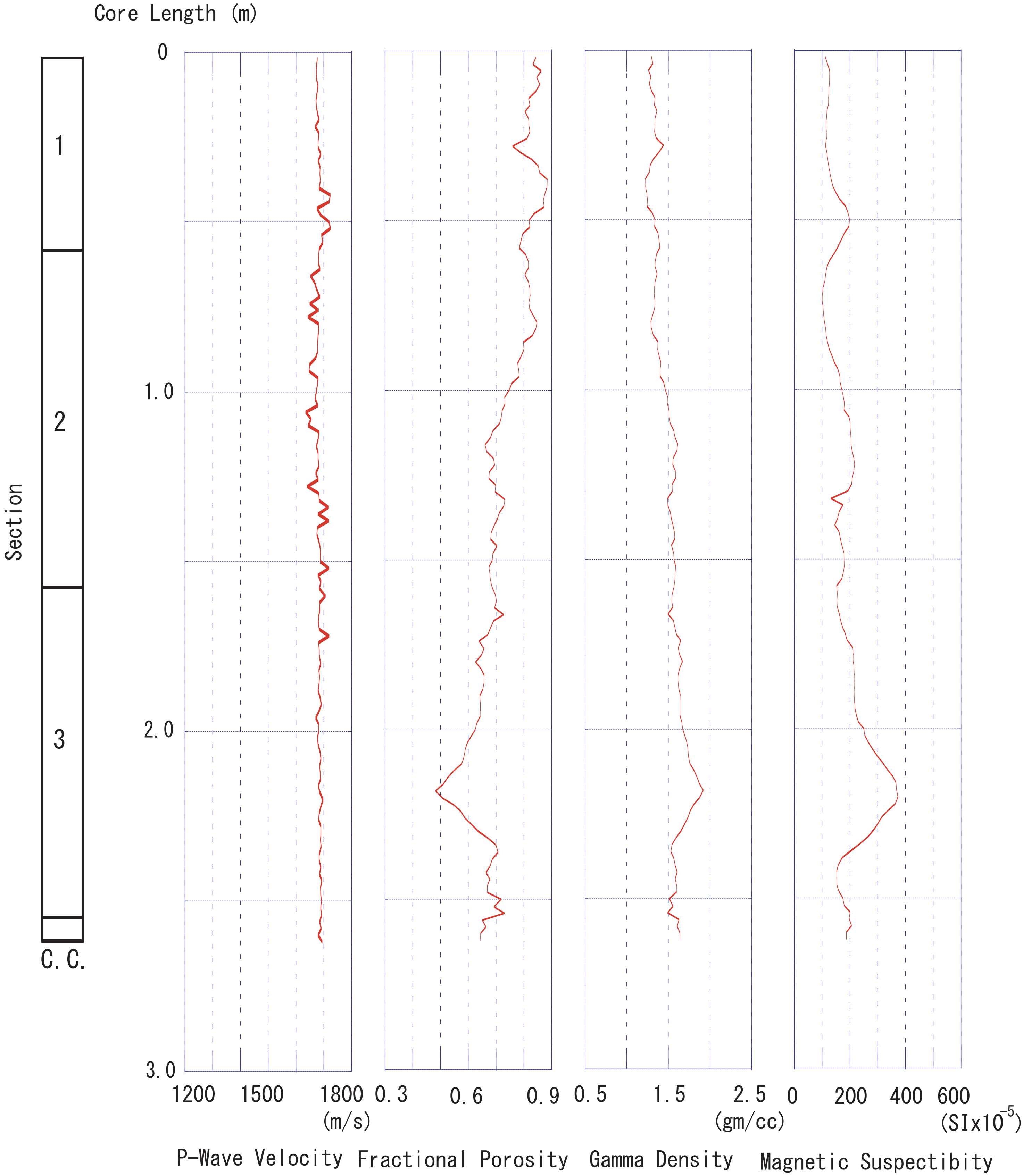


Fig. 3-3-5-5 MSCL data of GC-1

3-3-7 Microfossils

Margarita E. Marchant (Concepcion University)
Tapia I. Raul (Concepcion University)
Carina B. Lange (Concepcion University)

The sediment in core catchers of piston and gravity cores was divided into 3 samples, one for foraminifers, another one for radiolarians and a third one was kept as archive.

Samples for foraminifera were analysed for general microfossil content (Table II) and preliminary detailed foraminifer analysis (Tables III and IV). Samples were sieved through three sieves and divided into three fractions (>212, 150-212 and 63-150 µm sieves), dried in an oven at 50ºC and once dried kept in vials.

The results presented here refer to the two bigger fractions. These were observed under an Olympus stereoscope. Relative abundances are based on a total of >200 individuals per sample. A short characterization of the types of microfossils found in the cores is given below, and details are shown in Tables II-IV.

(1) PC-01

Radiolaria, rest of Echinodermata and Pisces were observed in the 212 µm fraction. Highest concentrations of planktic and benthic foraminifera were found in this piston core. The dominant species are *Uvigerina peregrina* (benthics) and *Globigerina bulloides* (planktics). *Neogloboquadrina pachyderma* (sin.) accompanies these species in the 150-212 µ fraction.

(2) PC-02

Only Radiolarians were observed as accompanying the foraminifer assemblages. The concentration of benthic foraminifera is low while planktics are abundant. The benthic assemblage is dominated by *Uvigerina peregrina*. Planktic foraminifer assemblage is typical of a Transitional fauna and is characterized by *Globigerina bulloides*, *Globorotalia inflata* and *Neogloboquadrina pachyderma* (dex). In the 150-212 µm fraction, *Neogloboquadrina pachyderma* sin and dex are present in equal proportions.

(3) GC-01

The same pattern as in PC-02 is seen in this core. The characteristic species of this transitional area are *Globigerina bulloides*, *Globorotalia inflata* in the >212 µm fraction and *N. pachyderma* (sin) and (dex) in the intermediate fraction. The dominant benthic species are *U. peregrina* and *Praeglobobulimina pyrula*.

(4) PC-03

This site is the most diverse: Radiolaria, Bivalvia, Pteropoda, Scaphopoda, Bryozoa, Porifera and Ostracoda are present.

After sieving, a lot of sediment remained in the 63-150 µm fraction, which filled 4 vials. Qualitative analysis revealed the presence of: Pteropoda, sponge spicules, Ostracoda and rests of Echinodermata. As for foraminifers, N. pachyderma (sin) and benthic foraminifera like Tetronphalus bulloides, Cibicides elmaensis, Patellina corrugata, Cassidulina delicata and the genera Bolivina, Spirillina and Elphidium were observed.

The benthic foraminifera assemblage is very diverse in the >212 µm with 18 species. *Quinqueloculina seminula* and *Florilus grateloupi*, which are typical shelf species dominate. The important species in the 150-212 µm fraction are *Cassidulina delicata*, *Cibicides elmaensis*, *Florilus grateloupi*, *Quinqueloculina seminula and Tetronphalus bulloides*. The diversity of planktic foraminifera is low with one dominant species in the >212 µm fraction, *Globigerina bulloides.* This species together with *N. pachyderma* (dex) and (sin) dominant the 150- 212 µm fraction, and the proportion of the two kinds of N. *pachyderma* is basically the same.

(5) PC-04

Dentalium, Bivalvia, Ostracoda and Pteropoda are present.

This site showed the lowest concentrations and diversity of Foraminifera. Planktic foraminifera are almost absent. The most important species of benthic Foraminifera in both fractions are *Cibicides elmaensis, Quinqueloculina seminula* and *Uvigerina peregrina.*

(6) GC-02

The sample shows fish remains, Pteropoda and Bivalvia.

As with PC-04, the concentration and diversity of foraminifers was low. The entire >212 fraction was analysed. Planktic foraminifera are practically absent. The most important benthic species are Quinqueloculina seminula accompanied by other species as Cassidulina delicata, Cibicides elmaensis, Florilus grateloupi, Pyrgo ringens and Uvigerina peregrina.

Table3-3-6-1. Faunal groups observed in core catcher samples of piston and gravity cores during Leg 3 of BEAGLE 2003 expedition. a = >212 µm, b = 150-212 µm, ND = no data, 0 = absent.

	PC1		**PC2**		**PC3**		**PC4**		**GC1**		**GC2**	
Faunal Groups	a	b	a	b	a	b	a	b	a	b	a	b
Radiolaria	X	0	X	0	X				ND	0	0	
Sponge spicules		0		0		X			ND	0	0	
Bivalvia		0		0	X	X	X		ND	0	0	X
Pteropoda		0		0		X		X	ND	0	0	X
Dentalium, Scaphopoda		0		0	X		X		ND	0	0	
Ostracoda		0		0	X	X	X	X	ND	0	0	
Bryozoa		0		0		X			ND	0	0	
Spicules of Echinodermata	X	0		0					ND	0	0	
Fish remains	X	0		0					ND	0	0	X

Table 3-3-6-2. Planktic foraminifers observed in core catcher samples of piston and gravity cores during Leg 3 of BEAGLE 2003 expedition. a = >212 µm, b = 150-212 µm.

	PC1		**PC2**		**PC3**		**PC4**		**GC1**		**GC2**	
Planktic Foraminifera	a	b	a	b	a	b	a	b	a	b	a	b
Globigerina bulloides	226	32	82	12	104	67	1		103	14	1	12
Globigerinita glutinata	9				2		2	4	2	22		4
Globorotalia crassaformis			2									
Globorotalia inflata	35	10	72	52					53			
Globorotalia scitula	1	8		4						2		
Gl.truncatulinoides	3					1						
Globorotaloides hexagonus			2									
N. pachyderma (sin.)	7	96		64	2	26			1	88		
N. pachyderma (dex.)		12	30	76	4	27			6	90		
Orbulina universa		2	8						4			
Turborotalia quinqueloba										2		
Total	**281**	**160**	**196**	**208**	**112**	**121**	**3**	**4**	**169**	**216**	**1**	**16**

Table 3-3-6-3. Benthic foraminifers observed in core catcher samples of piston and gravity cores during Leg 3 of BEAGLE 2003 expedition. a = >212 µm, b = 150-212 µm.

	PC1		**PC2**		**PC3**		**PC4**		**GC1**		**GC2**	
Benthic Foraminifera	a	b	a	b	a	b	a	b	a	b	a	b
Astrononion sp.				4	2		1	24				44
Bulimina inflata	2	40		12		1				18		
Bucella peruvianus					2		1	18				8
Cassidulina laevigata	2	12		12		5		4		4		4
Cassidulina delicata						15	8	92			25	64
Chillostomella sp.									1			
Cibicides elmaensis	1		2		14	12	20	102			34	60
Cibicides ornatus	13	2	2						4			
Cibicides variabilis		2			2		2	2				4
Cibicides wuellerstorfi	9											
Cibicides		2										
Dentalina elegans	1	2										
"Elphidium"		26										
Ehrembergina pupa									2			
Fissurina sp.	1		2						3	1		
Florilus grateloupi					32	11		10			17	20
Fursenkoina		2								3		
Globobulimina	1											
Guttulina comunnis			2						2			
Gyroidina soldani									6			
Hoeglundina elegans			2						7			
Lagena aspera						1		2				

Lagena sp.					5		1	4			1	4
Lenticulina australis					2			2			1	
Martinotiella comunnis	1											
Melonis pompilius									3			
Mililinella labiosa					1	1		2				
Nonionella turgida		6					4					
Nonionella			2									
Oridorsalis umbonatus	9											
Patellina corrugata						4						4
Praeglobobulimina pyrula	29	15	6	4	8	1	1		17	5	7	
Pullenia bulloides	2											
Pullenia subcarinata					5			2	1	1	1	
Pyrgo nasuta					1							
Pyrgo notalaria					1							
Pyrgo ringens							8		4		47	
Pyrgo sp.	1	2	2					2				8
Quinqueloculina seminula					47	30	25	12			70	24
Robertina arctica							1					
Spirillina sp.					1	9						
Tetromphalus bulloides					1	20		4		4		
Textularia gramen					1							
Trifarina carinata				4	8							
Triloculina			2							1		
Uvigerina peregrina	138	62	34	12			38	14	25	13	31	4
Virgulinella sp.		8										
Indeterminated					1	2					1	
Total	**210**	**181**	**56**	**48**	**134**	**112**	**110**	**296**	**75**	**50**	**235**	**248**

3-3-8 Analytical plan on land

3-3-8-1 Paleoenvironmental reconstruction derived by radiogenic isotopes of trace metal elements in core sediments off the south Pacific coast of Chile and in the Strait of Magellan.

Yoshihiro Asahara (Nagoya University)

Marine sediment gives information on marine and continental environments. Rivers and atmosphere transfer soluble and insoluble materials from land to ocean. Since intensity of chemical and physical weathering on land changes with climate, that is humidity and temperature, sediment including the weathering products is important to investigate paleoenvironment on land as well as in ocean. Radiogenic isotopes of trace metal elements such as $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, and $^{176}Hf/^{177}Hf$ ratios are powerful tracers of mass transfer from land to ocean (e.g. Dasch, 1969; Grousset et al., 1988; Asahara et al., 1999). Although the neodymium isotopic ratio in silicates hardly changes during weathering process and transportation, the isotopic ratios of strontium and hafnium slightly change (Asahara et al., 1999, 2002). Therefore, the combination of the three isotopes will reveal the origin of terrigenous material and the extent of weathering. In addition, most of dissolved neodymium and hafnium in river water are scavenged in estuary and coastal ocean and therefore the isotopes in biogenic and authigenic component in sediment will reflect soluble material from land. The isotopes in the soluble components will be also applied to reconstruction of marine and continental environments.

In this study, Sr, Nd, and Hf isotopes in silicate, biogenic and authigenic fractions of the core sediments off the south Pacific coast of Chile and in the Strait of Magellan will be investigated with a high time resolution, a few hundreds to a few thousands years interval, in order to reveal changes of source and flux of terrigenous material and to reconstruct paleoenvironment of the Southern hemisphere during the late Quaternary. Piston core and gravity core sediments will be used for the analysis, which were obtained during the MR03-K04 cruise of the R/V MIRAI from October to November 2003. Sediment samples were continuously sliced at every 2.2 cm in thickness throughout the cores on board, and 1 to 5 g of sediment for each slice was taken for the isotopic analysis. Firstly, separation method of silicate, biogenic, and authigenic components by chemical leaching will be established. Chemical extraction and isotopic measurement of strontium and neodymium have already been set up (Asahara et al., 1999). For hafnium analysis, method of extraction and isotopic measurement is now being established. The $^{87}Sr/^{86}Sr$, $Nd/^{144}Nd$, and $^{176}Hf/^{177}Hf$ ratios for samples will be measured by a sector-type thermal ionization mass spectrometer (VG Sector 54-30) at Nagoya University, Japan.

Reference

Asahara, Y., Tanaka, T., Kamioka, H., Nishimura, A. and Yamazaki, T., 1999. Provenance of the north Pacific sediments and process of source material transport as derived from Rb-Sr isotopic systematics. Chem. Geol. 158, 271-291.

Asahara, Y., Lee, D.-C., Frank, M., van de Friert, T., Halliday, A.N. and Nishimura, A., 2002. Hf-Nd isotopic variations of authigenic and silicate components in north Pacific sediments. Geochim. Cosmochim. Acta 66/S1, A33.

Dasch, E.J., 1969. Strontium isotopes in weathering profiles, deep-sea sediments, and sedimentary rocks. Geochim. Cosmochim. Acta 33, 1521-1552.

Grousset, F.E., Biscaye, P.E., Zindler, A., Prospero, J. and Chester, R., 1988. Neodymium isotopes as tracers in marine sediments and aerosols: North Atlantic. Earth Planet. Sci. Lett. 87, 367-378.

3-3-8-2 Paleoceanographic reconstruction based on radiolarian assemblages from the off Chile and the Strait of Magellan

Kota Katsuki (Kyushu University)
Kozo Takahashi (Kyushu University)

(1) Objectives

Radiolarians are siliceous micro zooplankton, which inhabit various depths of the water column and exhibit high diversity. Therefore, radiolarian assemblages are useful environmental tracers, especially for intermediate water masses. In this study, we employ radiolarian assemblages from piston core, gravity core and multiple core samples, which were obtained during the MR03-K04 Cruise of the R/V Mirai between October 2003 and November 2003. Main objective is the reconstruction of paleoceanography in the off Chile and the Strait of Magellan. The data from radiolarian assemblages in these areas give us information about biological productivity and ventilation of intermediate water during the late Quaternary.

(2) Sample and Method

Sediment samples were continuously sliced every 2.2 cm in thickness throughout the core on board, and we got the 5 cc sediment samples for analysis of radiolarian assemblages. An accurately weighed original wet material (100-300 mg) for radiolarian analysis will be placed in a 200 ml beaker containing a hydrogen peroxide solution (10%, 20 m*l*) and hydrochloric acid (1-N, 3 m*l*). The mixture will be heated on a hotplate (150 degree) for one hour, and then Calgon® (hexametaphosphate, surfactant) solution will be added to the mixture in order to disaggregate the sediments. After the decantation procedure, the treated sediments will be wet-sieved through a 45 μm mesh. Each sample will be permanently mounted on micro slide with Canada Balsam. Observation under a light microscope will be conducted at x 100-200 magnification, and at least 500 shells will be counted per one sample.

By the JAMSTEC rule, the result of radiolarian analysis will be officially announced in the Mirai Symposium or a paper within three years.

3-3-8-3 Magnetostratigraphy and Environmental magnetism

Toshiaki Mishima (JAMSTEC)
Toshiya Kanamatsu (JAMSTEC)

We will recover paleomagnetic records by NRM (natural remanet magnetization) measurements and stepwise alternating field demagnetization. We also measure some rock-magnetic properties such as magnetic susceptibility, ARM (Anhysteretic remanet magnetization) and IRM (Isothermal Remanet Magnetization) for the following purposes:

If we get high quality paleomagnetic data, we can use paleomagnetic features for the age determination of the cores. Although no core may reach the last polarity reversal (Brunhes/Matuyama boundary at 0.78 Ma), we have chance to find some geomagnetic excursions in the last glacial (Mono Lake and Laschamp excursions) in some cores. Relative paleointensity can be another tool for age determination.

However, low magnetic susceptibility and H_2S smell of the cores from the last two sites infers us that paleomagnetic records may not be preserved well in these two cores.

We will estimate the magnetic mineralogy, the amount of magnetic mineral, and the grain size of magnetic mineral using rock magnetic parameters. Changes in sea bottom environment can be reconstructed, because magnetic minerals are sensitive to post depositional diagenesis, especially in anoxic environment.

3-3-9 POGO Trainee activities

Luis Americo Conti (Oceanographic Institute, University of Sao Paulo)

(1) INTRODUCTION

The 130m ship Mirai form Japan Marine Science and Technology Institute (JAMESTEC) is one of the biggest research vessels in the world, and it is carry several instruments of marine and atmospheric observations. The oceanographic research equipments include multi-narrow beam echo sounder, ADCP, sub bottom profiler, Rosette water sampler and others while the atmospheric and meteorological research equipment include an integrated meteorological observation device, Doppler Radar and Satellite receiver system and others. It also has about 13 labs designed for several kinds of activities such as sampling measurements and analysis.

The cruise is part of the program BEAGLE (Blue Earth Global Ocean Experiment), developed by JAMESTEC / POGO-IOCCG. The expedition started in Brisbane (Australia) to Tahiti (leg 1), and then to Valparaiso - Chile (leg 2) where started this leg 3 with destination Santos (Brazil).

During this leg, it was made observations and measurements such as: Bio-Optical measurements, Sediment sampling, analysis, ocean, and atmosphere observations. In this leg, the scientific staff was composed by researches of 6 different countries (Japan, Chile, Argentina, Namibia, Uruguay and Brazil) and 11 different institutions. The chief scientist of this leg 3 was Dr. Naomi Harada from JAMESTEC.

(2) ON BOARD OF R/V MIRAI

I departed from Brazil on October, 17th and arrived in Santiago at 10:30 am where there was a car waiting for me and Ms Anna Agnotti from Argentina that was arriving at the same time, to take us to Valparaiso. After arrive in Valparaiso few documents checks and a fill a health form we could board on the ship. I was formally presented to Dr Naomi Harada who directed to my cabin.

The days before the departure was directed to know the other members of the cruise, make some and to be familiarized to the ship dependences and labs. We were also start to prepare the structure to receive the sediment samples labeling and ordering the syringes, plastic bags and acrylic cubes.

The scientific meeting was held on the 18^{th} on the conference room in order to presents all members from the scientific and technical staff and estipulate the plans of the sediment stations position and sampling methods. On this meeting, it was also informed about the workgroups and shifts to be made during the cruise. I was on the group of "deck work" and physical properties of the sediment cores. On October 19 at 3 PM the R/V Mirai departed from Valparaiso port. After a couple of hours it was held another meeting, this time to discuss the safety proceedings and the life on board of the ship.

On the same day, it was made the training for safety and emergencies where we were informed about the security equipments, lifeboats and fire drill. After that, we participated to the KOMPIRA-SAN, a prayer for safe and success of cruise to the shrine on Mirai, at the bridge leaded by the Captain.

(3) OVERALL ACTIVITIES

For the "sediment core team", that I was part of, there were four kinds of activities predicted:

- The pre-station activities or site survey (picture 1): with the use of echo sounders, multi-beam bathymetry sonar and sub-surface sounding systems, to find the core target site. It uses to be chosen some low declivity spot with specific depositional characteristics.

Picture 1 showing the site survey activity before the core sampling stations

- The station activities (pictures 2 and 3): it is the core sampling itself. It was made 3 types of sampling with: The piston corer (PC), gravity corer (GC) and Multiple corer (MUC). The piston corer has a 20 meters long pipe triggered by a piston device located on the top of the corer as shown in figure 2. The section of the tube has a caliber of 80 mm. It can be work with or without an acrylic liner. The gravity corer has a smaller pipe (7 meters) but a larger section (120 mm caliber) witch means low penetration but less perturbed sediment sampling. It is composed by 1-meter sections of acrylic liner. The Multi-corer has 8 tubes with 1 meter long connected to a circular structure what permit several sampling of the same spot.

- The sub sampling activities (pictures 4 and 5): after split the corers in two parts, starts two sorts of activities: the physical properties analysis and the sub sampling. The sub sampling is guided by the kind of future analysis that will be held with the sediment samples.

Picture – 2 lunching the piston corer at station 1

Picture – 3: Setting the Multiple corer

Pictures 4 and 5: sub sampling activities

(4) PHYSICAL PROPRIETIES – Color measurements

As it was mentioned before, my main tasks on Leg 3 of cruise was measure and analyze the color reflectance proprieties of the core samples. Since I was not familiarized with the continuous color measurements, I was instructed by Ms Ueno Tamami (from MWJ, Japan) and Dr Naomi Harada how to make the measurements and handle the equipment.

The most common use of color measurements in split-cores is the acquisition of reflectance parameters what indicates several characteristics of the sediments such as lithology, oxidation rate, concentrations of carbonates, organic matter and certain inorganic compounds. It is also frequently used to correlate different corers.

(5) ACKNOWLEDGEMENTS

I would like to thanks the POGO and JAMESTEC for the opportunity to participate to this cruise leg and in special to Ms Naomi Harada, Chief scientist of the cruise and Ms. Tony Payzant from POGO. My sincerely thanks to all crew of R/V Mirai for providing a great work atmosphere and friendship during this wonderful two weeks. My thanks also goes to the scientists from Universidad de Concepcion, Chile (Carina, Julio, Alessandro, Raul, Silvio and Margarita) and my cabin mates Kanai Tomoaki, Kuogo Tsuyoshi from JAMESTEC and Gustavo Martinez from UROU, Uruguay.

3-4 Plankton

Naokazu Ahagon (MIO, JAMSTEC)
Tomoaki Kanai (JAMSTEC)
Tsuyoshi Kogo (OD21, JAMSTEC)
Katsunori Kimoto (MIO, JAMSTEC shore-based participant)

(1) Objective

Planktonic foraminifera are useful tools for monitoring the past ocean environments because the surface ocean dynamics affects ecology, assemblage and shell chemistry of foraminifera. To understand meso-scale dynamics of planktonic foraminifera assemblage near sea surface of the Chile Margin, we carried out underway plankton collecting. Our main interest is to compare between living and fossil foraminifera assemblages for reconstructing sea surface environmental changes.

(2) Procedure

Planktonic foraminifera were collected by using water pump equipped in the stem of R/V *Mirai*. The entry port of seawater is located at ca. 4m under sea surface. Non-filtered seawater in the sea surface water-monitoring laboratory was screened over 100μm mesh for an appropriate time interval. The collected materials were soaked in the mixture of 1:1 volumetric ratio of seawater and ethanol in plastic vials. After addition of small amount of sodium tetra-borate as a pH buffer, the vials were sealed and then stored in the refrigerator at 4°C. Identification and count of planktonic foraminifers will be carried out on a shore-based laboratory. The flow rate of filtrated water was ca. 8.6 - 6.7L min^{-1} during the collection. The samples collected during the cruise are shown in Table 3-4-1.

Table 3-4-1. Inventory of plankton samples collected during MR03-K04 Leg.3.

ID	Start of Collection			End of Collection		
	Date Time (UTC)	Lon.	Lat.	Date Time (UTC)	Lon.	Lat.
PLK-1	2003.10.19 21:40	72-03.19 W	33-29.74 S	2003.10.19 21:40	74-24.87 W	39-59.84 S
PLK-2	2003.10.22 11:12	75-03.78 W	43-16.49 S	2003.10.23 22:00	74-50.58 W	50-24.64 S
PLK-3	2003.10.25 0:57	73-19.07 W	53-12.14 S	2003.10.26 0:02	69-37.25 W	52-31.82 S

3-5 Underway observation

3-5-1 Salinity,temperature,DO and Fluorescence

Tomoko Miyashita (MWJ)
Shuichi Watanabe (ORD, JAMSTEC)

(1) Objective

To measure salinity, temperature, dissolved oxygen, and fluorescence of near-sea surface water.

(2) Methods

Surface sea water monitoring system (Nippon Kaiyo co.,Ltd.) has five kind of sensors and fluorescence photometer. Salinity, temperature, dissolved oxygen, fluorescence and particle size of plankton near surface sea water are continuously measured every 1-minute. This system is set up in the "*sea surface monitoring laboratory*" on R/V Mirai. This system is connected to shipboard LAN-system. Measured data are stored in a hard disk of PC machine every 1-minute together with time and position of ship, and displayed in the data management PC machine.

Surface sea water is continuously pumped up to the laboratory and flowed into the system. The flow rate is controlled 12L/min except with fluorometer (about 0.3L/min). The flow rate is measured with two flow meters and each values were checked everyday.

Specification of the each sensor in this system is listed below.

a) Temperature and Salinity sensor
SEACAT THERMOSALINOGRAPH
Model: SBE-21, SEA-BIRD ELECTRONICS, INC.
Serial number: 2118859-2641
Measurement range: Temperature -5 to +35℃, Salinity0 to 6.5 S m^{-1}
Accuracy: Temperature 0.01 ℃ $6month^{-1}$, Salinity0.001 S m^{-1} $month^{-1}$
Resolution: Temperatures 0.001℃, Salinity0.0001 S m^{-1}

b) Bottom of ship thermometer
Model: SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number: 032175

Measurement range: -5 to +35℃
Resolution: ±0.001℃
Stability: 0.002 ℃ $year^{-1}$

c) Dissolved oxygen sensor
Model: 2127A, Orbisphere Laboratories Japan INC.
Serial number: 44733
Measurement range: 0 to 14 ppm
Accuracy: ±1% at 5 ℃ of correction range
Stability: 1% $month^{-1}$

d) Fluorometer
Model: 10-AU-005, TURNER DESIGNS
Serial number: 5562 FRXX
Detection limit: 5 ppt or less for chlorophyl a
Stability: 0.5% $month^{-1}$ of full scale

e) Particle Size sensor
Model: P-05, Nippon Kaiyo LTD.
Serial number: P5024
Measurement range: 0.02681 mmt to 6.666 mm
Accuracy: ±10% of range
Reproducibility: ±5%
Stability: 5% $week^{-1}$

f) Flow meter
Model: EMARG2W, Aichi Watch Electronics LTD.
Serial number: 8672
Measurement range: 0 to 30 l min-1
Accuracy: ±1%
Stability: ±1% day^{-1}

The monitoring Periods (UTC) during this cruise are listed below.
19-Oct.-‘03 21:12 to 26-Oct.-’03 02:59

(3) Preliminaly Result

We sampled about three times every day for salinity sensor calibration. All salinity samples were collected from the course of the system while on station or from regions with weak horizontal gradients. All samples will analyze on the Guildline 8400B.

(4) Date archive

The data were stored on a magnetic optical disk, which will be submitted to the Data Management Office (DMO) JAMSTEC, and will be opened to public via " R/V MIRAI Data Web Page " in JAMSTEC homepage.

3-5-2 Nutrients monitoring

Kenichiro Sato (MWJ)
Syuuichi Watanabe (JAMSTEC)

(1) Objective

Phytoplankton requires nutrient elements for growth, chiefly nitrogen, phosphorus and silicon. The data of nutrients in surface seawater is important for investigation of phytoplankton productivity.

(2) Sampling elements

Nitrate+ Nitrite, Nitrite, Phosphate and Silicate

(3) Inventory information for the sampling

Date: October 20, 2003 to October 26, 2003

(4) Instruments (including setting parameters if required), and methods

The nutrients monitoring system was performed on BRAN+LUEBBE continuous monitoring system Model TRAACS 800 (4 channels). This system was located at the surface seawater laboratory for monitoring in R/V Mirai. Seawater at depth of 4.5 m was continuously pumped up to the laboratory and introduced direct to monitoring system with narrow tube. The methods are as follows.

Nitrate + Nitrite: Nitrate in the seawater was reduced to nitrite by reduction tube (Cd-Cu tube), and the nitrite reduced was determined by the nitrite method as shown below. The flow cell was 3 cm length type.

Nitrite: Nitrite was determined by diazotizing with sulfanilamide by coupling with N-1-naphthyl-ethylendiamine (NED) to form a colored azo compound, and by being measured the absorbance of 550 nm using 3 cm length flow cell in the system.

Phosphate: Phosphate was determined by complexion with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 800 nm using 5 cm length flow cell in the system.

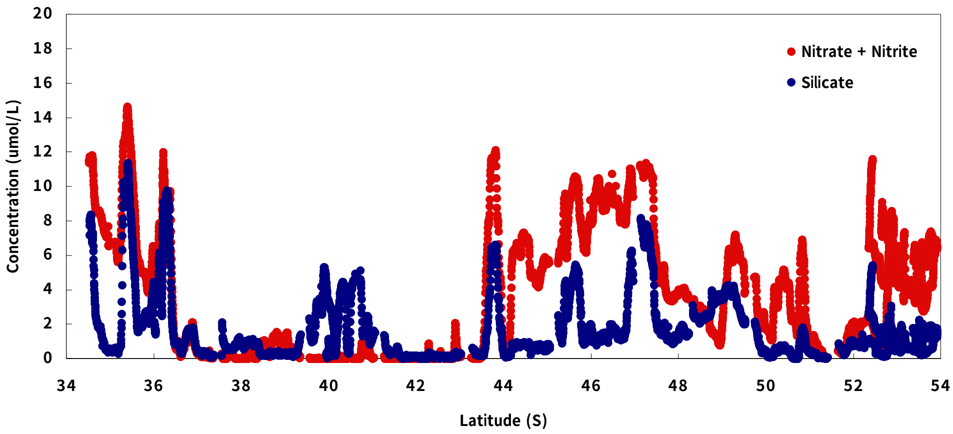
Silicate: Silicate was determined by complexion with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 800 nm using 3 cm length flow cell in the system.

(5) Results (Expected/preliminary results)

We are now arranging the method of data revision. Figure 3-5-2.1 is shown the results of measuring the nitrate + nitrite, silicate, nitrite and phosphate concentrations of surface seawater samples.

(6) Data archives

All raw and revised data files will be copied onto CD-R and submitted to Chief Scientist and JAMSTEC Data Management Office (DMO) according to the data management policy of JAMSTEC.



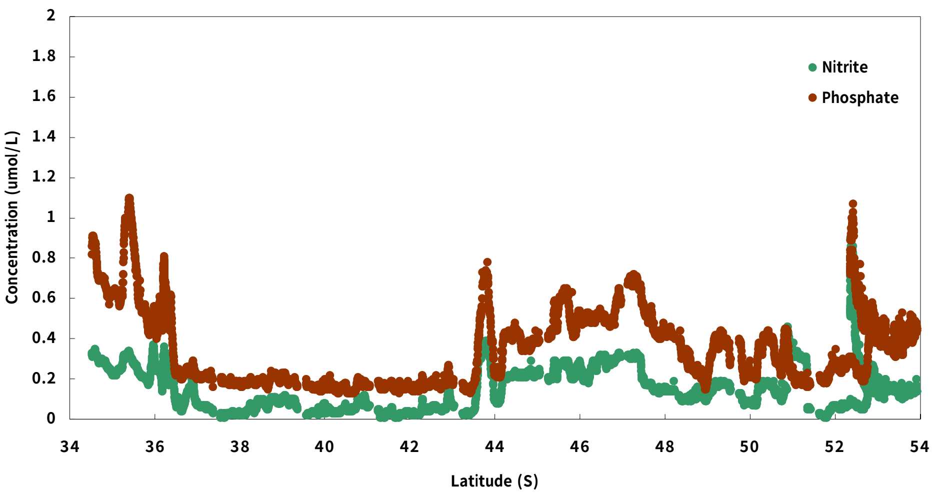


Fig. 3-5-2-1 Preliminary results of nutrients

3-5-3 pCO_2 measurement

Mikio Kitada (MWJ)
Syuuichi Watanabe (JAMSTEC)

(1) Introduction

Since the global warming is becoming an issue world-widely, studies on the green house gas such as CO_2 are drawing high attention. Because the ocean plays an important roll in buffering the increase of atmospheric CO_2, studies on the exchange of CO_2 between the atmosphere and the sea becomes highly important. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Unfortunately, the concentrations of these individual species of CO_2 system in solution cannot be measured directly. However, there are four parameters of alkalinity, total dissolved inorganic carbon, pH and pCO_2. If two of these four are measured, the concentration of CO_2 system in the water could be estimated (DOE, 1994).

(2) Inventory information

Surface seawater was continuously collected from October 19st, 2003 to October 26th, 2003 during the cruise.

(3) Materials and Methods

Concentrations of CO_2 in the atmosphere and the sea surface were measured continuously during the cruise using an automated system with a non-dispersive infrared (IR) analyzer (BINOS™). The automated system ran on one and a half hour cycle during which standard gasses, ambient air sample and a headspace sample from the equilibrator were analyzed. During one cycle, standard gasses were measured once each, twice for ambient air sample and 7 times of the sample from the equilibrator. The concentrations of the standard gas used to calibrate the analyzer were 270.09, 328.86, 359.10 and 409.22ppm.

The ambient air sample taken from the bow was introduced into the IR by passing through a mass flow controller which controlled the air flow rate at about 0.5L/min, a cooling unit, a perma-pure dryer (GL Sciences Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

A fixed volume of the ambient air taken from the bow was equilibrated with a stream of seawater that flowed at a rate of 5-6L/min in the equilibrator. The air passing the equilibrator was circulated with an air pump at 0.5-0.6L/min in a closed loop passing through two cooling units, a perma-pure dryer (GL Science Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

(4) Preliminary results

The Preliminary results are shown in Fig.3-5-3

(5) Data Archive

All data is submitted to JAMSTEC Data Management Office (DMO) and is currently under its control.

(6) Reference

DOE (1994), Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water; version 2, A.G. Dickson & C. Goyet, Eds., ORNS/CDIAC-74.

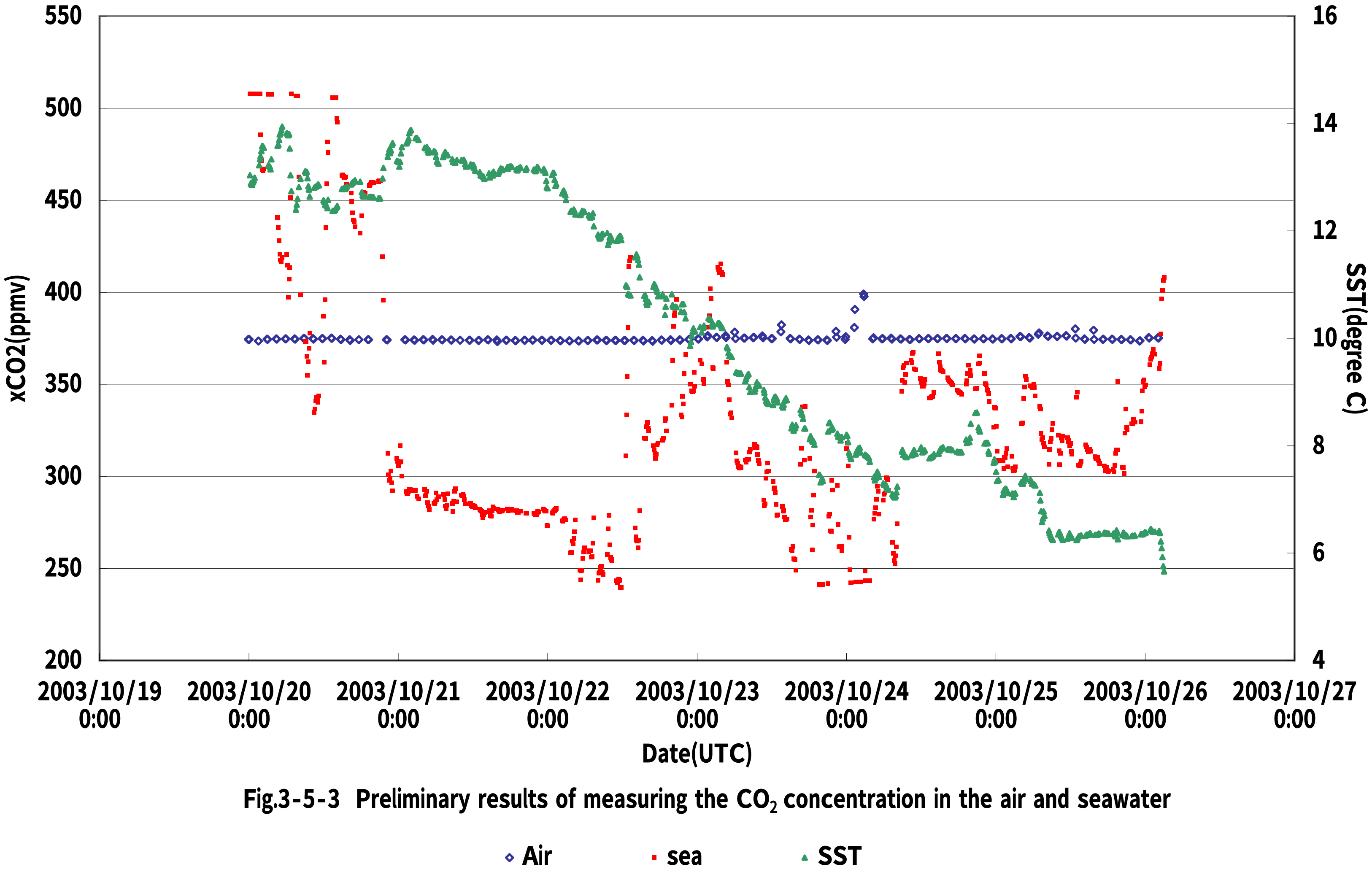


Fig.3-5-3 Preliminary results of measuring the CO_2 concentration in the air and seawater

3-5-4 Total Dissolved Inorganic Carbon Measurement

Mikio Kitada (MWJ)
Syuuichi Watanabe (JAMSTEC)

(1) Introduction

Since the global warming is becoming an issue world-widely, studies on the green house gas such as CO_2 are drawing high attention. Because the ocean plays an important roll in buffering the increase of atmospheric CO_2, studies on the exchange of CO_2 between the atmosphere and the sea becomes highly important. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Unfortunately, the concentrations of the individual species of CO_2 system in solution cannot be measured directly. However, there are four parameters of alkalinity, total dissolved inorganic carbon, pH and pCO_2. If two of these four are measured, the concentration of CO_2 system in the water could be estimated (DOE, 1994).

(2) Inventory information

Surface seawater was continuously collected from October 19th, 2003 to October 26th, 2003 during the cruise.

(3) Materials and Methods

Surface seawater was continuously collected by a pump from the depth of 4.5m. The TDIC of the introduced surface seawater was constantly measured by a coulometer that was set to analyze surface seawater specifically. Using a coulometer (Carbon Dioxide Coulometer Model 5012, UIC Inc.) and an automated sampling system controlled by a computer, the concentration of TDIC was measured as the followings.The sampling cycle set in the system was composed of 3 measuring factors; 70ml of standard CO_2 gas, 2ml of 10% saturated phosphoric acid solution and 5 seawater samples. The standard CO_2 gas was measured to confirm the constancy of the calibration factor during a run and phosphoric acid was measured for acid blank correction.

The seawater samples were measured as the followings. From the glass bottle, approximately 20ml of seawater was measured in a receptacle and was mixed with 2ml of 10% (v/v) phosphoric acid. The carbon dioxide gas evolving from the chemical reaction was purged by nitrogen gas (carbon dioxide free) for 13 minutes at the flow rate of 130ml/min and was absorbed into an electrolyte solution. In the electrolyte solution, acids forming from the reaction between the solution and the absorbed carbon dioxide were titrated with hydrogen ions in the coulometer and the counts of the titration were stored in the computer.

After the samples were measured, the calibration factor (slope) was calculated by measuring series of sodium carbonate solutions (0~2.5mM) and this calibration factor was applied to all of the data acquired throughout the cruise. By measuring QRM(#Q08) every time the cell was filled with fresh anode and cathode solutions, the slope was calibrated with the counts of this outcome. The set of cell solutions was changed in every three days.

(4) Preliminary results

The Preliminary results are shown in Fig.3-5-4.

(5) Data Archive

All data is submitted to JAMSTEC Data Management Office (DMO) and is currently under its control.

(6) Reference

DOE (1994), *Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water*; version 2, A. G. Dickson & C. Goyet, Eds., ORNS/CDIAC-74.

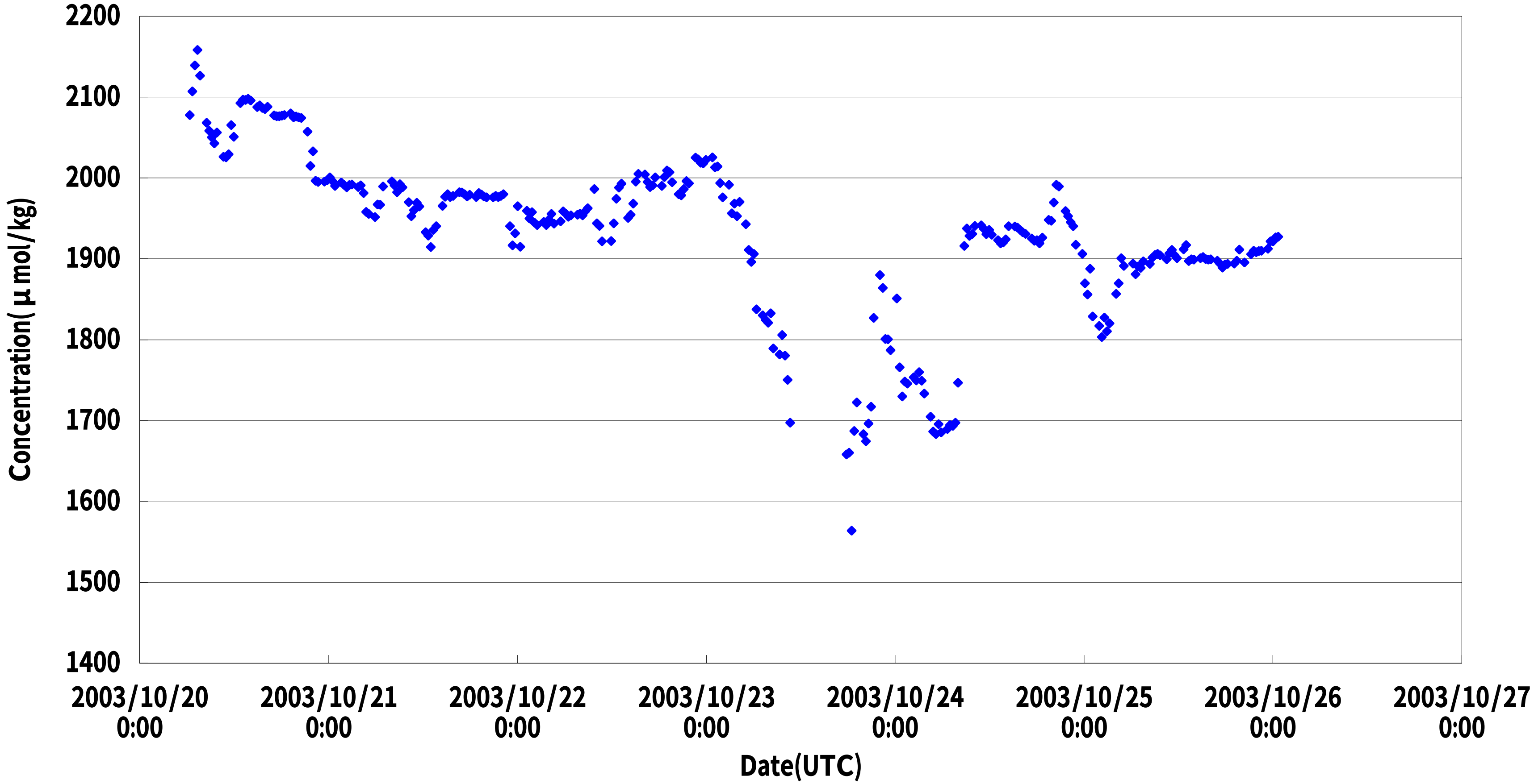


Fig.3-5-4 Preliminary results of measuring underway TDIC

3-6 Shipboard ADCP

Wataru Tokunaga (GODI)
Norio Nagahama (GODI)
Ryo Kimura (GODI)
Not onboard:
Yasushi Yoshikawa (JAMSTEC): Principal Investigator

(1) Parameters

Current velocity of each depth cell [cm/s]

Echo intensity of each depth cell [dB]

(2) Methods

Upper ocean current measurements were made throughout MR03-K04 Leg3 cruise departure of Valparaiso, Chile on 19 October 2003 to 26 October 2003 using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system that is permanently installed on the R/V MIRAI. The system consists of following components;

1) a 75 kHz Broadband (coded-pulse) profiler with 4-beam Doppler sonar operating at 76.8 kHz (VM-75; RD Instruments, USA), mounted with beams pointing 30 degrees from the vertical and 45 degrees azimuth from the keel
2) the Ship's main gyro compass (TG-6000; Tokimec, Japan), continuously providing ship's heading measurements to the ADCP
3) a GPS navigation receiver (Leica MX9400N) providing position fixes
4) an IBM-compatible personal computer running data acquisition software (VmDas version 1.3; RD Instruments, USA).

The ADCP was configured for 8-m processing bin, a 8-m blanking interval. The sound speed is calculated from temperature at the transducer head. The transducer depth was 6.5 m; 100 velocity measurements were made at 8-m intervals starting 23 m below the surface. Every ping was recorded as raw ensemble data (.ENR). Also, 60 seconds and 300 seconds averaged data were recorded as short-term average (.STA) and long-term average (.LTA) data, respectively. Major parameters for the measurement (Direct Command) are as follows:

VM-ADCP Configuration

Bottom-Track Commands

BP = 001 Pings per Ensemble

Environmental Sensor Commands

EA = +00000	Heading Alignment (1/100 deg)
EB = +00000	Heading Bias (1/100 deg)
ED = 00065	Transducer Depth (0 - 65535 dm)
EF = +0001	Pitch/Roll Divisor/Multiplier (pos/neg) [1/99 - 99]
EH = 00000	Heading (1/100 deg)
ES = 35	Salinity (0-40 pp thousand)
EX = 11000	Coord Transform (Xform:Type; Tilts; 3Bm; Map)
EZ = 1020001	Sensor Source (C;D;H;P;R;S;T)
	C(1): Sound velocity calculate using ED, ES, ET(temp.)
	D(0): Manual ED
	H(2): External synchro
	P(0), R(0): Manual EP, ER (0 degree)
	S(0): Manual ES
	T(1): Internal transducer sensor

Timing Commands

TE = 00:00:02.00	Time per Ensemble (hrs:min:sec.sec/100)
TP = 00:02.00	Time per Ping (min:sec.sec/100)

Water-Track Commands

WA = 255	False Target Threshold (Max) (0-255 counts)
WB = 1	Mode 1 Bandwidth Control (0=Wid,1=Med,2=Nar)
WC = 064	Low Correlation Threshold (0-255)
WD = 111 111 111	Data Out (V;C;A PG;St;Vsum Vsum^2;#G;P0)
WE = 5000	Error Velocity Threshold (0-5000 mm/s)
WF = 0800	Blank After Transmit (cm)
WG = 001	Percent Good Minimum (0-100%)
WI = 0	Clip Data Past Bottom (0=OFF,1=ON)
WJ = 1	Rcvr Gain Select (0=Low,1=High)
WM = 1	Profiling Mode (1-8)
WN = 100	Number of depth cells (1-128)
WP = 00001	Pings per Ensemble (0-16384)
WS = 0800	Depth Cell Size (cm)
WT = 000	Transmit Length (cm) [0 = Bin Length]
WV = 999	Mode 1 Ambiguity Velocity (cm/s radial)

(4) Preliminary result

Fig. 3-6-1 show 30-minutes averaged current vectors (25m-50m) along cruise track. The data was processed using CODAS (Common Oceanographic Data Access System), developed at the University of Hawaii.

(5) Data archive

These data obtained during this cruise will be submitted to the JAMSTEC Data Management Division, and will be opened to the public via “R/V MIRAI Data Web Page” in JAMSTEC home page.

(6) Remarks

Sometimes lost the position while the receiving status become worth when the number of satellites decreased or HDOP increased. The periods of losing the position are as follows.

(UTC)

10/20	19:18
10/23	07:22, 07:37 - 07:39, 18:56, 19:04
10/24	08:09, 18:48 - 18:56, 16:17, 18:44, 18:49 - 18:57

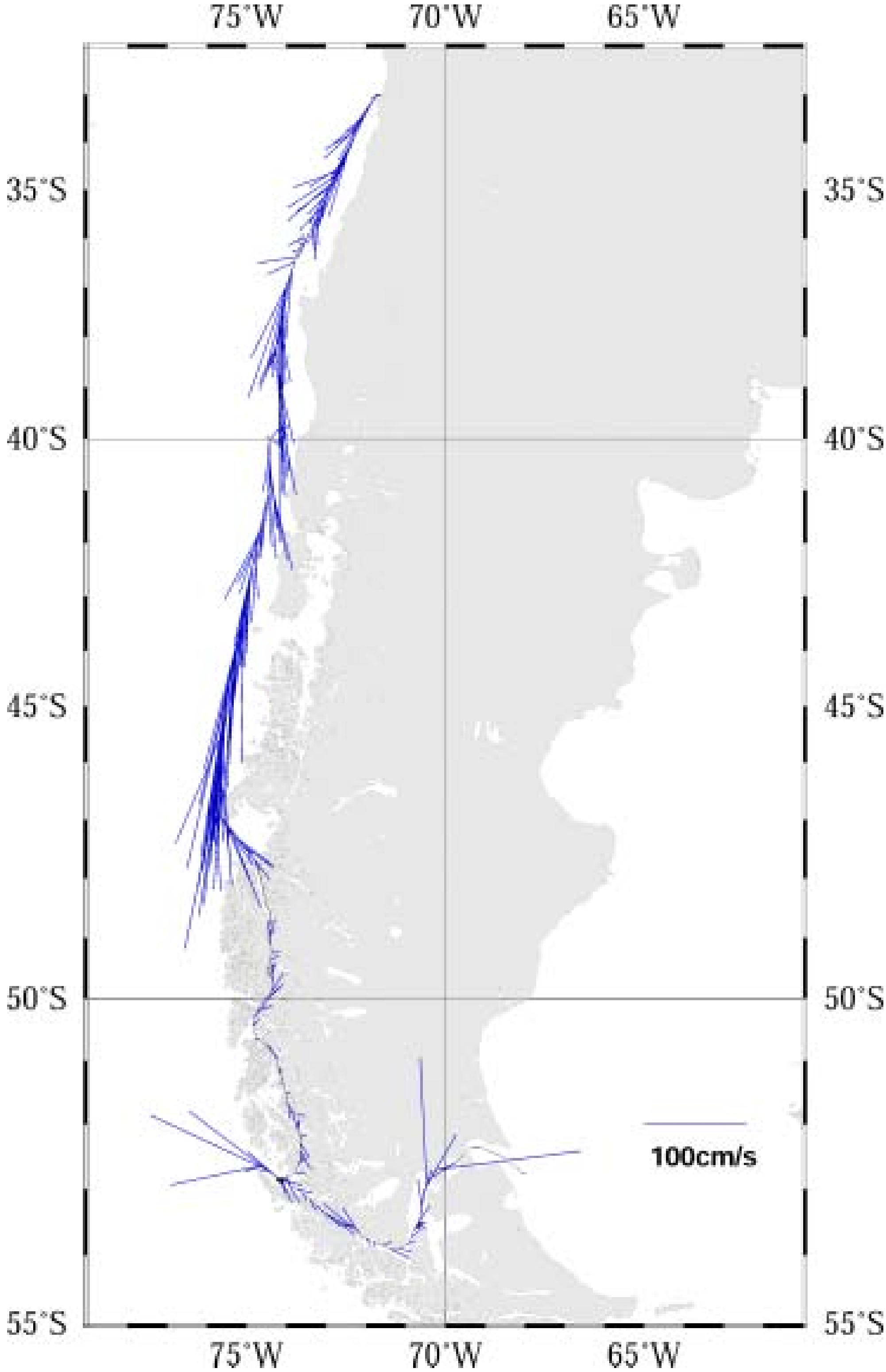


Fig. 3-6-1 30-minutes averaged surface current vectors (25m-50m)

3-7 Satellite observation

Wataru Tokunaga (GODI)
Norio Nagahama (GODI)
Ryo Kimura (GODI)
Not onboard:
Ichio Asanuma (JAMSTEC): Principal Investigator

(1) Objectives

It is our objectives to collect data of sea surface temperature in a high spatial resolution mode from the Advance Very High Resolution Radiometer (AVHRR) on the NOAA polar orbiting satellites and to build a time and depth resolved primary productivity model.

(2) Method

We receive the down link High Resolution Picture Transmission (HRPT) signal from NOAA satellites by the same way as the signal of OrbView-2. We processed the HRPT signal with the inflight calibration and computed the sea surface temperature by the multi-channel sea surface temperature (MCSST) method. A daily composite map of MCSST data is processed for each day on the R/V MIRAI for the area, where the R/V MIRAI located.

We received and processed NOAA data throughout MR03-K04 Leg3 cruise from the departure of Valparaiso on 19 October 2003 to 24 October 2003.

The sea surface temperature data will be applied for the time and depth resolved primary productivity model to determine a temperature field for the model.

(3) Preliminary results

The results will be public after the analysis.

(4) Data archives

The raw data obtained during this cruise will be submitted to JAMSTEC Data Management Division and will be under their control.

(5) Remarks

We could not operate the system on and after 1700UTC 24 October 2003 because of control workstation trouble.

3-8 Bio-optical observation

Vivian Lutz (Institute Nacional de Investigation y Desarrollo Pesquero)
Ana Dogliotti (Institudo de Astronomia y Fisica del Espacio POGO Trainee)
Gustavo Martinez (Universidad de la Republica Oriental del Uruguay POGO Trainee)

1. Objectives

The general objectives of the bio-optical project on this expedition are:

- To generate an important database of bio-optical measurements and primary production from the under-sampled Southern Ocean.

To reach this objective, measurements of radiation (seawater reflectance) are being measured with a variety of radiometers (Simbad, Simbada, Ocean Optics), samples are taken for the analysis of chlorophyll a concentration, and for the determination of absorption properties of particulate (phytoplankton and detritus) and coloured-dissolved-organic-matter (CDOM); P&I experiments are also performed for the estimation of primary production parameters. Samples for the determination of phytoplankton pigment composition by HPLC, as well as for the quantification and identification of the small-sized phytoplankton by flow-cytometry are also being collected. Results from these analysis are expected to contribute to the validation and calibration, and probably to develop regional algorithms, for satellite-derived products (eg., chlorophyll a) by sensors such as SeaWiFS, MODIS, and MERIS.

- To provide a training environment in which trainees could get a hands-on experience in collecting phytoplankton related samples and bio-optical data. To get a first knowledge about some of the analysis and processing of bio-optical data.

2. Sampling and Methods

Protocols for the sampling and methods being used for the optical measurements and analysis of biological samples can be consulted in the URL of IOCCG (http://www.ioccg.org/training/pogo_ioccg/protocols/protocols.html).

All samples are taken at the surface, or near surface, of the ocean. Analysis of chlorophyll concentrations, particulate and CDOM absorption, and P&I incubations are performed on board, while HPLC, flow cytometry and ^{13}C (for the calculations of P&I parameters), as well as a duplicate of particulate absorption samples are going to be processed in different laboratories (in Canada, Chile, South Africa, and Australia) after the end of the cruise. A preliminary processing of some of the data available is being developed onboard.

3. Peculiarities of Leg 3

During this leg the main focus of the expedition was on sediment analysis. There were only four stations scheduled, which were occupied for corer sampling. The survey to find a proper site and then the deployment of different types of corer in these deep areas of the ocean took several hours (almost the whole daylight). Therefore, in most cases only one sampling a day was made for the bio-optics project using a surface bucket. In the days when there were no fixed stations, two samplings a day were performed from the flow-through-system (FTS) of the ship, one around 10 a.m. and the other around 3 p.m. Occasionally an extra sample for chlorophyll a determination was taken from the FTS at noon (for the sake of matching SeaWiFS passing).

Weather conditions were not ideal for light measurements with the radiometers in this leg. During stations, when light measurements could be performed, it was mainly cloudy and foggy, even rainy. This weather is typical of this area of the Chilean Fjords, surrounded by mountains (the southern tip of the Andes) where humid air from the Pacific precipitates. Hence, a preliminary look at the few measurements obtained showed that there were not of good quality and there will not be included in this report. Nevertheless, these data could be later analysed by experts, who can better judge if there is valid information to be retrieved.

A problem encountered, and that would be the same for all legs, is that light measurements could only be done at stations with the ship stopped and from the aft area. This is because due to safety constrains you are not allowed to work on the bow of the Mirai at any time (even with the ship stopped), or at any place close to the board when the ship is sailing. Besides, the huge wake produced by the ship, making foam at the place where you are supposed to point the radiometer, would impede this type of measurements while steaming.

In this leg no CTD casts were performed, so there are no profiles of physical or chemical data available.

Sampling on this leg was restricted to the Pacific side, Chilean waters, since no authorization for sampling on the Atlantic side, including Argentinean, Uruguayan and Brazilian waters was obtained.

4. Biological Sampling

4-1 Photosynthesis v/s Irradiance (PI) Experiments

Everyday 1 or 2 experiments were carried out onboard. 42 bottles (+ 3 dark) were incubated with ^{13}C in a Larsen box for 3 hours, then filtered and dried.

Storing: filters were labelled and stored in sets of 15 envelopes.

4-2 CDOM

Water for the determination of coloured-dissolved-organic-matter were filtered through 0.2 μm membranes, and immediately scanned in a 10 cm quartz cuvette in a CARY spectrophotometer.

Storing: no samples were stored. Results are in folder JAMSTEC/CDOM/Leg.3/dailyfolder

4-3 Chlorophyll Concentration

Chlorophyll-a and phaeopigments concentrations were measured onboard using a digital Turner Designs fluorometer.

Storing: no samples were stored. Results are in folder JAMSTEC/Leg3/Chl/daily files

4-4 Particulate Absorption

Two samples were collected and filtered through GF/F glass fiber filters for the determination of particulate absorption. One sample was immediately scanned on board in a CARY spectrophotometer, and the other will be analysed at the Bedford Institute of Oceanography (Att: Dr. Venetia Stuart).

Storing: Results of samples analysed on board are in folder JAMSTEC/Absorption/Leg3/dailyfolder. Duplicate samples were frozen in liquid nitrogen into a labelled cryogenic vial and then stored in a deep freezer (-80^{o}C).

4-5 High Performance Liquid Chromatography

Two samples were collected and filtered through GF/F glass fiber filters for the determination of phytoplankton pigment composition by HPLC. These samples will be analysed in 2 different laboratories: Cape Town (South Africa) and Hobart (Australia).

Storing: Both samples were frozen in liquid nitrogen and then stored in 2-separated labelled aluminium foil envelopes into a deep freezer (-80^{o}C).

5. Optical Sampling

The weather conditions were not good for collecting optics data due to high cloud cover most of the time. However, a few measurements were performed with the different radiometers available.

5-1 SIMBAD

The hand-held battery operated radiometer collects data in five spectral bands that are centred at 443, 490, 560, 670, 870 nm. This instrument has an external GPS antenna and measures direct sunlight intensity and water leaving radiance. The GPS must first find the instruments position before readings can be made. The sequence of measurements are 1 Dark, 3 Sun, 6 Sea, 3 Sun, and 1 Dark.

Storing: The files are in the folder JAMSTEC/Leg3/simbad03/dailyfolder.

5-2 SIMBADA

This instrument is an above-water radiometer and it measures water-leaving radiance and aerosol optical thickness in 11 spectral bands. The bands are centred at 350, 380, 412, 443, 490, 510, 565, 620, 670, 750 and 870 nm. The instrument has an internal GPS antenna that must home in on 3 or more satellites before readings can be taken. The sequence of measurements are 1 Dark, 3 Sun, 6 Sea, 3 Sun, and 1 Dark.

Storing: The files are in the folder JAMSTEC/Leg3/simbada21/dailyfolder.

5-3 Hyperspectral radiometer

This instrument measures irradiance from 350 to 1000 nm at 0.5 nm intervals and has a special fibre optic that collects the irradiance from the sky and the sea surface. The downwelling irradiance is measured using a spectralon that diffuses the incident irradiance.

Storing: Files are in folder JAMSTEC/Leg3/HyperSp/dailyfolder.

5-4 Photosynthetic Active Radiation (PAR)

The PAR sensor is mounted outside, above the Atmospheric Observation laboratory. The Licor 1400 data logger connected to the sensor reads measurements every 60 seconds and records hourly average on the hour. Data are downloaded at the end of the leg to be later processed at BIO in Canada.

Storing: Files are in folder JAMSTEC/Leg3/PAR_sensor_data/PAR_Leg3.txt

6. Pogo Trainees Activities

The two trainees working on this leg, Ana Dogliotti and Gustavo Martínez, had an excellent background on bio-optics and worked hardly and with enthusiasm in all the activities developed on board not only on the practical aspects, but also on the data processing part.

6-1 Trainees Remarks

Ana Dogliotti

My experience in R/V Mirai was as extraordinary as unique. I've learned a lot about biological and optical measurements and how to work in a laboratory on board of a ship, the difficulties found when the vessel starts rolling and the precaution to be taken during sampling, filtering and measuring different variables, like absorption and chlorophyll concentration.

Even though the weather didn't help, due to the high latitudes we navigated, a few light measurements could be taken. It was hard to complete a set of measurements without having clouds covering the sun and the ship wasn't always in the correct position.

SIMBADA was easier, lighter and faster to start operating than SIMBAD instrument, which took longer to find the GPS signal. But there was a specific program for SIMBAD instrument that allowed us to analyse the data, which lacked for SIMBADA.

The hyperspectral radiometer (Ocean Optics) gives a lot of information, but it requires at least two persons to operate it and sometimes it was hard to see the computer screen to set the integration time on deck. Analysing the data helped us realising problems or mistakes made during sampling and to change a little bit the protocols in order to avoid making the same mistakes in the future legs.

It was also interesting to process and analyse the absorption data on board, thanks to Vivian's experience and knowledge and Gustavo's help with programming.

It was a shame we couldn't take measurements in the Atlantic part of leg 3. It would have been interesting to sample the SouthWestern Atlantic Ocean, being a very important area and a poorly sampled one.

All the kind of measurements taken during this cruise were new to me, also being on board. It was a whole new experience that I'll probably never forget.

I would like to thank POGO for this great training opportunity and to all the JAMSTEC people for their collaboration.

Gustavo Martínez

Although I had previous experience in oceanographic sampling on board, the experience of working in the R/V MIRAI was totally different. The amplitude of the different laboratories permitted us to work comfortably and to have equipment on board that allowed obtaining data to be processed. The radiometric measurements were new for me. The sea conditions we had were not optimal for these measurements, but we could get some practice in handling and using the different sensors. For reasons already commented, we had time to do data processing. That was very important because Vivian teached us through the analysis of real data. In that way we learned the practical details that facilitate later application of the techniques. In relation with the light measurements, when we tried to process the data, we understood the relevance of respecting the conditions of sampling, mainly regarding the angles and position in relation with the sun.

The life on board the MIRAI was good. I felt a very good disposition from the crew, technical staff and other scientists, trying to help when we needed.

7 Data Processing

A series of Fortran routines were produced to process the absorption data. They can be found in the directory /JAMSTEC/leg3/data-process. These data can be later reprocessed to make any necessary adjustments, for example choosing a more appropriate Beta factor (once HPLC pigments would be available; see Stuart et al., 1998).

In the case of the particulate absorption, the first routine 'absorption_n.for' retrieves the optical density values (OD) from the ASCII files produced by the Cary spectrophotometer in a format which can be read by Fortran. The second routine 'absorption_f.for' processes the OD values following the steps described in the protocols. Basically:

1) it subtracts the value of absorption at 750 nm from the whole spectrum;
2) it averages the 10 replicates of each type of measurement;
3) it subtracts the averaged blank from the averaged sample absorption;
4) it organises the spectrum from the lower to the higher wavelength;
5) it corrects the spectrum for the Beta factor (using the equation proposed by Hoepffner & Sathyendranath, 1992; see reference in protocols);
6) it transforms OD into absorption (passing from $\log_{10}$ to $\log_e$ and considering the area and volume of filtration);
7) it subtracts the detritus from the total to retrieve the phytoplankton absorption;
8) it calculates the specific absorption coefficient of phytoplankton (dividing the phytoplankton absorption by the chlorophyll *a* concentration of the sample).

The program generates four output files with the results of the processing:

SampleID+ABT.txt
SampleID+ABD.txt
SampleID+ABPHY.txt
SampleID+ABSPHY.txt

The OD values of CDOM were first retrieved by the routine 'cdom_n.for'. Then the routine 'cdom_f.for' process the data following these steps:

1) it subtracts the value of absorption at 700 nm from the whole spectrum;
2) it transforms OD into absorption (passing from $\log_{10}$ to $\log_e$ and considering the pathlength of the cuvette).

The output of the program is a file with the name 'AC+sampleID.csv'.

8 Preliminary Results

This is just a preliminary analysis of some of the results obtained on Leg 3. Location of the sampling points is shown in figure 1.

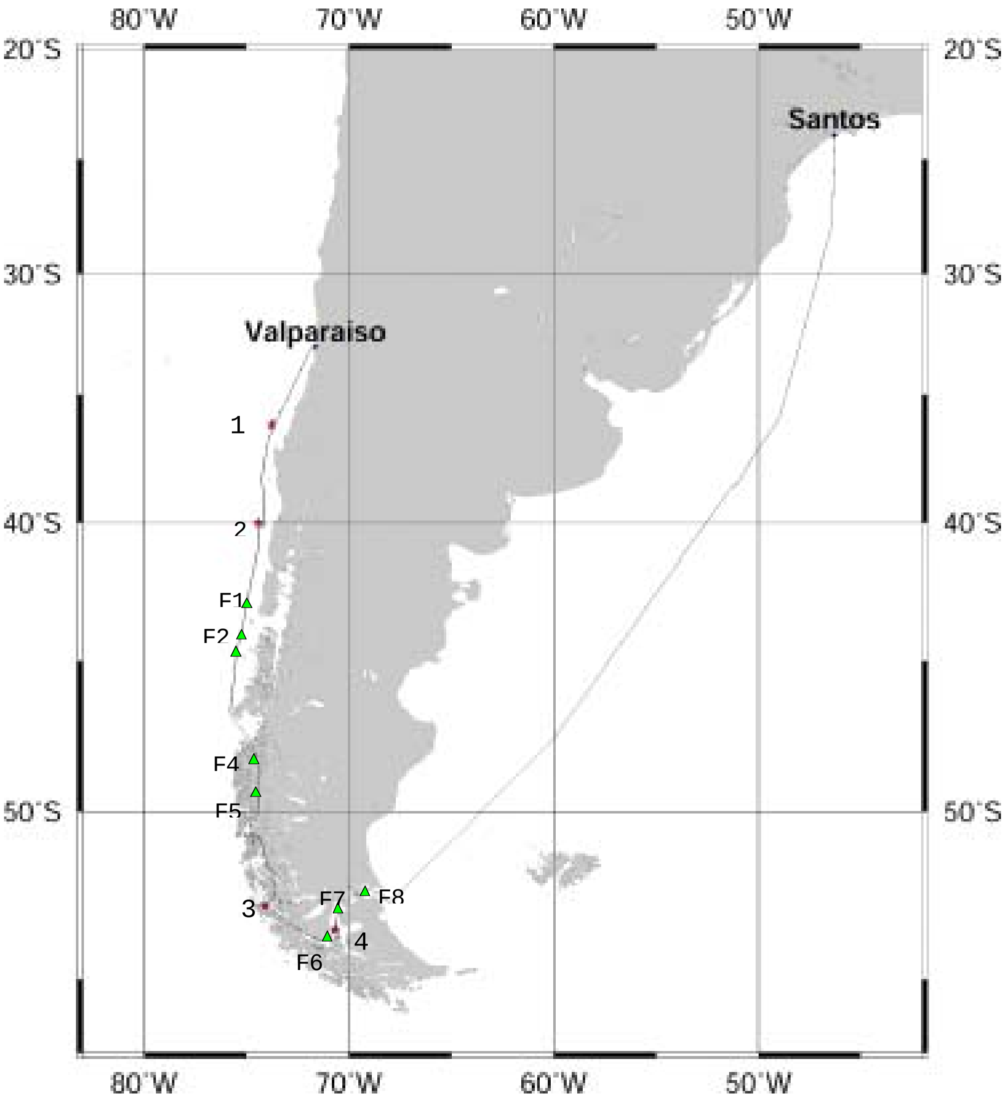


Figure 1. Sampling points during Leg 3. Numbers alone correspond to the corer stations, and F+number correspond to sampling points from the flow-through-system.

Table 1. Chlorophyll a concentrations in the samples of Leg 3.

Sample ID	Station #	Chla (mg m^{-3})
264302	1	0.418
264303	2	0.249
264304	F1	1.125
264305	F2	0.654
264306	F3	0.708
264307	F4	2.048
264308	F5	2.947
264309	3	0.739
264310	F6	5.925
264311	4	7.669
264312	F7	4.417
264313	F8	1.026

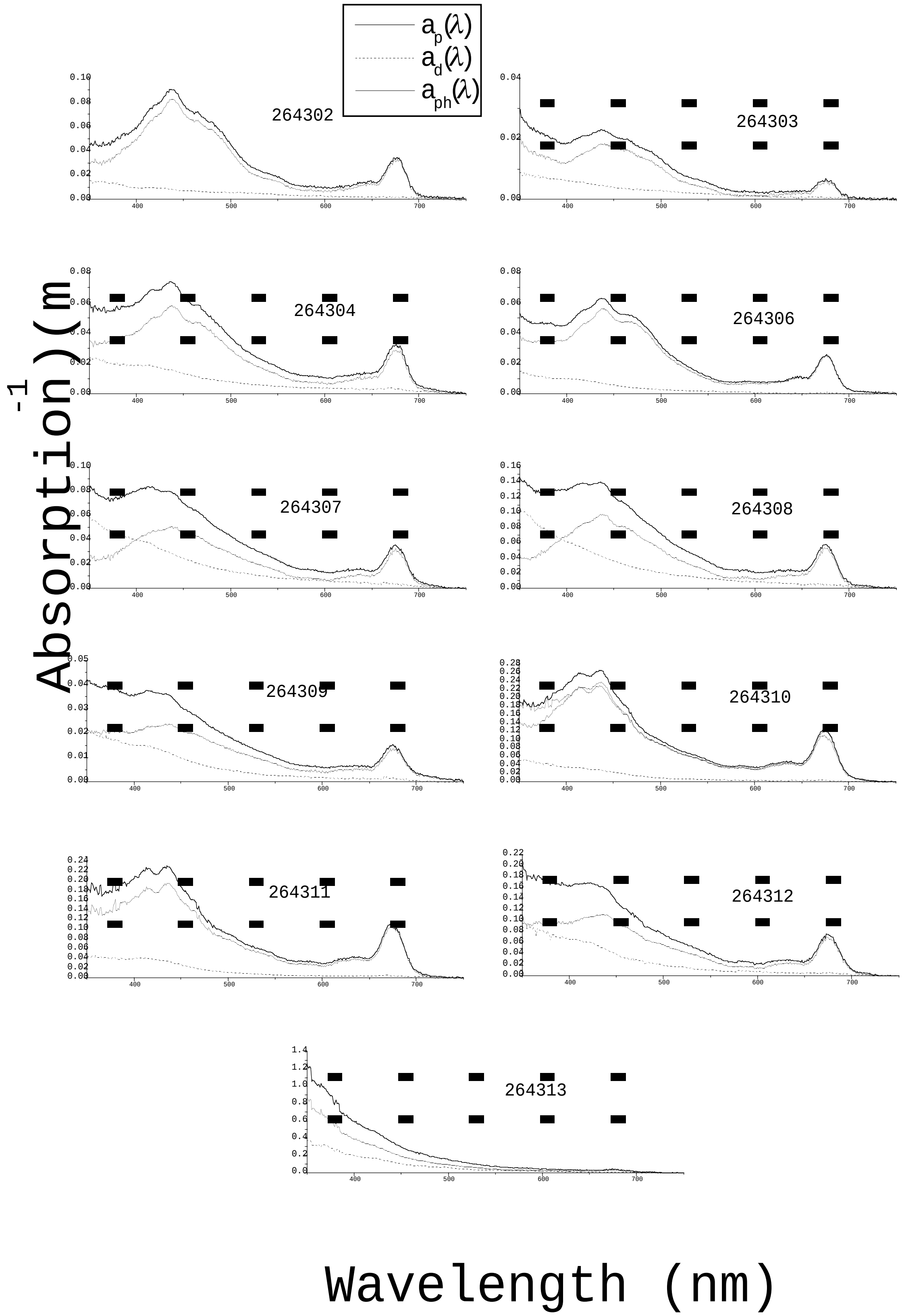


Figure 2. Absorption coefficients of total particulate material, $a_p(l)$, detritus, $a_d(l)$, and phytoplankton, $a_{ph}(l)$, in the samples of Leg 3.

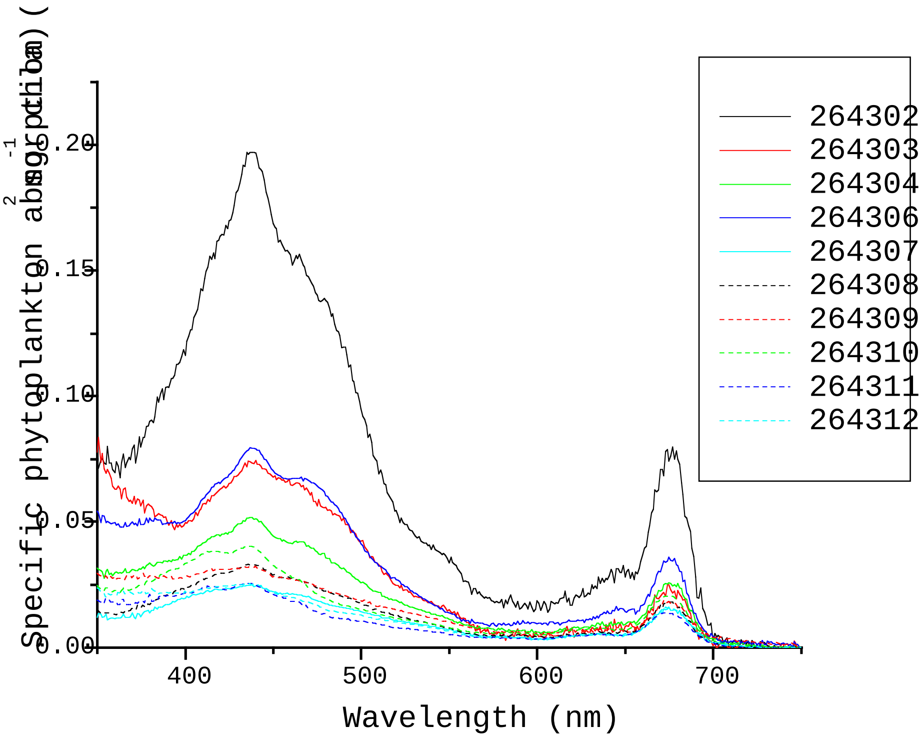


Figure 3. Specific absorption coefficient of phytoplankton, $a^*_{ph}(\lambda)$ in the samples.

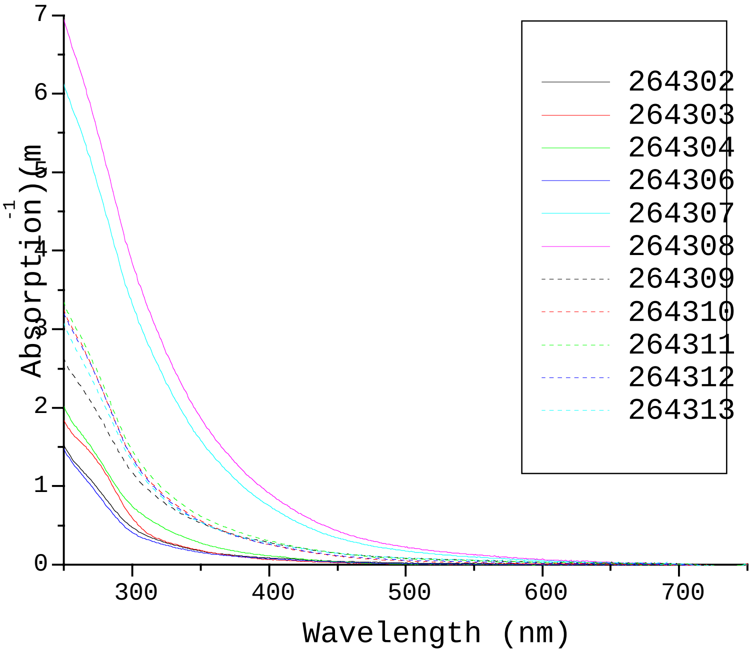


Figure 4. Absorption coefficient of CDOM, $a_y(l)$ in the samples.

Although there were not many samples taken in this leg, only eleven, they showed a large variability in chlorophyll concentrations and absorption characteristics. This is because the cruise track covered a large latitudinal range, from about 36 to 53 degrees S (Figure 1). Even more, some of the samples in the North were taken (although close to the coast) in open deep waters, while others in the South were well within the Chilean Fjords and the Magellan Strait.

According to the specific absorption coefficients of phytoplankton, $a^*_{ph}(\lambda)$ (Figure 3), and the absorption coefficients of CDOM, $a_y(l)$ (Figure 4), we can make a first division of the samples into two groups. The first one includes stations in open waters (stations 1, 2, F1, and F3), and the second corresponds to stations within the channels and the strait (F4, F5, 3, F6, 4, F7, and F8).

The first group showed in general low chlorophyll concentrations (Table 1), low detritus absorption, $a_d(l)$ (Figure 2), relatively high $a^*_{ph}(\lambda)$, and low $a_y(l)$ typical conditions of clear waters. Station 1 on this group corresponded to the CONCEPCION time series study, and showed an extremely high $a^*_{ph}(\lambda)$, probably due to the presence of small phytoplankton (Figure 3). These cells would be less affected by the packaging effect, and probably having high concentrations of photoprotective pigments as evidenced by the sharp peak at 440 nm. Station 2, had a somewhat lower $a^*_{ph}(\lambda)$, but showed a conspicuous increase in the absorption towards the UV (Figure 3). This feature coincided with a bump around 280 nm in the $a_y(l)$. This might be due to the presence of UV absorbing compounds in the phytoplankton, which could also be exuded to the water.

The second group showed in general high chlorophyll concentrations (Table 1), higher $a_d(l)$ (Figure 2), low $a^*_{ph}(\lambda)$, and higher $a_y(l)$ characteristic of land influenced waters. This low $a^*_{ph}(\lambda)$ may be explained by the presence of large phytoplankton more affected by the flattening effect. Stations F4 and F5, which were located inside narrow channels (Figure 1), showed extremely high $a_y(l)$. This may be the result of organic matter washed by numerous narrow streams coming down from the mountains, covered by forests, and carrying water from the ice caps. Station 3 had the general characteristics of group 2. Stations within the Magellan Strait showed a marked increase in $a_d(l)$ from the Pacific entrance (Stations 4 and F6), middle (Station F7), towards the Atlantic end (station F8). The extremely high values of detritus absorption at this last station impeded to filter enough volume of water to obtain a clear phytoplankton absorption signal. This clogging of the filters resulted in very long filtration times, which wouldn't have been adequate to treat samples incubated for the P&I experiments. This huge amount of thin sediment (clay- like) in the samples may have its origin in airborne dust brought by the strong winds sweeping the dry Patagonian terraces surrounding the strait at this end.

9 Acknowledgements

We would like to thank people at POGO, IOCCG and JAMSTEC for giving us the opportunity of being able to participate in this exciting BEAGLE-2003 expedition, specially Prof.

Masao Fukasawa for his support and overall leadership of the whole expedition. The experience will be most useful to us in our future work. We want to thank Kathleen Peard and Bronwen Currie from Namibia, who helped us in different occasions with the sampling on board. Special thanks go to Shubbha Sathyendranath, Venetia Stuart, Tony Paysant, Marie Helene Forget, Robert Frouin and previous participants in legs 1 and 2 for their long distance support. We appreciate the collaboration received on board from Naomi Harada chief scientist, and Shuichi Watanabe and his team, as well as the captain and crew of the R/V Mirai.

3-9 Atmospheric observation

3-9-1 Particulate carbonaceous substances and Ozone

Mitsuo Uematsu (Ocean Research Institute, The University of Tokyo): Principal Investigator
Kiyoshi Matsumoto (Ocean Research Institute, The University of Tokyo / Japan Science and Technology Corporation)

(1) Objectives

The potential influence of increasing tropospheric aerosols on negative radiative forcing in the atmosphere has attracted considerable attention, since these aerosols may have a cooling effect through direct and indirect radiative processes, thus mitigating the global warming. In order to understand the effects of carbonaceous aerosols on climate, it is necessary to determine their geographical distributions and seasonal changes, especially over the remote ocean. In this cruise, continuous measurements of particulate carbonaceous substances were conducted over the western Pacific Ocean. Ozone concentrations were also measured during this cruise, since ozone is a good indicator of air mass histories and photochemical activities.

(2) Methods

The concentrations of carbonaceous substances, organic carbon (OC) and elemental carbon (EC) in aerosols were measured for every 4 hours by using an Ambient Carbon Particulate Monitor (Rupprechet & Patashnick Co. Inc., Model 5400). This instrument can automatically measure the concentrations of OC and EC in aerosols by a thermal analysis. Only ambient aerosols with diameter < 2.5µm were introduced into the instrument using a PM2.5 cyclone (with a 50% effective cut-off diameter of 2.5µm) to eliminate coarse aerosols such as sea-salt particles. The inlet tube was heated at 50°C to avoid dewfall. Aerosols were collected with an impactor (with a 50% effective cut-off diameter of 0.14µm) at a flow rate of 16.7L min^{-1}. The collection plate of the impactor was heated at 50°C in order to minimize the adsorption of gaseous organic matter during sampling; therefore, large fraction of the particulate carbonaceous matters evolved below 50°C may have been lost from our measurements. The collected samples of carbonaceous matters were volatilized by heating the collection plate and then transformed to CO_2 by combustion at 750°C with an afterburner. The concentration of CO_2 was then measured by a NDIR CO_2 sensor. The heating temperatures of the collection plate were set at four stages, 200°C, 250°C, 340°C and 750°C. In this study, OC and total carbon (TC) were defined as the carbonaceous matters evolved below 340°C and below 750°C, respectively. And then, the difference between the amounts of TC and OC yielded the amount of EC.

Our preliminary experiments found that the monitor overestimates particulate OC concentration, probably due to the adsorption of organic vapors on the collection plate that is called “positive artifact”. In order to avoid the positive artifact, a parallel plate organic denuder, which is produced by Sunset Laboratory Inc., was installed at the inlet of the monitor.

The concentration of ozone was measured at 12-second intervals by using an ozone monitor (Dylec, Model 1150).

The inlets of air were located on the compass deck (about 17m above the sea surface).

(4) Future Plane and Data Archives

The data of the concentrations of carbonaceous aerosols and ozone obtained in this cruise will be analyzed to determine the concentration levels of these species over each oceanic region and discuss their geographical distribution, seasonal and diurnal variations. They will be archived at Ocean Research Institute (ORI), the University of Tokyo.


Thank you !!