Cruise summary of MR08-06 Leg.2 and 3

1. Outline of the cruise
   (1) Cruise No./ R/V: MR08-06 Leg.2 and 3/ MIRAI
   (2) Title of the cruise: Studies on geophysics and paleoceanography in the South Pacific: Evolution of climate changes and biogeochemical cycles in the Chilean continental marginal area.
   (3) Cruise period:
   Leg.2: March, 14, 2009-March, 30, 2009
   Leg.3: April, 2, 2009-April, 8, 2009
   (4) Port:
   Leg.2: Valparaiso – Punta Arenas
   Leg.3: Punta Arenas - Valparaiso
   (5) Research area:
   Chilean coast including fjord: 45˚S-56˚S and 66˚W-76˚W
   (6) Cruise track

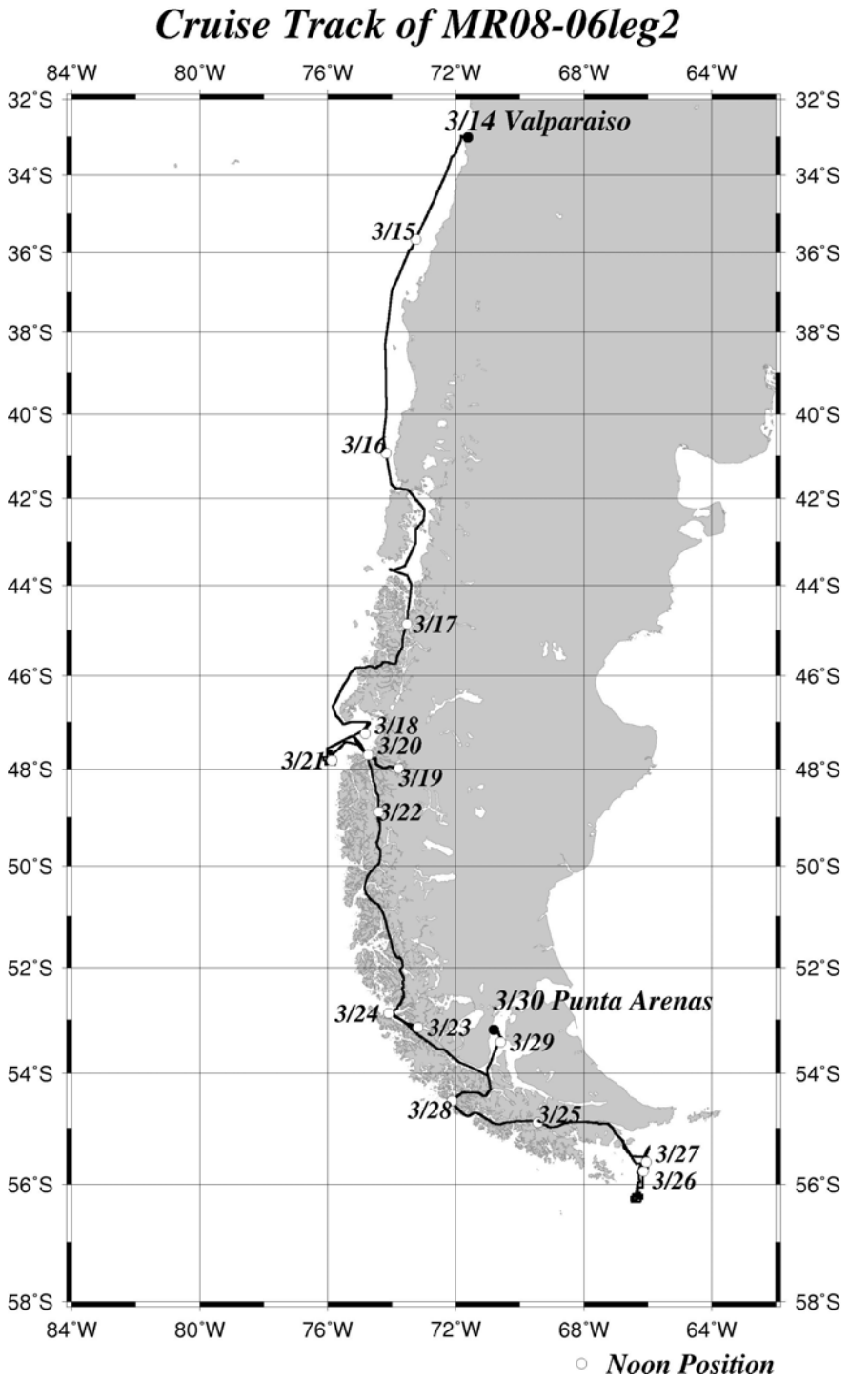

Fig.1 Cruise track of leg.2.

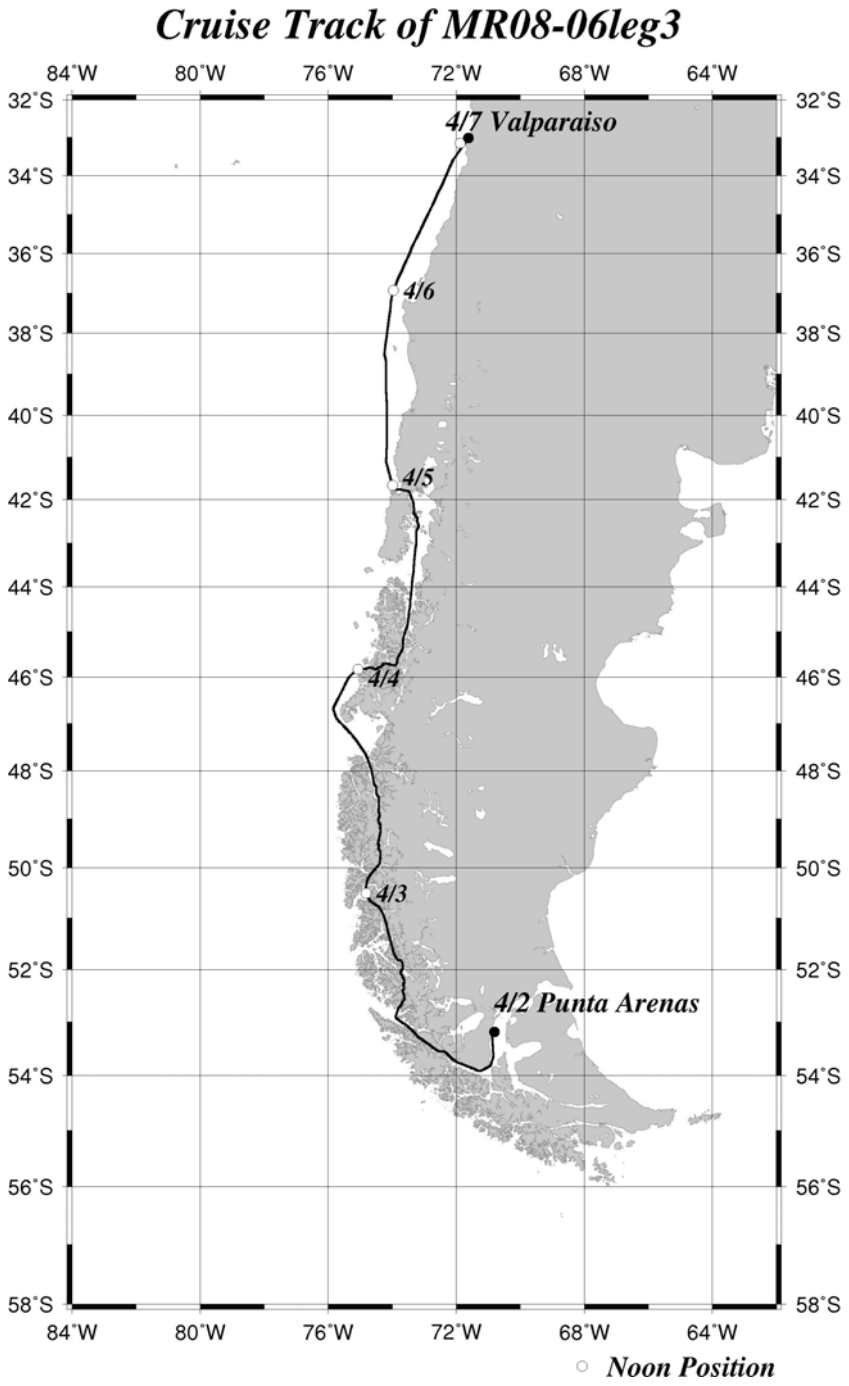

Fig.2 Cruise track of leg.3.

2. Participants:

(1) Chief Scientist/ Affiliation (Leg.2 and Leg.3): Naomi Harada / Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
(2) Principal Investigator/ Affrication: Same as above
(3) Other participants

Leg.2

1) Miyako Sato (JAMSTEC, Sediment coring)
2) Atsushi Kurasawa (Hokkaido Univ./JAMSTEC, Plankton)
3) Keiji Horikawa (Nagoya Univ./JAMSTEC, Sediment coring, hydrocast)
4) Kazuyo Shiroya (Univ. of Tokyo/JAMSTEC, Sediment coring)
5) Carina B. Lange (Concepcion Univ., Sediment coring)
6) Silvio Pantoja (Concepcion Univ., Dissolved organic matter)
7) Wolfgang Schneider (Concepcion Univ., CTD and hydrocast)

8) Karol Patricia Espejo Sepúlveda (Concepcion Univ., Hydrocast at bottom boundary layer)
9) Alejandro J. Avila Santis (Concepcion Univ., Sediment coring)
10) Jose Luis Iriarte Machuca (Universidad Austral De Chile, Primary production)
11) Eduardo Menschel Aguilar (COPAS/Universidad Austral de Chile, Drifting sediment trap)
12) Giovanni Daneri Hermosilla (Centro de Investigacion en Ecosistemas de la Patagonia (CIEP), Universidad Austral de Chile, Primary production)
13) Ryo Anma (Univ. of Tsukuba, Sediment coring, Rock)
14) Kiichiro Kawamura (Fukada Geological Institute, Sediment coring)
15) Isao Motoyama (Univ. of Tsukuba, Sediment coring)
16) Yasumi Yamada (Univ. of Tsukuba, Sediment coring)
17) Hiroshi Furutani (Univ. of Tokyo, Aerosol)
18) Jinyoung Jung (Univ. of Tokyo, Aerosol)
19) Satoshi Okumura (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
20) Harumi Ota (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
21) Takashi Kawamura (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
22) Yusuke Sato (Marine Works Japan, Sediment coring)
23) Kazuhiro Yoshida (Marine Works Japan, Sediment coring)
24) Yohei Taketomo (Marine Works Japan, Sediment coring)
25) Takami Mori (Marine Works Japan, Sediment coring)
26) Ei Hatakeyama (Marine Works Japan, Sediment coring)
27) Satoshi Ozawa (Marine Works Japan, CTD/hydrocast)
28) Shinsuke Toyoda (Marine Works Japan, CTD/hydrocast)
29) Tatsuya Tanaka (Marine Works Japan, CTD/hydrocast)
30) Kenichiro Sato (Marine Works Japan, CTD/hydrocast)
31) Minoru Kamata (Marine Works Japan, CTD/hydrocast)
32) Masanori Enoki (Marine Works Japan, CTD/hydrocast)
33) Junji Matsushita (Marine Works Japan, CTD/hydrocast)
34) Yasuhiro Arii (Marine Works Japan, CTD/hydrocast)
35) Misato Kuwahara (Marine Works Japan, CTD/hydrocast)

Leg.3
1) Miyako Sato (JAMSTEC)
2) Atsushi Kurasawa (Hokkaido Univ./JAMSTEC)
3) Keiji Horikawa (Nagoya Univ./JAMSTEC)
4) Kazuyo Shiroya (Univ. of Tokyo)
5) Ryo Anma (Univ. of Tsukuba)
6) Isao Motoyama (Univ. of Tsukuba)
7) Yasumi Yamada (Univ. of Tsukuba)
8) Hiroshi Furutani (Univ. of Tokyo)
9) Jinyoung Jung (Univ. of Tokyo)
10) Harumi Ota (Global Ocean Development)
11) Takashi Kawamura (Global Ocean Development)
12) Yusuke Sato (Marine Works Japan)
13) Kazuhiro Yoshida (Marine Works Japan)
14) Takami Mori (Marine Works Japan)
15) Ei Hatakeyama (Marine Works Japan)
16) Junji Matsushita (Marine Works Japan)
17) Yasuhiro Arii (Marine Works Japan)

18) Tomonori Watai (Marine Works Japan)
19) Hideki Yamamoto (Marine Works Japan)
20) Katsunori Sagishima (Marine Works Japan)
21) Shinichiro Yokogawa (Marine Works Japan)
22) Yuichi Sonoyama (Marine Works Japan)
23) Ayaka Hatsuyama (Marine Works Japan)

3. Backgrounds and Purpose:

The southern region of the eastern South Pacific (ESP) has several important components to be considered: a) the West Wind Drift current that splits into an equatorward Chile-Peru Current and a poleward Cape Horn Current; b) strong poleward winds; c) heavy precipitation during frequent storms which result in large surface buoyancy fluxes; d) input of freshwater by river input, ice melting and rainfall origin greatly enhance the supply of terrigenous sediment; e) enhancement of the vertical stratification by continental fresh water runoff; f) formation of Subantarctic Mode Water (the precursor of Antarctic Intermediate Water, AAIW) offshore southern Chile. The coastal area south of 42º S, characterized by a complex system of fjords and channels, is particularly vulnerable to climate change and human influence. At present, ice sheet and glaciers that are retreating at an alarming rate constitute one of the main factors affecting some of the major Patagonian ecosystems. In the past, changes in the Patagonian ice fields have had a large impact on circulation and climate. Understanding circulation, water masses and large-scale processes and the effect of their variability on present and past biological productivity and biogeochemical cycling in the ESP off Southern Chile including the fjords system, constitutes our primary motivation for this cruise.

The MR08-06 legs.2 and 3, R/V MIRAI cruise proposal has two main objectives: 1) to identify and calibrate biogeochemical proxies (biomarkers, Mg/Ca, Sr/Ca ratio in foraminifera, stable isotope ratio of carbon and nitrogen in foraminifera, zoo- and phytoplankton assemblages, etc.) in the modern ocean (water column and the most recent sediments), and 2) to investigate past changes in the biological pump, which transports carbon from the surface to the deep ocean, sea-surface water temperatures, and the ventilation rate of the intermediate water with high time resolution.

4. Relationship with Other Project:

The cruise includes sampling in inland waters, only in the Baker Channel and the mouth of the Guafo. Other coastal stations are included south of the Taitao peninsula (see map of Leg.2 in Fig.4). The strategic sampling in these areas is directly related to the objectives of the COPAS Sur-Austral Development Plan (Base Financing Program of the CONICYT (http://www.conicyt.cl/573/article-28139.html). Participants in this Development Plan are the COPAS Center of the University of Concepción, the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA), and the Center for Research on Patagonian Ecosystems (CIEP). The upcoming MIRAI cruise is part of the Development Plan.

Collaboration between the COPAS Center of the University of Concepción and the Japan Marine Science and Technology Center (JAMSTEC, http://www.jamstec.go.jp) dates back to the Beagle 2003 expedition dedicated to the study of the impact of global climate change on the Antarctic Intermediate Water (AAIW). Collaborations started during that cruise extended later to the training of UDEC graduate students in Japan, joint publications, presentations at congresses, etc. This interaction strengthens the agreement between IORGC Agreement (JAMSTEC) and COPAS (UdeC) signed by the respective authorities in 2007, and facilitates the operation of the oceanographic platform for access to the southern zone.

5. Preliminary results:

Piston cores, PC01, 02, 03 and 04 were collected during the leg.1. Total 5 piston cores were collected at five stations in this leg.2. The first piston core, PC05 was collected at the St.38 (47-14'S, 74-50'W, water depth 192m) with a multiple core at Taitao. The sediment core length was 624cm. The grain components are silty clay with some pellets, and major lithology is kaolinite, illite, quarts, and pellets. Radiolarians and diatoms are a few, but other fossils such as foraminifera are rare. The PC06 was collected at St.40, Baker fjord (47-42'S, 74-44'W, water depth 259m). The sediment core length was 1,411cm. The major lithology is clayey silt with nanno fossils and some pellets. The grain components are kaolinite, illite, and quarts. Radiolarians and nanno plankton fossils existed, but foraminifera and diatoms were few. In the inner area of Baker fjord, even though the multiple core could not been collected, because the coring was failure due to too soft bottom sediment containing much amount of pore water such as a liquid. For PC07 at St.43 Oceanic site of Baker Bay (47-49'S, 75-52’W, water depth 1,388m), the sediment of 495.7cm was collected. The major grain components are sandy clay with nanno fossils. The quarts content was the highest in the clay with rock fragments, mica, and accessory minerals. Foraminifers were also contained. The PC08 was collected at same position of the PC03 in the Magellan mouth during the MR03-K04 MIRAI cruise in 2003 (52-52’S, 74-05’W, water depth 558m). Because we could not access the first planed position in the Pacific side of Magellan due to rough condition. The sediment core length was 749.7cm. The major lithology was calcareous clayey sand and major grain components are nanno fossils, foraminifera, bioclasts, pellets, radiolarians with minerals and quarts. The PC09 was collected at St.44 in Drake Passage (55-43’S, 66-08’W, water depth 684m). The core length was 997.2cm. The major lithology was foraminiferal sand and major grain components are foraminiferal fossils and bioclasts. The minerals and quarts contents were relatively small.

In addition, 12 casts of multiple coring (including 5 failure casts), 15 casts of CTD/hydrocasts, 38 tows of plankton net, 7 casts of drifting sediment trap casts, 7 casts of benthic boundary layer water sampling were done. The SeaBeam, sub bottom profiler, aerosols collection, and pCO_2, were continuously observed according to the cruise track.

We have no observation during the leg.3, because Chilean national observer disembarked at Punta Arenas.

Table 1 Multiple and piston core list of MR08-06 Leg.2 cruise

Date in 2009 (ddyy)	Core ID	St. ID	Location	Lat. S (SOJ)	Lon. W (SOJ)	Depth (m)	Tube length (m)	Core length (cm)	Corer type
3.17	MC37	St.37	Guafo Channel	43-37.1345'	74-03.1323'	199	0.6	7.3	-
3.18	MC38	St.38	Taitao	47-14.1362'	74-50.3648'	187	0.6	35.5	-
3.19	MC42	St.42	Baker Fjord C	47-59.3141'	73-47.2992'	1,063	0.6	48.3	-
3.19	MC42B	St.42	Baker Fjord C	47-59.2687'	73-47.2752'	1,071	0.6	0	-
3.20	MC40	St.40	Baker Fjord A	47-42.3893'	74-44.3787'	260	0.6	0	-
3.20	MC40B	St.40	Baker Fjord A	47-42.3741'	74-44.3697'	258	0.6	0	-
3.20	MC41	St.41	Baker Fjord B	47-58.7856'	74-15.6120'	737	0.6	0	-
3.20	MC41B	St.41	Baker Fjord B	47-58.7966'	74-15.5403'	735	0.6	0	Ashura

3.21	MC43	St.43	Oceanic Baker	47-48.7117'	75-51.6733'	1,389	0.6	16.0	-
3.24	MC46	St.46	Magellan Mouth	52-51.9724'	74-05.0229'	558	0.6	19.8	-
3.27	MC44	St.44	Drake	55-42.5904'	66-08.0276'	685	0.6	14.4	-
3.28	MC45	St.45	Agnes I.	54-31.0669'	72-06.3570'	487	0.6	25.0	-
Date in 2009 (ddyy)	Core ID	St. ID	Location	Lat. S (SOJ)	Lon. W (SOJ)	Depth (m)	Core barrel length (m)	Core length（cm）	Corer type
3.18	PC05	St.38	Taitao	47-14.1473’	74-50.3793'	192	20	624.0	Inner
3.20	PC06	St.40	Baker Fjord A	47-42.3899'	74-44.3780'	259	20	1,411	Inner
3.20	PL06	St.40	Baker Fjord A	47-42.3899'	74-44.3780'	259	0.6	37.2	Ashura
3.21	PC07	St.43	Oceanic Baker	47-48.7115'	75-51.6771'	1,388	10	495.7	Inner
3.24	PC08	St.46	Magellan Mouth	52-52.0045'	74-04.9972'	558	20	749.7	Inner
3.27	PC09	St.44	Drake	55-42.58’	66-08.0591'	684	10	997.2	Outer