Cruise summary of MR08-06 Leg. 1

1. Outline of the cruise
   (1) Cruise No./ R/V: MR08-06 Leg.1a,b / 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.1a: January, 15, 2009-February 3, 2009
   Leg.1b: February, 4, 2009-March, 14, 2009
   (4) Port:
   Leg.1a: Sekinehama – Papeete
   Leg.1b: Papeete - Valparaiso
   (5) Research area:
   Leg1a: The Pacific Ocea: 41°N - 17.5˚S and 141°E - 149 ˚W
   Leg1b: French Polynesia, Southeast Pacific and Chilean EEZ area: 17.5°S- 49°S, 72°W - 150°W
   (6) Cruise track (see Figs 1 & 2)

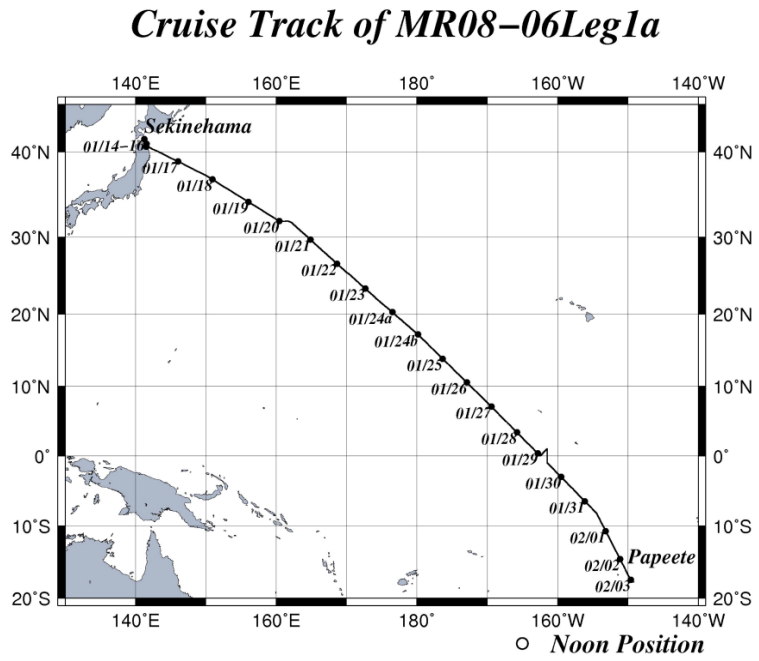

Fig.1 Cruise track of MR08-06 Leg.1a.

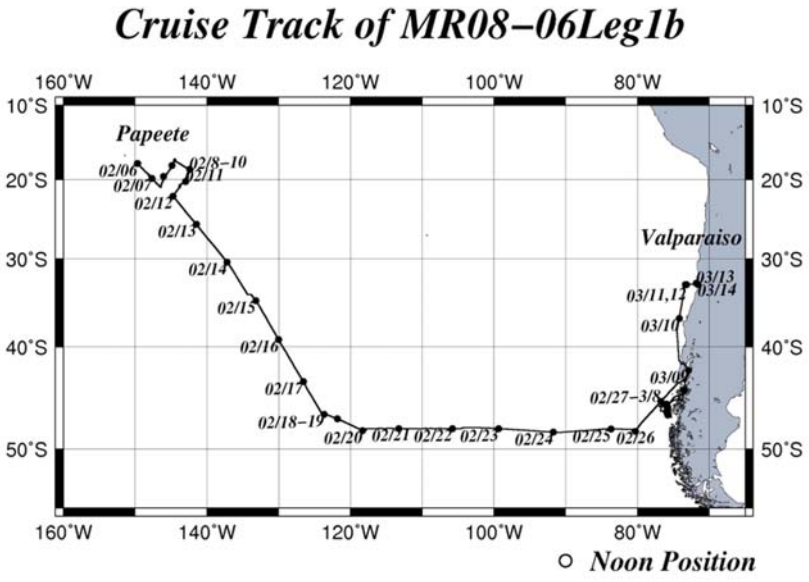

Fig. 2 Cruise track and noon position in MR08-06 Leg1b

2. Participants:
   (1) Chief Scientist/ Affiliation (Leg.1): Natsue Abe / Institute for Research on Earth Evolution (IFREE), Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
   (2) Principal Investigator/ Affrication: Same as above
   (3) Other participants

Leg.1a

1) Atsushi Kurasawa (Hokkaido Univ./JAMSTEC, Plankton)
2) Hiroshi Furutani (Univ. of Tokyo, Aerosol)
3) Jinyoung Jung (Univ. of Tokyo, Aerosol)
4) Ryo Kimura (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
5) Satoshi Okumura (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
6) Asuka Doi (Global Ocean Development, SeaBeam, SBP, Meteorological measurement)
7) Minoru Kamata (Marine Works Japan, CTD/hydrocast)
8) Seike (Marine Works Japan, CTD/hydrocast)
9) Syunsuke Tanaka (Marine Works Japan, CTD/hydrocast)

Leg 1b

1) Toshiya Kanamatsu (JAMSTEC, Sediment coring, Earth Magnetics)
2) Hiroko Sugioka (JAMSTEC, Seismology)
3) Takafumi Kasaya (JAMSTEC, Electromagnetics)
4) Noriko Tada (JAMSTEC, Electromagnetics)
5) Aki Ito (JAMSTEC, Seismology)
6) Shiki Machida (ORI, Univ. Tokyo, Petrology)
7) Takehi Isse (ERI, Univ. of Tokyo, Seismology)
8) Kiyoshi Baba (ERI, Univ. of Tokyo, Electromagnetics)
9) Ryo Anma (Univ. of Tsukuba, Sediment coring, Rock)
10) Yuji Orihashi (ERI, Univ. Tokyo, Geochemistry)
11) Masatake Aniya (Univ. of Tsukuba, Geomorphology)
12) Kiichiro Kawamura (Fukada Geological Institute, Sediment coring)
13) Toshitsugu Yamazaki (AIST, Sediment coring, Earth Magnetics)
14) Takaya Shimono (Univ. of Tsukuba, Sediment coring, Earth Magnetics)
15) Naoto Hirano (Tohoku Univ., Petrology)
16) Atsushi Kurasawa (Hokkaido Univ./JAMSTEC, Plankton)
17) Hiroshi Furutani (Univ. of Tokyo, Aerosol)
18) Jinyoung Jung (Univ. of Tokyo, Aerosol)
19) Sung-Hyun Park (Korea Polar research Institute)
20) Eugenio Andres E. Veloso (Universidad de Catolica del Norte)
21) Cristina C.A.O. Caurapan (Universidad de Chile)
22) Akihisa Motoki (Universidade do Estado do Rio de Janeiro)
23) Rodrigo Soares de Souza (Universidade do Estado do Rio de Janeiro)
24) Jalowitki, Tiago L. R. (Universidade do Federal do Rio Grande do Sul)
25) Sebastian Martini Salame (Universidad de Chile)
26) Ryo Kimura (Global Ocean Development, SeaBeam, Geophysical measurement, SBP, Meteorological measurement)
27) Wataru Tokunaga (Global Ocean Development, SeaBeam, , Geophysical measurement SBP, Meteorological measurement)
28) Ryo Ooyama (Global Ocean Development, SeaBeam, , Geophysical measurement SBP, Meteorological measurement)
29) Asuka Doi (Global Ocean Development, SeaBeam, , Geophysical measurement SBP, Meteorological measurement)
30) Satoshi Shimizu (Nippon Marine Enterprises, SCS)
31) Shinichi Hosoya (Nippon Marine Enterprises, SCS)
32) Syusuke Machida (Nippon Marine Enterprises, SCS)
33) Yoshitake Matsuura (Marine Works Japan, Sediment coring, Dredge, Rock coring)
34) Kazuhiro Yoshida (Marine Works Japan, Sediment coring, Dredge, Rock coring)
35) Syohei Taketomo (Marine Works Japan, Sediment coring, Dredge, Rock coring)
36) Yasushi Hashimoto (Marine Works Japan, Sediment coring, Dredge, Rock coring)

37) Syugo Oshitani (Marine Works Japan, Sediment coring, Dredge, Rock coring)
38) Hideki Yamamoto (Marine Works Japan, CTD/hydrocast)
39) Shinichiro Yokogawa (Marine Works Japan, CTD/hydrocast)
40) Ayumi Takeuchi (Marine Works Japan, CTD/hydrocast)

3. Backgrounds and Purpose:

The Southeast Pacific in the MR08-06 Leg1b cruise target area is a huge blank area of mass of data on the earth sciences because it is a remote corner with the roughest weather on the earth. Although it is the intriguing place, here are intraplate volcanisms with one of the superplume upwelling possibly from core-mantle boundary, plate divergent boundaries (mid-ocean ridges) and plate convergent boundaries (subduction zone) in the research area. Despite the intriguing place, there are few data available with systematic observations using by research vessels. For example, the precise geomagnetic intensity and the sedimentary rate between South East Pacific Rise and Chile Ridge are unknown. Therefore, the tectonics of the oceanic plate in the area remains obscure.

On the other hand, the Chile Triple Junction area is famous for tectonically unique place. It is one particular area to be able to observe a current subduction of an active ridge system on Earth. There are many evidences that the phenomena occurred in some subduction zones including Japan island arcs in the past. They probably play important role of the continental crust formation on the earth evolution. In addition to this, the research area around Chile Triple Junction is expected as the dead end of the 600km-long rupture of the 1960's Chile Earthquake (Mw = 9.5). The seismicities in the south from this area is very low. The ocean floor investigations seldom take place in the south area of the Chile Triple Junction, though a lot of research, such as high resolution seismic explorations by Germany and French research vessels, have been done in the north of it.

Moreover R/V MIRAI crossed the Pacific Ocean completely from the northwest to the southeast during MR08-06 Leg cruise. The trans-Pacific cruise gives us continuous data with same quality and same process. Therefore, the purpose of the cruise is to do various invesitigations taking R/V MIRAI's advantage of her stability on the rough weather.

This research cruise is composed of three sub-themes;

1) Oceanic and continental crust formation around the Chile Triple Junction (area "c" in Fig.2). To characterize the geological processes of the ridge subduction and to understand the processes of the continental crust growth interacted with ridge subduction systems. To understand the mantle dynamics and mass transfer between the upper and lower mantle around the Society hotspot in Polynesia with determining the seismic structure and conductivity structure.

2) Large-scale mantle flow,'superplume'around the Society hotspot in Polynesia (area "a" in Fig.2).

3) Paleomagnetic study in the South Pacific (area "b" in Fig.2). To understand geomagnetic inclination anomaly, which would be caused by non-dipole in the South Pacific over the past geological period.

4. Relationships with Other Projects:

1) Tectonic, Petrologic and Paleo-environmental Researches in the Chile Triple Junction Area:

In order to conduct all observations in the Chilean water during MR08-06 leg1, we contracted a joint research agreement between Department of Geology Faculty of Physical and Mathematical Sciences of University of Chile and IFREE, JAMSTEC at least for three years on Tectonic, Petrologic and Paleo-environmental Researches in the Chile Triple Junction Area.

The content of the activities is agreed as below:1) Collecting bathymetrical and geophysical (magnetic, gravimetric, seismic) data of the Chile Triple Junction area to understand geodynamic development of this area. 2) Understanding tectono-magmatic history of the Chile Triple Junction area using rock samples dredged from the area. 3) Reconstructing the magnetic and environmental change with high time resolution in the Chile triple Junction area using sediments recovered by piston cores. 4) Collection of information on modern seasonal, annual and decadal climate conditions of the Chile Triple Junction area and its related land area.

2) The Seafloor Geophysical Observation Project, the Society Hot Spot Region, French Polynesia:
With regard to the Research Project of Seafloor Geophysical Observation near the Society Hot Spot Region in French Polynesia (the Seafloor Geophysical Observation Project), IFREE/JAMSTEC, Ocean Hemisphere Research Center, Earthquake Research Institute of the University of Tokyo (OHRC/ERI), Laboratoire Terre Océan de l'Université de la Polynésie Française (UFP), Laboratoire Géosciences de l'Université Montpellier II (MONTPELLIER-II), Commissariat à l'Énergie Atomique de France (CEA), Laboratoire CNRS Domaines Océaniques de l'Université de Bretagne Occidentale (UBO), and Institut de Physique du Globe de Paris (IPGP), have an implementation agreement on the joint research project. OHRC/ERI and IFREE/JAMSTEC shall form the Japanese Group. UFP, MONTPELLIER-II, CEA, UBO, and IPGP shall form the French Group. The Japanese Group and the French Group shall consult mutually for the deployment, maintenance, and retrieval of the BBOBS and OBEM near the Society hot spot region in French Polynesia.

3) Integrated Ocean Drilling Program (IODP) proposal 612-Full3 "Paleochlimatic and Orbital Modulation of the Earth's magnetic field: A possible external energy source of the geodynamo:
A IODP proposal was submitted to science advisory structure (SAS) of IODP by T. Yamazaki, T. Kanamatsu, and others, which has been forwarded to the Science Planning Committee (SPC) for ranking. The aim of the IODP proposal is to clarify geomagnetic field variations during the last ca. 10 m.y., and in particular to prove or disprove the hypothesis that the geomagnetic field is modulated by changes of the Earth's orbit. During the cruise, we planed to take piston cores to prove the sediments at the proposed sites having magnetic properties suitable for paleomagnetic studies. We also planned to conduct seismic reflection profiling for fulfilling the minimum requirements of the IODP Site Survey Panel (SSP) for drilling: single-channel seismic reflection lines that cross a proposed site, when proposed penetration depth is less than 400m in an open ocean.

5. Preliminary results:

Totally 56 days ship time and 25,000km length of the cruise track during MR08-06 Leg1 was successfully done without any serious trouble. All of the underway observations, such as bathymetry, surface ship gravity and geomagnetic data, sea surface seawater and plankton, aerosol, volatile and precipitation samplings, have done from Japan to Chile, that is complete trans-Pacific.

We deployed 9 BBOBSs & 9 OBEMs around the Society Hotspot in French Polynesia (Table 1). The one-year observation on the mantle has been started since early February 2009. The equipments will be recovered in 2010.

While the sediment sampling using 20m-long piston core in the southeast Pacific area was expected 5 stations on the 50°S line, three of them on the 48°S line were taken placed successfully (Table 2). Three cross-line seismic explorations using the single channel streamer system have also done on the same stations.

5 long-term OBSs were deployed with air gun shooting on each of them (Table 1), and SCS explorations on the lines on the 5 OBSs at Chile Triple Junction. These OBSs also started the one-year observation and will be recovered in 2010. 7 times dredges and a rock corer sampling have taken rock samples, and one sedimentary sampling by 10m PC has each time successfully done in this area (Table 3).

Table 1 BBOBS and OBEM deployment position list during MR08-06 Leg1b cruise

Date (yymmdd)	Equipment ID	St. ID	Location	Lat. S (SOJ)	Lon.W (SOJ)	Depth (m)	Type of equipment
2009.2.7	SOC1	St. 1	French Polynesia	19-28.197	148-02.923	4398	OBEM/ BBOBS
2009.2.7	SOC2	St 2	French Polynesia	20-57.306	146-26.384	4766	OBEM/ BBOBS
22009..8	SOC3	St.3	French Polynesia	19-55.647	146-01.474	4632	OBEM/ BBOBS
22009.2.9	SOC4	St.4	French Polynesia	18-25.502	144-56.197	4457	OBEM/ BBOBS
2009.2.9	SOC5	St. 5	French Polynesia	17-29.997	144-30.360	4031	OBEM/ BBOBS
2009.2.10	SOC6	St. 6	French Polynesia	18-03.099	142-17.629	4484	OBEM/ BBOBS
2009.2.11	SOC7	St.7	French Polynesia	19-56.465	142-41.301	4467	OBEM/ BBOBS
2009.2.11	SOC8	St. 8	French Polynesia	20-57.202	143-45.380	4779	OBEM/ BBOBS
2009.2.12	SOC9	St. 9	French Polynesia	22-10.164	144-41.790	4513	OBEM/ BBOBS
2009.3.1	LC4	St.21	Chile TJ	46.116433	75.91919	2841	LTOBS
2009.3.1	LC2	St.18	Chile TJ	46.330797	76.095627	2773	LTOBS
2009.3.1	LC3	St.20	Chile TJ	46.33615	75.76685	2605	LTOBS
2009.3.1	LC5	St.19	Chile TJ	46.286502	75.471313	1106	LTOBS
2009.3.1	LC1	St.17	Chile TJ	46.63808	75.926237	3358	LTOBS

Table 2 Piston core list during MR08-06 Leg1b cruise

Date (yymmdd)	Core/ Dredge/ Rock Corer ID	St. ID	Location	Lat. S (SOJ)	Lon. W (SOJ)	Depth (m)	Tube length (m)	Core length (m)	Corer type
2009.2.18	PC01	St.10a	SE Pacific	46-49.863	123-40.302	3951	20	10.665	Outer
2009.2.20	PC02	St.11	SE Pacific	48-14.949	118-18.640	3358	20	6.255	Outer
2009.2.26	PC03	St.14	SE Pacific	48-25.041	80-28.438	4098	20	19.510	Outer
2009.3.2	PC04	St.27P	Chile TJ (Taitao)	46-39.313	75-54.016	3345	10	8.447	Inner

Table 3 Dredge and Rock core list during MR08-06 Leg1b cruise

Date (yymmdd)	Core/ Dredge/ Rock Corer ID	St. ID	Location	Lat. S (SOJ)	Lon. W (SOJ)	Depth (m)	Weight (kg)	note
2009.3.2	D01	St.26D	Chile TJ (Taitao)	46-53.55	75-47.57	2532	299	Sedimentary & volcanic rock
2009.3.2	D02	St.27D	Chile TJ (Taitao)	46-38.056	75-46.657	2808	51.8	Sedimentary, volcanic & plutonic rock
2009.3.4	D03	St.29a	Chile TJ (Chile ridge)	46-02.395	75-53.823	3288	1.5	Mud w/ detrital minrals
2009.3.6	D04	St.29a	Chile TJ (Chile ridge)	46-04.200	75-54.39	3000	37.4	basalt

2009.3.6	D05	St.29b	Chile TJ (Chile ridge)	46-06.378	75-52.843	3149	14.0	basalt
2009.3.7	D06	St.28a	Chile TJ (Taitao)	46-29.440	75-51.900	2511	194	Sedimentary rock
2009.3.7	D07	St.28b	Chile TJ (Taitao)	46-33.300	75-58.002	2339	233	Sedimentary & volcanic rock
2009.3.8	RC01	St.30a	Chile TJ (Chile ridge)	45-52.46	75-59.46	3285	0.02	Volcanic rock
2009.3.11	D08	St.36a	Valparaiso	33:05.19	73-09.76	4113	70 pieces	Volcanic rock & mud
2009.3.12	D09	St.36b	Valparaiso	33-03.70	73-22.30	3782	30 pieces	Mn-crust & Volcanic fragment
2009.3.12	D10	St.36c	Valparaiso	33-04.69	73-19.67	3701	50 pieces	Volcanic rock & mud stone