

## MIRAI MR09-01 Leg3 Partial Pressure of CO<sub>2</sub> (pCO<sub>2</sub>)

Last Modified: 2017-04-11

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Cruise ID: [MR09-01 Leg3](#)

Partial Pressure of CO<sub>2</sub> (pCO<sub>2</sub>): Processed (PI)

Data Policy: [JAMSTEC](#)

Observation Items: CO<sub>2</sub>, Air temperature, Atmospheric pressure, Wind direction, Wind speed, Sea surface temperature, Sea surface salinity

Science Keywords:

OCEANS > OCEAN CHEMISTRY > CARBON DIOXIDE

Cruise Report

[http://www.godac.jamstec.go.jp/catalog/data/doc\\_catalog/media/MR09-01\\_leg1-3\\_all.pdf](http://www.godac.jamstec.go.jp/catalog/data/doc_catalog/media/MR09-01_leg1-3_all.pdf)

### For Using Data

#### Principal Investigator

Akihiko Murata (JAMSTEC)

#### Use Constraints

See [Terms and Conditions](#) about constrain of use.

#### Data Citation

See [Terms and Conditions](#) about data citation.

### Instrument

Instrument:

pCO<sub>2</sub> measurement system ( - MR10-06)



### Overview

Please see the [Data book](#) for details of data.

### Information on pCO<sub>2</sub> measurement

**Investigator:** Dr. Akihiko Murata

**Organization:** Research Institute for Global Change (RIGC)/Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

**Address:** 2-15, Natsushima-cho, Yokosuka, Kanagawa, 237-0061, Japan

#### Vessel:

Vessel Name: Mirai

Vessel ID: JNSR

Country: Japan

Vessel Owner: JAMSTEC

#### Equilibrator Design:

Equilibrator type: Shower-head type equilibrator

Equilibrator volume (L): 1.2

Water\_Flow\_Rate (L/min): 5-8

Headspace\_Gas\_Flow\_Rate (L/min): 0.6-0.8

Vented: During equilibrium, closed circulation of air. When measured by NDIR, vented to ambient air.

#### Measurement Method:

Continuous underway measurements of atmospheric and surface seawater pCO<sub>2</sub> were made with the CO<sub>2</sub> measuring system (Nippon ANS, Ltd) installed in the R/V Mirai of JAMSTEC. The system comprises of a non-dispersive infrared gas analyzer (NDIR; BINOSR model 4.1, Fisher-Rosemount) or the variations, an air-circulation module and a showerhead-type equilibrator. To measure concentrations (mole fraction) of CO<sub>2</sub> in dry air (xCO<sub>2a</sub>), air sampled from the bow of the ship (approx. 30 m above the sea level) was introduced into the NDIR through a dehydrating route with an electric dehumidifier (kept at ~ 2 °C), a Perma Pure dryer (GL Sciences Inc.), and a chemical desiccant (Mg(ClO<sub>4</sub>)<sub>2</sub>). The flow rate of the air was 500 ml min<sup>-1</sup>. To measure surface seawater concentrations of CO<sub>2</sub> in dry air (xCO<sub>2s</sub>), the air equilibrated with seawater within the equilibrator was introduced into the NDIR through the same flow route as the dehydrated air used in measuring xCO<sub>2a</sub>. The flow rate of the equilibrated air was 600 - 800 ml min<sup>-1</sup>. The seawater was taken by a pump from the intake placed at the approx. 4.5 m below the sea surface. The flow rate of seawater in the equilibrator was 500 - 800 ml min<sup>-1</sup>.

The CO<sub>2</sub> measuring system was set to repeat the measurement cycle such as 4 kinds of CO<sub>2</sub> standard gases (Table 1), xCO<sub>2a</sub> (twice), xCO<sub>2s</sub> (7 times). This measuring system was run automatically throughout cruises by a PC control. Effects of water temperature increased between the inlet of surface seawater and the equilibrator on xCO<sub>2s</sub> were adjusted based on Gordon and Jones (1973), although the temperature increases were slight, being ~ 0.5 °C at maximum.

Gordon, L. I. and L. B. Jones (1973), The effect of temperature on carbon dioxide partial pressure in seawater. Mar. Chem., 1, 317 - 322.

#### Manufacturer of Calibration Gas:

Concentrations of CO<sub>2</sub> of the standard gases are listed in Table 1, which were calibrated by the JAMSTEC primary standard gases after 2000 (MR00-K01 and later). Before that time, the standard gases were calibrated against the scale of the Meteorological Research Institute, Tsukuba, Japan, and fitted to the 1985 World Meteorological Organization scale by using the equation of Inoue et al. (1995). The CO<sub>2</sub> concentrations of the primary standard

gases were calibrated by C. D. Keeling of the Scripps Institution of Oceanography, La Jolla, CA, USA. The values are 230.33 ppm (Cyl. No. 11325), 259.74 (11326), 279.67 (11327), 308.93 (11328), 328.25 (11329), 348.79 (11330), 369.55 (11331), 389.54 (11333), 411.60 (11334), 440.94 (11335), 460.42 (11336), and 478.54 (11337).

Since differences of concentrations of the standard gases between before and after the cruise were all allowable (< 0.1 ppmv), the averaged concentrations (Table 1) were adopted for the subsequent calculations.

Table 1. Concentrations of standard gases used in individual cruises.

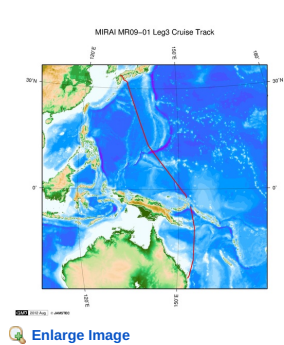
Cruise #	STD1	STD2	STD3	STD4	Remark
MR98-06	-	-	-	-	No records left
MR98-K01	270.28	330.95	360.48	410.85	
MR99-K02	270.28	330.95	360.48	410.85	
MR99-K04	270.26	330.98	360.43	410.85	
MR99-K05	247.74	304.98	333.32	382.57	
MR00-K01	329.71	359.17	409.39	439.94	
MR00-K03	269.60	329.71	359.17	439.94	
	269.60	329.71	359.17	409.39	
MR00-K06	246.95	305.13	333.44	382.74	
	305.13	333.44	382.74	409.40	
MR01-K02	269.60	329.74	359.22	409.39	
MR01-K03	269.60	329.74	359.22	409.39	
MR01-K04 Leg1	298.56	321.17	370.75	439.95	
MR01-K04 Leg2	298.56	321.17	370.75	439.95	
MR01-K05 Leg1-2	247.99	298.56	321.17	370.75	
MR01-K05 Leg3-4	247.99	298.56	321.17	370.75	
MR02-K03	269.20	329.52	359.11	408.76	
MR02-K05 Leg1	246.69	297.83	320.05	391.66	
MR03-K01	270.16	340.21	371.39	389.97	
MR03-K02	270.08	328.87	359.10	409.23	
MR03-K04 Leg1	270.08	328.87	359.10	409.23	
MR03-K04 Leg2	270.08	328.87	359.10	409.23	
MR03-K04 Leg4	270.08	328.87	359.10	409.23	
MR03-K04 Leg5	268.84	330.16	369.37	414.39	
MR04-04	268.85	328.87	369.39	414.43	
MR04-05	268.84	330.16	369.37	414.39	
MR05-02	262.94	320.42	381.04	420.76	
MR05-05 Leg1	262.94	320.42	381.04	420.76	
MR05-05 Leg2	262.94	320.42	381.04	420.76	
MR05-05 Leg3	262.94	320.42	381.04	420.76	
MR06-04 Leg1	289.76	349.00	393.75	439.72	
MR06-04 Leg2	289.76	349.00	393.75	439.72	
MR07-04	289.77	349.02	393.77	439.75	
MR07-05	289.77	349.02	393.77	439.75	
MR07-06 Leg1	270.02	330.40	369.28	419.68	
MR07-06 Leg2	270.02	330.40	369.28	419.68	
MR09-01 Leg1	270.22	330.43	360.04	420.32	
MR09-01 Leg2	270.22	330.43	360.04	420.32	

Inoue, H. Y., H. Matsueda, M. Ishii, K. Fushimi, M. Hirota, I. Asanuma, and Y. Takasugi (1995), Long-term trend of the partial pressure of carbon dioxide (pCO<sub>2</sub>) in surface waters of the western North Pacific 1984 - 1993. Tellus 47B, 391 - 413.

CO<sub>2</sub> Sensors:

Manufacturer: Rosemount Analytical  
Model: BINOS 4.1  
Resolution: -  
Uncertainty: -

Related Information



**MR09-01 Leg3**  
Ship Name: MIRAI  
Period: 2009-06-19 - 2009-07-02  
Chief Scientist: Kenichi Sasaki (JAMSTEC)  
Project Name: [South Pacific Ocean Research Activity 2009]

Update History

2017-04-11      An observation data was registerd.  
2012-09-28      An observation data was registerd.

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YOKOSUKA DEEP TOW  
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6K Sonar DEEP TOW  
KM-ROV  
POWER GRAB SAMPLER (SHELL)  
POWER GRAB SAMPLER (CLOW)  
BMS

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## MIRAI MR09-01 Leg3 Partial Pressure of CO2 (pCO2)

Last Modified: 2017-04-11

ReadMe Observation Data **Data Format**

Cruise ID: [MR09-01 Leg3](#)

Partial Pressure of CO2 (pCO2) Processed (PI)

Data Policy: [JAMSTEC](#)

### pCO2 FORMAT\_J

#### Air-xCO<sub>2</sub>

The file is in fixed length, comma separated text file (csv) format.

The "missing value" is defined as -999.

Column NO.	Column Heading	Comments
1	Date	Year/Month/Day (YYYY/MM/DD) in UTC
2	Time	Hour:Minute:Second (HH:MM:SS) in UTC
3	Latitude	Latitude (degree) ; Positive in north
4	Longitude	Longitude (degree) ; degree in eastward (0 - 360)
5	Atm_Tmp	Air temperature (degree C)
6	Atm_Prs	Barometric pressure (hPa)
7	Wind_Dir	Wind direction (degree)
8	Wind_Spd	Wind speed (m/s)
9	SST	Sea surface temperature (degree C)
10	SSS	Sea surface salinity (PSU)
11	xCO2_Air	CO <sub>2</sub> mixing ratio (ppmv) in the 'dry air' taken from the fore-mast of the ship.

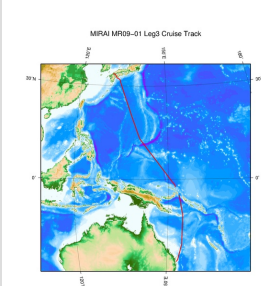
#### Sea-xCO<sub>2</sub>

The file is in fixed length, comma separated text file (csv) format.

The "missing value" is defined as -999.

Column NO.	Column Heading	Comments
1	Date	Year/Month/Day (YYYY/MM/DD) in UTC
2	Time	Hour:Minute:Second (HH:MM:SS) in UTC
3	Latitude	Latitude (degree) ; Positive in north
4	Longitude	Longitude (degree) ; degree in eastward (0 - 360)
5	Eq_Tmp	Temperature in equilibrator (degree C)
6	Eq_Prs	Pressure in equilibrator (mmHg)
7	SST	Sea surface temperature (degree C)
8	Atm_Prs	Air pressure (hPa)
9	SSS	Sea surface salinity (PSU)
10	xCO2_Sea	CO <sub>2</sub> mixing ratio (ppmv) in the 'dry air' equilibrated with surface.

### Related Information



[Enlarge Image](#)

#### MR09-01 Leg3

Ship Name: MIRAI

Period: 2009-06-19 - 2009-07-02

Chief Scientist: Kenichi Sasaki (JAMSTEC)

Project Name: [South Pacific Ocean Research Activity 2009]

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## MIRAI MR09-01 Leg3 Partial Pressure of CO2 (pCO2)

Last Modified: 2017-04-11

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Cruise ID: [MR09-01 Leg3](#)

Partial Pressure of CO2 (pCO2): Processed (PI)

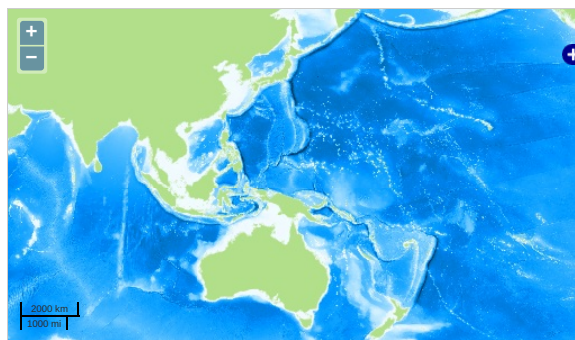
Data Policy: [JAMSTEC](#)

Observation Items: CO2, Air temperature, Atmospheric pressure, Wind direction, Wind speed, Sea surface temperature, Sea surface salinity

Science Keywords:

OCEANS > OCEAN CHEMISTRY > CARBON DIOXIDE

### Observation Map



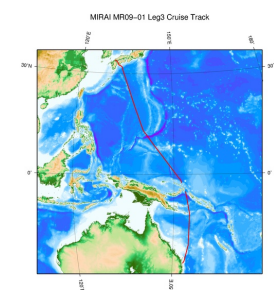
... Observation Line ... Navigation ... Observation, Dive Point, Hole

### Data List

File names

☐ MR09-01\_leg3\_pco2.zip

### Related Information



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Period: 2009-06-19 - 2009-07-02

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