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Chlorophyll *a* concentration of phytoplankton during the cruise of the 47th Japanese Antarctic Research Expedition in 2005-2006

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1. Introduction

This is a report on the phytoplankton chlorophyll *a* concentration on the cruise of the icebreaker *Shirase* during the 47th Japanese Antarctic Research Expedition (JARE) in the 2005-2006 austral summer. Chlorophyll *a* concentration of phytoplankton was measured in two series: (1) spatial variation of chlorophyll *a* in the surface water along the cruise track, and (2) vertical profile of chlorophyll *a* in the Indian Ocean sector of the Southern Ocean.

2. Materials and methods

Surface seawater was sampled routinely four times a day by pumping up through the hull in cruising and with a plastic bucket in stoppage. Subsurface water was collected with a Van-Dorn bottle. Seawater samples of 100-500 ml were filtered onto a glass fiber filter (Whatman, GF/F). The filter was immediately soaked in *N*, *N*-dimethylformamide (Suzuki and Ishimaru, 1990), and pigments were extracted. The concentrations of chlorophyll *a* and pheopigments were determined fluorometrically (Parsons *et al.*, 1984) with a fluorometer (Turner Design, 10-AU). The fluorometer was calibrated against a chlorophyll *a* standard (Sigma Chemical Co.) using a spectrophotometer and the value of specific absorption coefficient obtained by Porra *et al.* (1989).

3. Data

A map of the sampling stations during JARE-47 cruise is illustrated in Fig. 1. Chlorophyll *a* and pheopigment concentrations in sea surface and subsurface water are shown in Tables 1 and 2, respectively. The data in this report are available on digital media (see section 5).

4. Scientists on board

Sampling and analysis were mainly carried out by M. Honda, M. Ichinomiya and K. Saito.

5. Data policy

Before using the data for publication or presentation, please request permission in writing. Inquiries should be addressed to:

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Requests for digital data should also be placed with Prof. Fukuchi.

Acknowledgments

We thank to all the members of the JARE-47 for their support and help. We also wish to thank officers and crew members of the icebreaker *Shirase*.

References

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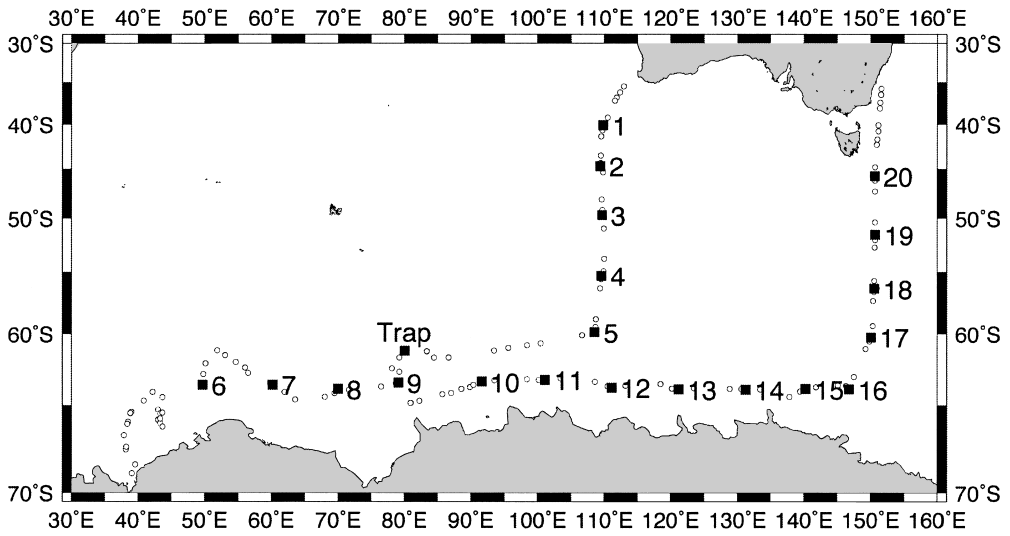


Fig. 1. Map showing the sites of sampling stations during JARE-47 in 2005/06. Open circles indicate surface water sampling. Solid squares are stations for vertical water sampling.

Table 1. Chlorophyll *a* and pheopigment concentrations of surface water during JARE-47.
 ND indicates losses of data due to mistake of analytical operation.

Sample#	Pump /Bucket	Date(GMT)	Time(GMT)	Latitude		Longitude		Chl. <i>a</i> (mg m ⁻³)	Pheo. (mg m ⁻³)
				Degrees	Minutes	Degrees	Minutes		
Fremantle Australia									
1	Pump	2005/12/3	23:12	35	32.3 S	112	54.2 E	0.26	0.07
2	Pump	2005/12/4	3:43	36	15.5 S	112	22.1 E	0.50	0.14
3	Pump	2005/12/4	8:15	36	54.1 S	111	51.3 E	0.48	0.19
4	Pump	2005/12/4	11:16	37	17.0 S	111	33.8 E	0.46	0.18
5	Pump	2005/12/5	0:00	39	16.1 S	110	28.4 E	0.44	0.17
6	Pump	2005/12/5	4:05	39	56.3 S	110	2.5 E	0.40	0.07
7	Pump	2005/12/5	9:00	40	43.6 S	109	43.0 E	0.55	0.10
8	Pump	2005/12/5	13:00	41	26.3 S	109	32.6 E	0.48	0.05
9	Pump	2005/12/6	0:03	43	33.4 S	109	28.9 E	0.46	0.14
10	Pump	2005/12/6	4:12	44	22.4 S	109	25.0 E	0.59	0.20
11	Pump	2005/12/6	9:09	44	35.5 S	109	25.8 E	0.52	0.16
12	Pump	2005/12/6	13:24	45	21.5 S	109	48.6 E	1.07	0.19
13	Pump	2005/12/6	23:58	48	13.0 S	109	36.6 E	0.29	0.04
14	Pump	2005/12/7	4:00	49	14.6 S	109	40.4 E	0.88	0.20
15	Pump	2005/12/7	9:06	49	49.6 S	109	45.4 E	0.42	0.00
16	Pump	2005/12/7	13:30	51	2.8 S	109	55.3 E	0.47	0.02
17	Pump	2005/12/8	0:03	53	51.8 S	109	58.4 E	0.43	-0.02
18	Pump	2005/12/8	3:56	54	55.5 S	109	50.7 E	0.35	-0.02
19	Pump	2005/12/8	10:02	55	37.0 S	109	31.3 E	0.30	-0.01
20	Pump	2005/12/8	13:16	56	24.3 S	109	21.4 E	0.28	-0.02
21	Pump	2005/12/9	0:42	58	55.7 S	108	45.0 E	0.23	-0.02
22	Pump	2005/12/9	3:55	59	31.1 S	108	39.5 E	0.29	-0.02
23	Pump	2005/12/9	9:00	59	55.6 S	108	26.3 E	0.47	ND
24	Pump	2005/12/9	13:03	60	9.1 S	106	37.7 E	0.36	0.00
25	Pump	2005/12/10	0:22	60	46.1 S	100	25.4 E	0.46	0.06
26	Pump	2005/12/10	4:00	60	54.1 S	98	25.9 E	0.57	ND
27	Pump	2005/12/10	9:09	61	5.3 S	95	34.4 E	0.76	0.03
28	Pump	2005/12/10	12:58	61	17.0 S	93	25.2 E	0.70	0.01
29	Pump	2005/12/11	1:00	61	47.4 S	86	35.2 E	1.72	ND
30	Pump	2005/12/11	5:00	61	47.2 S	84	24.8 E	0.30	0.00
31	Pump	2005/12/11	10:11	61	20.7 S	83	23.6 E	0.36	-0.01
32	Pump	2005/12/13	10:59	62	52.7 S	56	27.0 E	0.31	0.01
33	Bucket	2005/12/14	19:24	65	30.49 S	38	49.43 E	0.13	0.03
34	Bucket	2005/12/15	1:08	66	10.82 S	38	20.01 E	0.18	-0.01
35	Bucket	2005/12/15	5:29	66	50.65 S	37	49.96 E	0.22	0.01
36	Bucket	2005/12/15	10:37	67	40.65 S	38	7.96 E	0.29	0.00
37	Bucket	2005/12/22	11:25	68	59.26 S	39	1.59 E	0.17	0.00
Syowa Station, Antarctica									
38	Bucket	2006/2/14	7:30	68	30.95 S	39	32.68 E	0.61	0.05
39	Bucket	2006/2/14	11:55	67	31.34 S	38	10.24 E	0.20	0.01
40	Bucket	2006/2/15	8:04	66	50.42 S	37	49.24 E	0.08	0.00
41	Bucket	2006/2/15	11:54	66	10.28 S	38	20.33 E	0.07	0.00
42	Pump	2006/2/15	12:51	66	2.39 S	38	27.11 E	0.08	0.00
43	Pump	2006/2/15	17:00	65	30.10 S	38	49.16 E	0.09	ND
44	Pump	2006/2/16	3:57	65	31.75 S	38	47.89 E	0.10	0.00
45	Bucket	2006/2/16	6:03	65	29.47 S	38	47.36 E	0.09	0.00

Sample#	Pump /Bucket	Date(GMT)	Time(GMT)	Latitude		Longitude		Chl.a (mg m ⁻³)	Pheo. (mg m ⁻³)
				Degrees	Minutes	Degrees	Minutes		
46	Pump	2006/2/16	7:51	65	26.28 S	38	59.42 E	0.09	0.00
47	Pump	2006/2/16	13:01	64	42.98 S	40	49.57 E	0.10	0.00
48	Pump	2006/2/16	17:00	64	8.66 S	42	11.96 E	0.12	0.00
49	Pump	2006/2/17	4:00	65	16.66 S	42	59.61 E	0.22	0.00
50	Pump	2006/2/17	8:03	65	55.28 S	42	59.39 E	0.20	0.01
51	Pump	2006/2/17	13:00	66	7.31 S	43	19.16 E	0.18	0.01
52	Pump	2006/2/17	17:00	65	31.77 S	43	20.06 E	0.20	0.01
53	Pump	2006/2/18	4:00	65	51.21 S	43	19.99 E	0.13	0.00
54	Pump	2006/2/18	8:00	64	29.64 S	43	39.65 E	0.12	0.00
55	Pump	2006/2/18	12:56	65	29.16 S	43	40.05 E	0.17	0.00
56	Pump	2006/2/18	17:00	66	19.42 S	43	40.00 E	0.19	0.01
57	Pump	2006/2/24	12:58	62	56.75 S	49	46.16 E	0.17	0.00
58	Pump	2006/2/24	17:00	62	12.41 S	50	6.34 E	0.26	0.00
59	Pump	2006/2/25	4:16	61	16.82 S	51	51.26 E	0.28	0.01
60	Pump	2006/2/25	8:07	61	37.92 S	53	0.89 E	0.25	0.02
61	Pump	2006/2/25	12:56	62	6.44 S	54	37.20 E	0.25	0.01
62	Pump	2006/2/25	16:52	62	30.63 S	56	1.57 E	0.21	0.00
63	Pump	2006/2/26	2:23	63	33.70 S	59	46.17 E	0.19	0.01
64	Pump	2006/2/26	7:05	63	36.88 S	60	8.70 E	0.18	0.01
65	Pump	2006/2/26	11:55	64	9.52 S	61	53.00 E	0.20	0.01
66	Pump	2006/2/26	16:00	64	37.90 S	63	33.25 E	0.18	0.01
67	Pump	2006/2/27	3:00	64	28.50 S	67	58.68 E	0.18	0.01
68	Pump	2006/2/27	7:08	64	13.39 S	69	27.86 E	0.20	0.02
69	Pump	2006/2/27	12:00	63	55.41 S	69	56.46 E	0.17	0.01
70	Pump	2006/2/27	15:54	64	0.01 S	71	40.65 E	0.35	0.00
71	Pump	2006/2/28	1:47	63	47.95 S	76	27.84 E	0.55	0.05
72	Pump	2006/2/28	6:54	63	36.83 S	78	37.91 E	0.42	0.00
73	Pump	2006/2/28	11:24	63	25.90 S	78	55.05 E	0.32	0.03
74	Pump	2006/2/28	15:00	62	48.19 S	79	11.49 E	0.31	0.01
75	Pump	2006/3/1	10:57	61	46.83 S	79	14.19 E	0.56	-0.02
76	Pump	2006/3/1	14:53	62	33.43 S	78	4.49 E	0.52	0.03
77	Pump	2006/3/5	11:00	64	52.01 S	80	56.00 E	0.42	0.04
78	Pump	2006/3/5	14:58	64	43.03 S	82	14.26 E	0.42	0.05
79	Pump	2006/3/6	1:50	64	18.79 S	85	43.42 E	0.45	0.05
80	Pump	2006/3/6	5:51	64	14.26 S	87	0.25 E	0.63	0.09
81	Pump	2006/3/6	11:00	63	57.73 S	88	33.00 E	0.69	0.03
82	Pump	2006/3/6	15:00	63	49.46 S	89	50.11 E	0.35	0.04
83	Pump	2006/3/7	1:00	63	41.02 S	90	19.65 E	0.43	0.04
84	Pump	2006/3/7	5:37	63	33.12 S	91	38.36 E	0.30	0.03
85	Pump	2006/3/7	10:00	63	26.91 S	91	43.59 E	0.49	0.02
86	Pump	2006/3/7	14:00	63	22.13 S	93	31.62 E	0.26	0.05
87	Pump	2006/3/8	0:58	63	17.63 S	98	26.16 E	0.27	0.03
88	Pump	2006/3/8	4:50	63	21.82 S	100	10.01 E	0.35	0.04
89	Pump	2006/3/8	10:00	63	18.94 S	101	13.41 E	0.37	0.05
90	Pump	2006/3/8	14:02	63	15.47 S	103	26.60 E	0.23	0.03
91	Pump	2006/3/9	0:00	63	29.53 S	108	34.77 E	0.20	0.02
92	Pump	2006/3/9	4:14	63	46.80 S	110	29.87 E	0.25	0.00

Sample#	Pump /Bucket	Date(GMT)	Time(GMT)	Latitude		Longitude		Chl.a (mg m ⁻³)	Pheo. (mg m ⁻³)
				Degrees	Minutes	Degrees	Minutes		
93	Pump	2006/3/9	8:58	63	54.33 S	111	12.12 E	0.26	0.00
94	Pump	2006/3/9	13:00	63	44.23 S	113	9.55 E	0.49	0.00
95	Pump	2006/3/10	0:00	63	37.76 S	118	25.63 E	0.15	0.01
96	Pump	2006/3/10	3:49	63	56.66 S	120	7.54 E	0.19	0.01
97	Pump	2006/3/10	9:00	63	58.12 S	121	28.07 E	0.18	0.01
98	Pump	2006/3/10	13:00	63	54.34 S	123	30.02 E	0.17	0.01
99	Pump	2006/3/10	23:00	63	57.04 S	128	50.27 E	0.46	0.04
100	Pump	2006/3/11	2:58	63	58.67 S	130	33.57 E	0.55	0.03
101	Pump	2006/3/11	8:00	63	59.99 S	131	33.67 E	0.39	-0.01
102	Pump	2006/3/11	12:00	63	59.44 S	133	25.98 E	0.24	0.01
103	Pump	2006/3/11	22:00	64	29.12 S	137	47.23 E	1.06	0.09
104	Pump	2006/3/12	2:00	64	8.10 S	139	24.81 E	0.37	0.02
105	Pump	2006/3/12	7:04	63	54.51 S	140	4.13 E	0.30	0.04
106	Pump	2006/3/12	11:00	63	50.65 S	141	44.87 E	0.53	0.04
107	Pump	2006/3/12	22:00	63	43.99 S	145	1.63 E	0.42	0.05
108	Pump	2006/3/13	2:06	63	45.86 S	146	17.88 E	0.43	0.02
109	Pump	2006/3/13	7:17	63	54.43 S	146	52.75 E	0.41	0.02
110	Pump	2006/3/13	10:57	63	9.92 S	147	28.87 E	0.28	0.03
111	Pump	2006/3/13	21:39	61	10.51 S	149	14.04 E	0.21	0.01
112	Pump	2006/3/14	1:04	60	37.38 S	149	45.51 E	0.20	0.02
113	Pump	2006/3/14	6:00	60	13.48 S	150	8.11 E	0.19	0.00
114	Pump	2006/3/14	10:04	59	26.61 S	150	18.59 E	0.22	0.05
115	Pump	2006/3/14	21:00	57	27.60 S	150	20.77 E	0.20	0.01
116	Pump	2006/3/15	1:10	56	43.78 S	150	27.62 E	0.18	0.01
117	Pump	2006/3/15	6:40	56	24.33 S	150	52.84 E	0.11	0.02
118	Pump	2006/3/15	10:00	55	46.63 S	150	30.24 E	0.25	0.09
119	Pump	2006/3/15	22:00	52	49.22 S	150	34.78 E	0.18	0.02
120	Pump	2006/3/16	1:00	52	6.66 S	150	38.09 E	0.23	0.05
121	Pump	2006/3/16	6:05	51	34.17 S	150	47.83 E	0.27	0.07
122	Pump	2006/3/16	10:00	50	27.54 S	150	37.80 E	0.30	0.06
123	Pump	2006/3/16	20:57	47	21.46 S	150	35.71 E	0.65	0.22
124	Pump	2006/3/17	1:03	46	14.46 S	150	36.60 E	0.56	0.26
125	Pump	2006/3/17	6:15	45	40.68 S	150	29.55 E	1.07	0.50
126	Pump	2006/3/17	10:02	44	48.79 S	150	37.42 E	0.93	0.37
127	Pump	2006/3/17	21:00	42	22.11 S	150	52.64 E	1.17	0.52
128	Pump	2006/3/18	1:00	41	45.95 S	150	58.31 E	0.61	0.19
129	Pump	2006/3/18	6:00	40	49.41 S	151	8.01 E	0.24	0.09
130	Pump	2006/3/18	9:55	40	9.43 S	151	8.56 E	1.25	0.82
131	Pump	2006/3/18	20:55	38	10.49 S	151	21.48 E	0.31	0.09
132	Pump	2006/3/19	1:05	37	30.29 S	151	26.22 E	0.17	0.07
133	Pump	2006/3/19	6:00	36	33.46 S	151	31.51 E	0.12	0.04
134	Pump	2006/3/19	9:55	35	48.22 S	151	34.77 E	0.12	0.03

Sydney, Australia

Table 2. Vertical profile of chlorophyll *a* and pheopigment concentrations during JARE-47.
 ND¹ indicates water samplings were cancelled due to rough weather condition or trouble of water sampler. ND² indicates losses of data due to mistake of analytical operation.

Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Pheo. (mg m ⁻³)	Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Pheo. (mg m ⁻³)
1	2005/12/5	40° 07.72 S 109° 52.13 E	0	0.41	0.09	6	2006/2/24	63° 40.10 S 49° 41.10 E	0	0.21	0.01
			10	ND ¹	ND ¹				10	ND ¹	ND ¹
			20	ND ¹	ND ¹				20	ND ¹	ND ¹
			30	ND ¹	ND ¹				30	ND ¹	ND ¹
			50	ND ¹	ND ¹				50	ND ¹	ND ¹
			75	ND ¹	ND ¹				75	ND ¹	ND ¹
			100	ND ¹	ND ¹				100	ND ¹	ND ¹
			125	ND ¹	ND ¹				125	ND ¹	ND ¹
			150	ND ¹	ND ¹				150	ND ¹	ND ¹
200	ND ¹	ND ¹	200	ND ¹	ND ¹						
2	2005/12/6	44° 41.56 S 109° 24.33 E	0	0.57	0.15	7	2006/2/26	63° 39.52 S 60° 10.70 E	0	0.20	0.01
			10	0.54	0.15				10	0.17	0.01
			20	0.49	0.15				20	0.18	0.00
			30	0.51	0.15				30	0.18	0.01
			50	0.53	0.17				50	0.18	0.01
			75	0.64	0.16				75	0.27	0.06
			100	0.57	0.17				100	0.31	0.13
			125	0.31	0.18				125	0.18	0.08
			150	0.20	0.12				150	0.10	0.06
200	0.12	0.08	200	0.01	0.02						
3	2005/12/7	49° 44.51 S 109° 40.44 E	0	0.35	0.02	8	2006/2/27	63° 56.01 S 69° 57.92 E	0	0.21	0.01
			10	0.49	0.04				10	0.18	0.01
			20	0.48	-0.02				20	0.19	0.01
			30	0.46	0.06				30	0.21	0.00
			50	0.53	0.08				50	0.25	-0.03
			75	0.50	0.20				75	0.31	0.10
			100	0.34	0.29				100	0.26	0.16
			125	0.15	0.25				125	0.17	0.09
			150	0.08	0.17				150	0.10	0.05
200	0.05	0.14	200	0.03	0.03						
4	2005/12/8	55° 19.84 S 109° 34.86 E	0	0.38	ND ²	9	2006/2/28	63° 31.08 S 79° 04.11 E	0	0.35	0.00
			10	0.46	-0.02				10	0.36	0.00
			20	0.55	-0.02				20	0.35	-0.02
			30	0.51	0.00				30	0.31	0.02
			50	0.77	0.06				50	0.35	0.12
			75	0.65	0.10				75	0.42	0.21
			100	0.40	0.10				100	0.27	0.16
			125	0.15	0.08				125	0.14	0.07
			150	0.05	0.06				150	0.08	0.06
200	0.02	0.03	200	0.03	0.04						
5	2005/12/9	59° 53.76 S 108° 33.07 E	0	0.46	ND ²	Trap	2006/3/1	61° 17.71 S 80° 02.61 E	0	0.52	0.03
			10	0.45	-0.01				10	0.59	0.04
			20	0.44	0.02				20	0.48	0.04
			30	0.58	-0.05				30	0.50	0.04
			50	0.65	-0.02				50	0.38	0.05
			75	0.38	0.10				75	1.82	0.19
			100	0.34	0.13				100	0.28	0.09
			125	0.11	0.03				125	0.15	0.06
			150	ND ¹	ND ¹				150	0.06	0.04
200	0.01	0.02	200	0.03	0.03						

Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Pheo. (mg m ⁻³)
10	2006/3/7	63° 26.92 S 91° 35.06 E	0	0.49	0.05
			10	0.49	0.05
			20	0.54	0.12
			30	0.58	0.14
			50	0.59	0.08
			75	0.33	0.16
			100	0.19	0.12
			125	0.09	0.07
			150	0.06	0.04
			200	0.02	0.02
11	2006/3/8	63° 20.37 S 101° 05.96 E	0	0.24	0.06
			10	0.25	0.03
			20	0.24	0.04
			30	0.28	0.03
			50	0.41	0.08
			75	0.61	0.18
			100	0.39	0.11
			125	0.15	0.08
			150	0.09	0.09
			200	0.02	0.03
12	2006/3/9	63° 51.86 S 111° 09.43 E	0	0.30	0.02
			10	0.25	0.01
			20	0.24	0.01
			30	0.26	-0.01
			50	0.27	0.01
			75	0.70	0.16
			100	0.41	-0.09
			125	0.09	0.06
			150	0.02	0.04
			200	0.01	0.02
13	2006/3/10	63° 57.58 S 121° 10.29 E	0	0.19	0.01
			10	0.18	0.01
			20	0.18	0.02
			30	0.19	0.02
			50	0.22	0.02
			75	0.23	0.11
			100	0.23	0.07
			125	0.29	0.07
			150	0.16	0.04
			200	0.02	0.02
14	2006/3/11	64° 00.25 S 131° 14.76 E	0	0.33	-0.01
			10	0.33	0.01
			20	0.34	-0.02
			30	0.33	0.04
			50	0.34	0.03
			75	0.25	0.09
			100	0.12	0.07
			125	0.08	0.05
			150	0.07	0.04
			200	0.04	0.03
15	2006/3/12	63° 56.65 S 140° 12.73 E	0	0.37	0.01
			10	1.07	0.10
			20	1.07	0.05
			30	1.05	0.12
			50	1.05	0.08
			75	0.35	0.08
			100	0.10	0.05
			125	0.05	0.04
			150	0.03	0.03
			200	0.02	0.02
16	2006/3/13	63° 57.80 S 146° 45.39 E	0	0.43	0.01
			10	0.38	0.01
			20	0.38	0.04
			30	0.39	0.03
			50	0.42	0.07
			75	0.13	0.05
			100	0.05	0.03
			125	0.03	0.02
			150	0.01	0.02
			200	0.01	0.02
17	2006/3/14	60° 17.99 S 150° 00.50 E	0	0.20	0.00
			10	0.19	0.02
			20	0.20	0.01
			30	0.20	0.01
			50	0.22	0.03
			75	0.20	0.05
			100	0.18	0.07
			125	0.09	0.03
			150	0.02	0.01
			200	0.01	0.01
18	2006/3/15	56° 25.19 S 150° 31.05 E	0	0.10	0.02
			10	0.14	0.01
			20	0.13	0.02
			30	0.12	0.01
			50	0.14	0.02
			75	0.17	0.03
			100	0.31	0.12
			125	0.27	0.09
			150	0.14	0.06
			200	0.01	0.02
19	2006/3/16	51° 36.21 S 150° 40.30 E	0	0.28	0.07
			10	0.30	0.07
			20	0.31	0.08
			30	0.32	0.09
			50	0.33	0.10
			75	0.31	0.13
			100	0.31	0.12
			125	0.28	0.13
			150	0.22	0.11
			200	0.01	0.02
20	2006/3/17	45° 44.13 S 150° 35.15 E	0	0.99	0.38
			10	0.75	0.33
			20	0.74	0.31
			30	0.73	0.34
			50	0.78	0.34
			75	0.41	0.28
			100	0.17	0.14
			125	0.05	0.05
			150	0.02	0.03
			200	0.01	0.03