

Chlorophyll *a* concentration of phytoplankton during a cruise of the 46th Japanese Antarctic Research Expedition in 2004–2005

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1. Introduction

This is a report on the phytoplankton chlorophyll *a* concentration on a cruise of the icebreaker *Shirase* during the 46th Japanese Antarctic Research Expedition (JARE) in 2004–2005 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 two or three times a day with a plastic bucket and by pumping up through the hull. Subsurface water was collected with a Niskin bottle attached to the Rosette multi-sampler on a CTD or Van-Dorn bottle. Seawater samples of 200–300 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 concentration 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

Map of the sampling stations during JARE-46 cruise is illustrated in Fig. 1. Chlorophyll *a* and pheopigments concentration 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 chapter 5).

4. Scientists on board

Sampling and analysis were mainly carried out by A. S. Otsuki.

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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Place to contact in requiring the digital data is also same.

Acknowledgments

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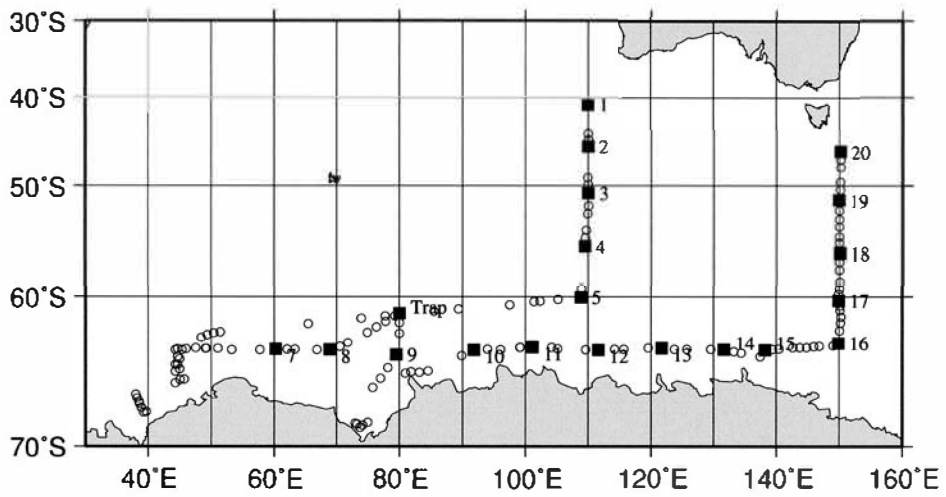


Fig. 1. Map showing the sites of sampling stations during JARE-46 in 2004/05. Open circles indicate surface water sampling. Solid squares are stations for vertical water sampling.

Table 1. Chlorophyll *a* and pheopigments concentration of surface water during JARE-46.

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	2004/12/5	23:00	44	20.85	S	109	60.00	E	0.65	0.17
2	Bucket	2004/12/6	2:00	45	0.48	S	110	0.93	E	1.68	0.45
3	Pump	2004/12/6	23:00	49	10.99	S	109	55.78	E	0.44	0.03
4	Bucket	2004/12/7	2:00	49	54.61	S	109	59.25	E	0.66	0.11
5	Pump	2004/12/7	14:00	52	2.12	S	110	4.79	E	0.91	0.17
6	Pump	2004/12/7	17:00	52	48.63	S	109	55.97	E	1.03	0.21
7	Pump	2004/12/7	23:00	54	24.48	S	109	40.85	E	0.80	0.10
8	Bucket	2004/12/8	2:00	55	4.60	S	109	33.39	E	0.59	0.06
9	Bucket	2004/12/9	2:00	59	22.18	S	108	57.28	E	0.46	0.04
10	Pump	2004/12/9	17:00	60	13.76	S	105	13.87	E	0.43	0.05
11	Pump	2004/12/9	23:00	60	22.26	S	102	21.29	E		
12	Bucket	2004/12/10	1:00	60	24.78	S	101	23.02	E	1.06	0.11
13	Pump	2004/12/10	9:00	60	41.07	S	97	29.65	E	0.94	0.12
14	Bucket	2004/12/11	2:00	60	59.01	S	89	21.14	E	0.81	0.07
15	Pump	2004/12/11	10:00	61	10.21	S	85	29.98	E	1.16	0.24
16	Pump	2004/12/12	10:00	61	42.49	S	73	54.04	E	1.23	0.14
17	Bucket	2004/12/12	2:00	61	31.67	S	77	42.44	E	2.05	0.13
18	Bucket	2004/12/13	3:00	62	5.74	S	65	26.81	E	0.47	0.09
19	Pump	2004/12/14	6:00	62	42.74	S	51	24.53	E	0.77	0.08
20	Pump	2004/12/14	8:00	62	47.47	S	50	22.58	E	0.21	0.01
21	Pump	2004/12/14	10:00	62	54.72	S	49	22.36	E	0.38	0.04
22	Pump	2004/12/14	12:00	63	6.66	S	48	25.31	E	0.30	0.04
Syowa Station, Antarctica											
23	Pump	2005/2/10	8:00	66	57.33	S	37	58.03	E	0.31	-0.02
24	Pump	2005/2/10	9:00	67	11.05	S	38	12.83	E	0.29	0.09
25	Pump	2005/2/10	10:00	67	24.39	S	38	28.65	E	0.38	0.02
26	Pump	2005/2/10	11:00	67	31.59	S	38	34.34	E	0.33	0.04
27	Pump	2005/2/10	12:00	67	47.17	S	38	54.50	E	0.57	0.12
28	Pump	2005/2/10	13:00	68	2.87	S	39	14.23	E	0.43	0.00
29	Pump	2005/2/10	13:50	68	1.25	S	39	40.73	E	1.62	0.31
30	Pump	2005/2/22	9:00	64	0.34	S	44	20.06	E	0.11	0.01
31	Pump	2005/2/22	14:00	65	0.38	S	44	20.06	E	0.12	0.02
32	Pump	2005/2/22	16:20	65	29.05	S	44	19.92	E	0.14	0.02
33	Pump	2005/2/22	20:00	66	14.17	S	44	20.00	E	0.26	0.05
34	Pump	2005/2/23	3:30	65	0.94	S	44	39.98	E	0.13	0.02
35	Pump	2005/2/23	6:00	64	29.89	S	44	39.98	E	0.10	0.02
36	Pump	2005/2/23	8:40	63	57.24	S	44	39.99	E	0.10	0.01
37	Pump	2005/2/23	13:55	64	39.10	S	45	0.00	E	0.14	0.01
38	Pump	2005/2/23	17:10	65	19.76	S	45	0.02	E	0.13	0.01
39	Pump	2005/2/23	20:30	66	0.43	S	45	3.27	E	0.16	0.00
40	Pump	2005/2/24	6:40	64	0.27	S	45	19.98	E	0.12	0.00
41	Pump	2005/2/24	18:40	65	58.97	S	45	40.07	E	0.17	0.00
42	Pump	2005/2/25	6:00	63	57.01	S	45	59.97	E		
43	Pump	2005/2/25	9:30	63	52.68	S	47	32.48	E	0.21	0.00
44	Bucket	2005/2/25	13:00	63	54.18	S	49	4.43	E	0.16	0.00
45	Pump	2005/2/25	13:20	63	54.13	S	49	12.05	E	0.17	0.01
46	Pump	2005/2/25	17:05	63	55.45	S	51	3.50	E	0.21	-0.01

Table 1. Continued.

Sample #	Pump /Bucket	Date (GMT)	Time (GMT)	Latitude		Longitude		Chl. <i>a</i> (mg m ⁻³)	Pheo. (mg m ⁻³)		
				Degrees	Minutes	Degrees	Minutes				
47	Pump	2005/2/25	21:00	64	0.01	S	53	13.73	E	0.14	0.01
48	Bucket	2005/2/26	5:00	64	0.41	S	57	44.83	E	0.13	0.01
48'	Pump	2005/2/26	5:00	64	0.41	S	57	44.83	E	0.13	0.01
49	Pump	2005/2/26	17:00	63	58.94	S	62	1.79	E	0.18	0.02
50	Pump	2005/2/26	20:00	63	58.35	S	63	21.12	E	0.19	0.02
51	Bucket	2005/2/27	4:00	64	0.67	S	66	48.80	E	0.23	0.01
51'	Pump	2005/2/27	4:00	64	0.67	S	66	48.80	E	0.27	0.02
52	Pump	2005/2/27	16:00	63	45.97	S	70	29.63	E	0.28	0.02
53	Pump	2005/2/27	19:00	63	28.75	S	71	43.05	E	0.23	0.01
54	Bucket	2005/2/28	3:00	62	44.40	S	74	49.61	E	0.15	0.02
54'	Pump	2005/2/28	3:05	62	44.15	S	74	50.76	E	0.19	0.02
55	Pump	2005/2/28	7:00	62	20.47	S	76	18.34	E	0.17	0.01
56	Bucket	2005/2/28	11:00	61	56.22	S	77	47.45	E	0.12	0.02
56'	Pump	2005/2/28	11:00	61	56.22	S	77	47.45	E	0.15	0.00
57	Pump	2005/2/28	15:00	61	30.32	S	79	14.83	E	0.18	0.01
58	Bucket	2005/3/2	11:00	65	15.20	S	78	8.78	E	0.21	0.02
58'	Pump	2005/3/2	11:00	65	15.20	S	78	8.78	E	0.23	0.01
59	Pump	2005/2/28	19:00	61	14.03	S	79	57.91	E	0.17	0.01
60	Pump	2005/3/1	15:00	62	2.44	S	79	58.08	E	0.29	0.01
61	Pump	2005/3/1	19:00	62	49.48	S	79	58.72	E	0.15	0.01
62	Pump	2005/3/2	15:00	65	56.12	S	76	59.32	E	0.38	0.02
63	Pump	2005/3/2	19:00	66	31.17	S	75	42.64	E	0.46	0.01
64	Pump	2005/3/3	8:10	68	42.79	S	72	57.19	E	5.25	0.78
65	Pump	2005/3/3	8:40	68	44.88	S	73	13.26	E	6.22	0.75
66	Pump	2005/3/3	9:50	68	56.65	S	73	38.91	E	7.97	0.50
67	Pump	2005/3/3	10:56	68	49.43	S	74	8.00	E	6.18	0.83
68	Pump	2005/3/3	12:35	68	38.18	S	74	54.12	E	4.47	0.21
69	Pump	2005/3/5	5:20	65	36.23	S	80	54.28	E	0.66	0.09
70	Pump	2005/3/5	8:30	65	31.27	S	81	47.67	E	1.76	0.05
71	Pump	2005/3/5	11:05	65	33.07	S	83	7.19	E	0.97	0.06
72	Pump	2005/3/5	13:40	65	26.14	S	84	29.53	E	1.63	0.08
73	Pump	2005/3/6	14:00	63	59.05	S	94	0.11	E	0.35	0.02
74	Pump	2005/3/6	18:00	64	0.17	S	96	1.59	E	0.38	0.02
75	Bucket	2005/3/6	2:00	64	25.63	S	89	54.23	E	0.38	0.01
75'	Pump	2005/3/6	2:00	64	25.63	S	89	54.23	E	0.39	0.02
76	Bucket	2005/3/7	1:00	63	49.95	S	99	7.54	E	0.29	0.03
76'	Pump	2005/3/7	1:05	63	50.13	S	99	9.93	E	0.32	0.05
77	Pump	2005/3/7	14:00	63	51.38	S	104	8.77	E	0.26	0.02
78	Pump	2005/3/7	17:00	63	56.72	S	105	8.11	E	0.28	0.05
79	Bucket	2005/3/8	1:00	64	1.02	S	109	34.73	E	0.45	0.00
79'	Pump	2005/3/8	1:00	64	1.02	S	109	34.73	E	0.50	0.01
80	Pump	2005/3/8	13:00	63	58.89	S	114	14.69	E	0.45	0.02
81	Pump	2005/3/8	16:00	63	57.67	S	115	42.38	E	0.60	0.02
82	Bucket	2005/3/9	0:00	63	53.54	S	119	34.50	E	0.54	0.00
82'	Pump	2005/3/9	0:00	63	53.54	S	119	34.50	E	0.59	-0.01
83	Pump	2005/3/9	12:00	63	58.73	S	123	46.67	E	0.60	0.00
84	Pump	2005/3/9	16:00	63	58.83	S	125	45.42	E	0.55	0.01

¹ Mark in the sample # column represent pumping sample collected with bucket sampling simultaneously.

Table 1. Continued.

Sample #	Pump /Bucket	Date (GMT)	Time (GMT)	Latitude		Longitude		Chl.a (mg m ⁻³)	Pheo. (mg m ⁻³)		
				Degrees	Minutes	Degrees	Minutes				
85	Bucket	2005/3/10	0:00	63	59.65	S	129	36.47	E	0.29	0.00
85'	Pump	2005/3/10	0:00	63	59.65	S	129	36.47	E	0.29	0.00
86	Pump	2005/3/10	12:00	64	7.92	S	133	14.29	E	0.25	0.01
87	Pump	2005/3/10	15:00	64	12.91	S	134	24.65	E	0.30	0.01
88	Bucket	2005/3/10	23:00	64	28.85	S	137	27.52	E	0.24	0.02
88'	Pump	2005/3/10	23:00	64	28.85	S	137	27.52	E	0.26	0.01
89	Pump	2005/3/11	11:00	63	59.53	S	139	22.08	E	0.31	0.01
90	Pump	2005/3/11	15:00	63	55.79	S	140	25.29	E	0.40	0.01
91	Bucket	2005/3/11	23:00	63	51.80	S	142	38.36	E	0.41	-0.02
91'	Pump	2005/3/11	23:00	63	51.80	S	142	38.36	E	0.41	-0.01
92	Pump	2005/3/12	3:00	63	50.22	S	143	42.68	E	0.34	0.01
93	Pump	2005/3/12	10:50	63	46.18	S	145	57.87	E	0.74	-0.01
94	Bucket	2005/3/12	7:00	63	49.57	S	144	50.21	E	0.69	-0.01
94'	Pump	2005/3/12	7:00	63	49.57	S	144	50.21	E	0.66	-0.01
95	Pump	2005/3/12	14:00	63	45.26	S	146	49.69	E	0.96	0.03
96	Bucket	2005/3/12	22:00	63	42.03	S	149	2.82	E	0.81	0.06
96'	Pump	2005/3/12	22:00	63	42.03	S	149	2.82	E	0.85	0.06
97	Pump	2005/3/13	11:00	62	36.93	S	150	5.10	E	0.62	0.06
98	Pump	2005/3/13	14:00	62	3.02	S	150	13.11	E	0.74	0.02
99	Pump	2005/3/13	17:15	61	35.04	S	150	13.76	E	0.31	0.01
100	Pump	2005/3/13	20:00	61	6.70	S	150	6.98	E	0.27	0.03
101	Pump	2005/3/13	23:00	60	43.56	S	150	6.82	E	0.28	0.03
102	Pump	2005/3/14	8:00	59	48.48	S	149	55.10	E	0.38	0.03
103	Pump	2005/3/14	11:00	59	22.12	S	150	0.61	E	0.38	0.03
104	Pump	2005/3/14	14:40	58	51.85	S	150	2.27	E	0.29	0.04
105	Pump	2005/3/14	20:00	57	51.52	S	149	59.07	E	0.13	0.02
106	Bucket	2005/3/14	23:00	57	11.96	S	149	58.21	E	0.26	0.09
106'	Pump	2005/3/14	23:00	57	11.96	S	149	58.21	E	0.26	0.09
107	Pump	2005/3/15	11:00	55	33.05	S	150	0.16	E	0.25	0.07
108	Pump	2005/3/15	14:00	55	0.04	S	149	59.81	E	0.18	0.11
109	Pump	2005/3/15	17:20	54	4.79	S	149	58.59	E	0.30	0.10
110	Pump	2005/3/15	20:00	53	19.57	S	150	0.11	E	0.17	0.03
111	Bucket	2005/3/15	23:00	52	28.47	S	149	59.96	E	0.19	0.03
111'	Pump	2005/3/15	23:00	52	28.47	S	149	59.96	E	0.18	0.07
112	Pump	2005/3/16	11:00	50	25.48	S	150	5.92	E	0.61	0.23
113	Pump	2005/3/16	14:00	49	37.50	S	150	8.11	E	0.37	0.15
114	Pump	2005/3/16	20:00	48	3.73	S	150	9.38	E	0.67	0.24
115	Bucket	2005/3/16	23:00	47	17.70	S	150	10.85	E	0.62	0.45
115'	Pump	2005/3/16	23:00	47	17.70	S	150	10.85	E	0.59	0.42

Sydney, Australia

Table 2. Vertical profile of chlorophyll *a* and pheopigments concentration during JARE-46. ND indicates no data.

Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Phaeo (mg m ⁻³)	Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Phaeo (mg m ⁻³)
1	2004/12/5	40 - 57.255 S 109 - 58.08 E	0	0.30	0.07	7	2005/2/26	63 - 57.68 S 60 - 16.07 E	0	0.15	0.01
			10	0.31	0.06				10	0.15	0.00
		20	0.31	0.07	20			0.14	0.00		
		30	0.34	0.08	30			0.14	0.00		
		50	0.35	0.08	50			0.23	0.01		
		75	0.41	0.14	75			0.26	0.04		
		100	0.41	0.21	100			0.44	0.11		
		125	0.08	0.04	125			0.45	0.32		
		150	0.06	0.04	150			0.19	0.10		
		200	0.03	0.02	200			0.01	0.03		
2	2004/12/6	45 - 46.81 S 110 - 1.67 E	0	0.91	0.25	8	2005/2/27	64 - 0.16 S 68 - 53.23 E	0	0.27	0.00
			10	0.91	0.29				10	0.27	0.00
		20	0.80	0.31	20			0.25	0.01		
		30	0.77	0.27	30			0.24	0.00		
		50			50			0.56	0.01		
		75			75			0.76	0.33		
		100	0.18	0.18	100			0.22	0.10		
		125	0.13	0.15	125			0.04	0.03		
		150	0.08	0.19	150			0.02	0.03		
		200	0.03	0.06	200			0.00	0.02		
3	2004/12/7	50 - 46.60 S 110 - 1.22 E	0	1.19	0.12	Trap	2005/3/1	61 - 20.27 S 79 - 59.88 E	0	0.21	0.01
			10	1.19	0.13				10	0.23	0.01
		20	1.14	0.26	20			0.25	-0.01		
		30	1.15	0.33	30			0.24	0.00		
		50	1.03	0.28	50			0.28	0.00		
		75	1.32	0.51	75			0.18	0.05		
		100	0.56	0.49	100			0.11	0.04		
		125	0.33	0.25	125			0.06	0.03		
		150	0.29	0.23	150			0.02	0.02		
		200	0.16	0.19	200			0.01	0.02		
4	2004/12/8	55 - 52.24 S 109 - 28.76 E	0	0.45	0.06	9	2005/3/2	64 - 20.33 S 79 - 29.02 E	0	0.29	0.02
			10	0.34	0.04				10	0.35	0.02
		20	0.47	0.07	20			0.42	0.00		
		30	0.44	0.05	30			0.49	0.02		
		50	0.45	0.08	50			1.16	0.25		
		75	0.52	0.14	75			0.61	0.24		
		100	0.25	0.13	100						
		125	0.16	0.11	125			0.17	0.09		
		150	0.11	0.08	150			0.07	0.05		
		200	0.03	0.05	200			0.02	0.03		
5	2004/12/9	60 - 3.77 S 108 - 51.48 E	0	0.57	0.07	10	2005/3/6	64 - 0.82 S 91 - 47.92 E	0	0.29	0.02
			10	0.59	0.10				10	0.30	0.04
		20	0.59	0.03	20			0.31	0.02		
		30	0.57	0.07	30			0.29	0.02		
		50	0.79	0.08	50			0.47	0.08		
		75	0.59	0.17	75			0.55	0.19		
		100	0.37	0.24	100			0.42	0.18		
		125	0.22	0.12	125			0.20	0.11		
		150	0.15	0.07	150			0.14	0.07		
		200	0.03	0.05	200			0.05	0.04		

Table 2. Continued.

Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Phaeo (mg m ⁻³)	Station	Date	Position	Depth (m)	Chl. <i>a</i> (mg m ⁻³)	Phaeo (mg m ⁻³)		
11	2005/3/7	63 - 50.07 S 101 - 9.64 E	0	0.61	0.02	16	2005/3/13	63 - 31.24 S 149 - 50.85 E	0	0.82	0.04		
			10	0.59	0.00				10	0.86	0.04		
				20	0.60			0.00			20	0.92	0.04
				30	0.60			0.02			30	0.87	0.05
				50	0.90			0.08			50	1.38	0.19
				75	1.04			0.24			75	0.29	0.12
				100	0.26			0.13			100	0.14	0.08
				125	0.19			0.09			125	0.06	0.04
				150	0.11			0.06			150	0.03	0.03
				200	0.04			0.04			200	0.02	0.03
12	2005/3/8	64 - 1.05 S 111 - 39.89 E	0	0.70	0.01	17	2005/3/14	60 - 20.25 S 149 - 56.40 E	0	0.34	0.04		
			10	0.69	0.01				10	0.37	0.02		
				20	0.76			0.00			20	0.43	0.01
				30	0.71			0.00			30	0.42	0.01
				50	0.80			0.05			50	0.43	0.03
				75	0.75			0.21			75	0.46	0.05
				100	0.21			0.11			100	0.20	0.09
				125	0.06			0.05			125	0.19	0.09
				150	0.03			0.03			150	0.06	0.04
				200	0.01			0.03			200	0.03	0.02
13	2005/3/9	63 - 53.42 S 121 - 44.31 E	0	0.62	-0.02	18	2005/3/15	56 - 25.65 S 150 - 3.19 E	0	0.13	0.01		
			10	0.65	0.01				10	0.12	0.02		
				20	0.65			0.01			20	0.12	0.01
				30	0.66			0.00			30	0.11	0.01
				50	0.66			0.00			50	0.11	0.02
				75	0.98			0.19			75	0.15	0.01
				100	0.78			0.04			100	0.40	0.10
				125	0.19			0.12			125	0.07	0.05
				150	0.08			0.07			150	0.04	0.04
				200	0.03			0.04			200	0.03	0.04
14	2005/3/10	64 - 0.01 S 131 - 41.87 E	0	0.27	0.00	19	2005/3/16	51 - 28.89 S 149 - 57.03 E	0	0.27	0.04		
			10	0.25	0.00				10	0.27	0.05		
				20	0.25			0.01			20	0.28	0.06
				30	0.25			0.01			30	0.27	0.06
				50	0.27			0.01			50	0.27	0.06
				75	0.66			0.21			75	0.28	0.11
				100	0.42			0.16			100	0.28	0.21
				125	0.23			0.12			125	0.13	0.08
				150	0.09			0.07			150	0.08	0.06
				200	0.03			0.04			200	0.02	0.02
15	2005/3/11	64 - 0.98 S 138 - 10.23 E	0	0.24	0.01	20	2005/3/17	46 - 19.62 S 150 - 9.23 E	0	0.90	0.44		
			10	0.25	0.01				10	0.88	0.47		
				20	0.25			0.02			20	0.89	0.48
				30	0.22			0.02			30	0.96	0.53
				50	0.29			0.03			50	0.65	0.53
				75	0.44			0.18			75	0.45	0.41
				100	0.32			0.15			100	0.11	0.14
				125	0.11			0.08			125	0.02	0.04
				150	0.04			0.03			150	0.01	0.03
				200	0.02			0.02			200	0.01	0.03