Appendix Table 3 (1) Results of chemical analysis for manganese crusts

Sampling location No.	Code	Crust Type	layer	Co (%)	Ni (%)	Cu (%)	Mn (%)	Fe (%)	Pb (%)	Zn (%)	Ti (%)	Mo (%)	V (%)	Si (%)	Al (%)	Ca (%)	P (%)	Pt (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Thick (mm)
97SMC02CB04	CM1	Cr	Bk	0.30	0.27	0.04	20.84	16.82	0.04	0.08	1.10	0.03	0.06	3.99	1.11	2.21	0.41	0.30	234	508	47.50	179	38.40	9.29	41.80	6.84	39.60	8.33	24.20	3.54	23.00	3.59	45
97SMC02CB04	CM2		Ot	0.58	0.38	0.03	25.41	13.91	0.07	0.05	0.71	0.05	0.07	1.72	0.34	2.15	0.41	0.20	221	474	43.80	166	35.30	8.86	39.10	6.71	39.80	8.46	25.50	3.70	24.00	3.81	12
97SMC02CB04	CM3		In	0.28	0.34	0.06	16.59	19.12	0.01	0.05	1.41	0.02	0.05	6.67	2.38	2.19	0.39	0.90	196	515	35.83	132	27.90	7.03	31.90	5.32	31.40	6.86	20.90	3.03	20.60	3.45	30
97SMC02CB04	CM4	Cr	Bk	0.48	0.37	0.06	21.65	18.35	0.03	0.07	1.31	0.03	0.06	4.58	1.39	2.17	0.42	0.60	219	599	40.86	147	31.70	7.94	36.30	6.11	36.00	7.87	24.00	3.52	23.50	3.89	40
97SMC02CB04	CM5		Ot	0.66	0.40	0.03	28.22	15.93	0.06	0.05	0.99	0.04	0.07	2.62	0.60	2.37	0.48	0.40	232	616	45.07	167	35.50	8.86	39.10	6.72	39.50	8.48	26.20	3.87	25.20	4.01	8
97SMC02CB04	CM6		In	0.26	0.30	0.05	17.18	19.68	0.01	0.05	1.48	0.02	0.05	6.31	2.09	1.88	0.41	0.80	205	533	35.49	131	27.60	6.91	32.10	5.26	32.20	7.11	22.10	3.25	21.60	3.66	28
97SMC02LC05	CM1	Cr	Bk	0.20	0.26	0.07	16.35	16.98	0.01	0.05	1.39	0.01	0.06	8.18	2.75	1.87	0.24	0.60	127	423	25.01	92	20.30	4.90	23.40	3.77	21.80	4.75	13.80	2.06	13.90	2.19	32
97SMC02LC06	CM1	Cr	Bk	0.41	0.40	0.13	19.85	17.59	0.01	0.07	1.24	0.02	0.06	6.01	2.03	1.82	0.41	0.50	161	471	31.07	114	24.10	5.94	26.80	4.32	25.20	5.10	15.00	2.21	14.50	2.35	22
97SMC03AD02	CM1	Cr	Bk	0.47	0.27	0.06	25.34	15.56	0.04	0.05	1.19	0.02	0.05	3.21	0.79	2.19	0.35	0.40	224	742	41.99	153	33.00	8.13	37.90	6.46	37.60	8.35	25.00	3.77	25.80	4.04	12
97SMC03AD02	CM2	Cr	Bk	0.30	0.34	0.03	25.56	17.16	0.06	0.05	0.75	0.04	0.07	3.46	0.64	2.26	0.48	0.10	246	429	46.85	175	37.50	9.51	42.50	7.40	44.40	9.63	29.40	4.27	28.20	4.45	10
97SMC03AD05	CM1	Cr	Bk	0.49	0.30	0.02	27.16	15.47	0.07	0.05	0.71	0.04	0.07	1.91	0.35	2.49	0.49	0.20	234	458	45.51	173	36.90	9.36	41.30	7.15	43.30	9.41	28.60	4.19	27.30	4.40	7
97SMC03AD05	CM2	Cr	Bk	0.54	0.48	0.14	20.31	16.59	0.01	0.10	0.78	0.03	0.06	2.92	1.10	3.65	0.51	0.30	187	458	35.88	135	29.60	7.27	33.90	5.62	32.30	7.08	20.90	3.05	20.70	3.32	1
97SMC03CB06	CM1	Cc	Bk	0.53	0.39	0.03	21.80	12.57	0.05	0.06	0.59	0.04	0.06	1.67	0.70	6.39	0.45	0.30	173	326	35.14	134	28.50	7.35	32.90	5.50	32.90	6.90	21.10	3.14	20.00	3.27	1
97SMC03CB06	CM2	Cc	Bk	0.50	0.36	0.02	27.07	15.19	0.07	0.05	0.62	0.04	0.07	1.88	0.51	3.37	0.51	0.20	224	414	46.58	177	39.00	9.75	43.60	7.32	42.60	9.18	27.50	4.03	26.50	4.07	1
97SMC03CB07	CM1	Cr	Bk	0.47	0.41	0.07	23.36	17.16	0.05	0.09	0.87	0.04	0.05	3.80	0.87	2.44	0.38	0.20	254	494	54.93	207	44.80	11.10	48.80	8.12	46.10	9.39	27.60	4.03	26.40	4.05	5
97SMC03CB08	CM1	Cr	Bk	0.42	0.41	0.07	22.19	17.87	0.04	0.05	1.06	0.03	0.05	3.75	0.89	2.36	0.39	0.30	230	589	65.01	237	52.00	12.90	54.60	9.04	51.50	10.30	29.40	4.28	27.50	4.25	12
97SMC03CB09	CM1	Cr	Bk	0.41	0.28	0.02	26.64	14.19	0.08	0.04	0.61	0.04	0.07	2.03	0.74	2.57	0.56	0.40	170	420	32.73	128	27.50	6.96	32.40	5.47	33.10	7.30	22.20	3.40	22.00	3.50	6
97SMC03CB09	CM2	Cr	Bk	0.61	0.32	0.03	28.05	14.10	0.06	0.06	0.71	0.04	0.07	1.82	0.62	2.41	0.48	0.30	229	487	46.07	171	37.90	9.52	40.90	7.29	43.00	9.18	28.10	4.01	26.10	4.19	2
97SMC03CB09	CM3	Cc	Bk	0.64	0.35	0.03	28.60	15.23	0.06	0.10	0.72	0.05	0.07	1.57	0.53	2.56	0.55	0.30	239	511	48.62	181	40.10	9.84	43.80	7.61	44.60	9.97	29.80	4.33	28.70	4.38	3
97SMC03CB10	CM1	Cr	Bk	0.24	0.21	0.03	22.08	17.03	0.03	0.05	0.78	0.02	0.06	4.62	0.97	2.14	0.35	0.20	236	434	46.79	185	38.70	9.82	45.60	7.35	44.30	9.35	27.30	4.15	26.50	4.15	5
97SMC03CB11	CM1	Cr	Bk	0.42	0.39	0.06	18.12	16.22	0.05	0.07	0.89	0.03	0.05	6.87	2.19	2.13	0.42	0.30	178	503	31.30	120	25.10	6.28	30.30	4.89	30.30	6.89	20.60	3.12	20.70	3.34	40
97SMC03CB11	CM2		Ot	0.49	0.31	0.06	23.93	16.82	0.05	0.06	0.95	0.03	0.06	3.58	0.74	2.29	0.41	0.30	235	596	44.43	168	35.70	8.71	40.90	6.71	40.10	8.84	25.90	3.84	25.80	3.95	20
97SMC03CB11	CM3		In	0.39	0.35	0.06	19.90	17.84	0.02	0.07	0.98	0.02	0.06	5.17	1.59	2.39	0.40	0.40	178	574	30.03	115	24.00	6.02	29.50	4.77	29.80	6.87	20.80	3.23	21.50	3.50	25
97SMC03CB11	CM4	Cr	Bk	0.85	0.49	0.12	26.71	15.68	0.07	0.12	1.31	0.03	0.06	2.34	0.52	2.27	0.36	0.80	248	902	47.87	172	37.10	8.98	41.10	6.80	39.50	8.38	25.60	3.71	24.90	3.92	10
97SMC03CB12	CM1	Cr	Bk	0.33	0.35	0.06	22.19	17.23	0.03	0.05	0.88	0.03	0.06	4.36	1.01	2.19	0.38	0.20	240	481	46.85	173	36.90	9.24	40.80	6.97	41.10	8.64	25.90	3.76	24.90	3.96	20
97SMC03CB13	CM1	Cr	Bk	0.48	0.34	0.05	22.23	17.87	0.02	0.05	1.38	0.02	0.05	3.44	0.75	2.39	0.35	0.70	203	818	65.49	233	52.60	12.32	52.80	8.81	48.20	9.74	28.00	3.97	26.30	3.94	12
97SMC04CB10	CM1	Cc	Bk	0.64	0.37	0.04	27.77	14.19	0.09	0.06	0.70	0.06	0.05	2.25	0.59	2.71	0.44	0.30	161	403	37.35	142	30.60	7.57	33.10	6.09	35.80	7.28	22.90	3.46	22.10	3.64	4
97SMC04CB10	CM2	Cc	Bk	0.59	0.46	0.04	27.91	15.22	0.07	0.06	0.68	0.06	0.07	2.59	0.76	2.52	0.47	0.20	205	403	39.32	155	32.20	8.20	38.60	6.12	37.10	7.96	23.40	3.63	23.10	3.64	3
97SMC04CB10	CM3	Cc	Bk	0.36	0.28	0.02	29.62	12.18	0.05	0.04	0.69	0.03	0.07	1.87	0.43	2.49	0.30	0.20	217	378	44.40	171	35.70	9.16	40.30	6.82	40.90	8.53	25.90	3.87	25.00	3.96	3
97SMC04CB11	CM1	Cc	Bk	0.45	0.38	0.05	26.11	14.50	0.12	0.06	0.73	0.04	0.06	2.30	0.76	2.36	0.45	0.30	231	584	38.63	173	33.90	8.17	34.10	6.13	36.50	7.71	25.10	3.67	22.40	3.91	1
97SMC04CB13	CM1	Cr	Bk	0.31	0.22	0.03	22.85	16.54	0.05	0.05	0.84	0.03	0.05	4.06	0.90	2.16	0.40	0.10	145	437	42.91	165	35.30	8.52	39.20	7.06	40.90	8.59	26.20	3.94	25.70	4.08	12
97SMC04CB13	CM2	Cr	Bk	0.52	0.32	0.04	25.19	15.87	0.05	0.06	0.91	0.04	0.05	3.06	0.61	2.34	0.39	0.20	166	503	52.15	201	43.20	10.31	45.20	8.01	46.10	9.27	27.50	4.11	26.00	4.11	7
97SMC04CB17	CM1	Cr	Bk	0.41	0.23	0.02	30.48	12.75	0.05	0.05	0.78	0.02	0.07	1.80	0.45	2.24	0.31	0.30	202	521	39.22	150	31.90	8.08	37.30	6.19	36.80	7.93	24.40	3.69	23.70	3.76	10
97SMC06CB04	CM1	Cr	Bk	0.61	0.33	0.04	16.66	20.96	0.01	0.05	1.47	0.01	0.05	5.11	1.41	1.55	0.42	0.60	245	804	42.65	163	31.80	7.80	38.50	5.59	31.90	6.73	19.40	2.84	18.40	2.99	10
97SMC06CB06	CM1	Cc	Bk	0.41	0.31	0.04	25.99	15.38	0.06	0.06	0.73	0.04	0.06	2.90	0.68	2.24	0.45	0.20	139	380	41.56	160	34.70	8.35	36.90	6.83	38.80	8.05	25.10	3.69	24.40	3.88	3
97SMC06CB06	CM2		Sf	0.46	0.48	0.04	27.82	15.37	0.09	0.06	0.69	0.05	0.07	3.09	0.67	2.23	0.44	0.20	220	372	42.70	171	35.60	9.01	41.00	6.73	40.70	8.59	25.30	3.86	24.60	3.85	4
97SMC06CB06	CM3		Rv	0.39	0.39	0.04	28.63	14.47	0.08	0.06	0.75	0.04	0.07	2.68	0.73	2.22	0.39	0.20	257	467	48.22	189	39.20	10.16	47.10	7.61	46.40	9.96	30.10	4.55	29.50	4.73	3
97SMC06CB06	CM4	Cc	Bk	0.35	0.21	0.03	24.66	15.72	0.05	0.05	0.74	0.03	0.06	3.04	0.60	2.42	0.46	0.20	161	412	49.54	194	41.10	9.93	42.90	7.75	45.20	8.98	27.00	4.00	25.20	4.01	4
97SMC06CB06	CM5	Nd	Bk	0.54	0.60	0.04	29.07	14.55	0.07	0.06	0.71	0.05	0.07	2.79	0.70	2.29	0.40	0.20	198	382	36.45	142	30.10	7.60	36.70	6.06	36.50	8.05	24.20	3.66	24.40	3.83	5
97SMC06CB06	CM6	Nd	Bk	0.44	0.44	0.03	28.52	14.34	0.08	0.05	0.73	0.04	0.07	3.04	0.72	2.29	0.39	0.20	193	372	37.14	144	30.10	7.75	35.20	5.94	36.00	7.65	23.50	3.57	23.40	3.79	5
97SMC06CB06	CM7	Cr	Bk	0.46	0.27	0.04	23.95	16.31	0.06	0.05	0.81	0.03	0.05	3.28	0.73	2.56	0.41	0.20	151	457	45.81	177	38.50	9.10	40.60	7.40	41.50	8.59	26.00	3.84	24.70	3.94	8
97SMC06CB07	CM1	Cr	Bk	0.43	0.33	0.07	24.93	15.46	0.12	0.06	0.73	0.03	0.06	2.99	0.74	2.54	0.42	0.30	203	440	37.90	147	30.70	8.03	37.30	6.17	37.30	7.92	24.40	3.66	23.80	3.83	5
97SMC06CB08	CM1	Cc	Bk	0.55	0.39	0.04	25.25	17.24	0.05	0.06	0.72	0.05	0.07	2.98	0.87	2.37	0.50	0.30	201	451	35.98	145	29.00	7.50	36.30	5.72	35.30	7.68	23.00	3.52	22.60	3.71	4
97SMC07CB02	CM1	Cr	Bk	0.25	0.23	0.03	23.21	17.20	0.06	0.05	0.98	0.02	0.06	3.92	0.80	2.30	0.39	0.10	236	435	44.63	174	35.50	9.20	43.00	7.21	44.50	9.39	28.60	4.27	27.60	4.37	7
97SMC07CB03	CM1	Cr	Bk	0.57	0.28	0.04	27.37	14.52	0.06	0.06	1.22	0.03	0.05	2.51	0.50	2.38	0.32	0.20	175	628	60.96	227	50.80	11.68	48.90	9.03	48.80	9.48	28.00	4.06	26.20	3.96	9
97SMC07AD06	CM1	Cr	Bk	0.74	0.41	0.03	32.99	11.07	0.06	0.05	0.85	0.04	0.05	1.46	0.41	2.27	0.32	0.30	171	441	32.09	127	26.30	6.62	31.90	5.23	32.10	7.03	21.10	3.33	21.20	3.29	7

Appendix Table 3 (2) Results of chemical analysis for manganese crusts

Sampling location No.	Code	Crust Type	layer	Co (%)	Ni (%)	Cu (%)	Mn (%)	Fe (%)	Pb (%)	Zn (%)	Ti (%)	Mo (%)	V (%)	Si (%)	Al (%)	Ca (%)	P (%)	Pt (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Thick (mm)
97SMC07AD08	CM1	Cr	Bk	0.39	0.24	0.03	24.34	15.48	0.07	0.05	1.02	0.03	0.05	3.21	0.61	2.25	0.36	0.20	165	484	51.62	198	42.20	10.35	44.30	8.13	47.40	9.28	28.30	4.15	26.80	4.19	5
97SMC07AD09	CM1	Cr	Bk	0.51	0.28	0.04	27.58	15.65	0.08	0.06	0.85	0.05	0.06	2.59	0.48	2.32	0.42	0.20	163	412	49.14	194	41.70	9.87	44.10	7.89	46.20	9.62	29.20	4.31	28.40	4.40	8
97SMC07CB14	CM1	Cr	Bk	0.36	0.31	0.04	21.38	16.84	0.04	0.05	0.95	0.03	0.06	5.75	1.30	2.30	0.41	0.10	246	446	53.59	202	43.50	10.85	48.20	8.20	46.90	9.52	27.70	4.01	26.30	4.02	5
97SMC07CB15	CM1	Nd	Bk	0.51	0.43	0.05	26.16	15.33	0.12	0.07	0.95	0.04	0.06	2.86	0.75	2.26	0.40	0.20	222	468	37.48	146	31.70	7.21	31.70	5.54	34.20	7.52	25.00	3.57	22.70	3.88	3
97SMC08LC01	CM1	Cr	Bk	0.16	0.37	0.18	20.36	14.24	0.01	0.06	0.97	0.02	0.05	6.55	2.45	1.68	0.26	0.10	205	463	54.00	203	45.50	11.30	47.60	8.15	46.00	8.71	24.90	3.69	23.70	3.71	10
97SMC08CB02	CM1	Cc	Bk	0.29	0.33	0.15	22.47	18.15	0.04	0.07	1.08	0.04	0.06	3.95	1.06	2.16	0.36	0.60	206	755	64.78	237	50.10	11.89	52.10	9.17	49.30	9.42	28.50	3.98	25.20	3.91	60
97SMC08CB02	CM2		Sf-Ot	0.41	0.30	0.05	23.97	17.06	0.12	0.05	0.88	0.05	0.06	2.96	0.43	2.11	0.38	0.10	342	608	62.72	249	53.70	12.03	51.70	8.91	53.90	10.80	34.40	4.77	28.90	4.77	30
97SMC08CB02	CM3		Sf-In	0.25	0.25	0.10	23.17	19.45	0.09	0.07	0.95	0.04	0.07	2.62	0.51	2.06	0.34	0.20	333	652	66.92	253	55.40	11.60	47.40	8.31	45.80	8.83	26.40	3.58	22.30	3.43	15
97SMC08CB02	CM4		Sf-Im	0.14	0.29	0.11	27.89	16.11	0.02	0.06	0.80	0.03	0.07	2.37	0.60	2.29	0.25	0.40	226	622	49.40	182	38.10	9.10	41.60	6.66	37.10	7.40	21.50	3.11	20.40	3.04	20
97SMC08CB02	CM5		Rv-In	0.26	0.27	0.13	19.25	12.89	0.04	0.06	0.97	0.02	0.05	7.81	2.78	1.76	0.23	0.70	127	489	27.30	98	21.10	4.83	21.60	3.66	19.40	3.75	11.40	1.65	10.70	1.67	13
97SMC08CB02	CM6		Rv-Im	0.17	0.28	0.15	17.10	14.70	0.07	0.08	0.95	0.04	0.07	3.05	0.82	9.36	3.23	0.70	329	907	55.87	204	36.90	8.97	45.50	6.54	39.30	8.52	26.30	4.04	26.30	4.44	40
97SMC08CB03	CM1	Cc	Bk	0.21	0.27	0.14	17.40	20.88	0.05	0.09	0.80	0.02	0.05	5.55	1.95	1.94	0.37	0.50	132	335	24.12	92	19.20	4.67	21.60	3.65	21.00	4.11	12.50	1.86	12.20	2.05	3
97SMC08CB04	CM1	Cr	Bk	0.41	0.39	0.07	27.29	13.31	0.09	0.06	0.94	0.07	0.07	3.87	1.13	2.54	0.53	0.40	202	1260	37.97	138	29.70	6.54	26.80	4.23	23.80	4.95	15.30	2.09	13.30	2.25	12
97SMC08CB04	CM2	Cc	Bk	0.16	0.24	0.10	15.61	12.92	0.06	0.07	0.73	0.03	0.05	2.82	0.80	11.39	4.06	0.60	160	691	43.09	158	31.80	7.54	34.40	5.58	31.40	6.11	18.30	2.61	16.50	2.69	30
97SMC08CB04	CM3	Nd	Bk	0.22	0.21	0.09	25.01	14.48	0.05	0.06	1.03	0.04	0.07	2.32	0.55	2.69	0.47	0.40	143	1066	44.48	157	31.20	7.14	34.70	5.34	29.20	5.46	16.50	2.43	15.30	2.52	32
97SMC08CB04	CM4	Nd	Bk	0.33	0.36	0.11	21.84	16.87	0.09	0.07	0.94	0.04	0.06	4.01	1.29	2.04	0.32	0.40	218	522	39.09	148	31.10	6.86	28.90	4.92	29.10	5.65	18.20	2.51	15.40	2.63	22
97SMC08CB05	CM1	Cc	Bk	0.40	0.37	0.05	24.19	14.58	0.06	0.06	0.85	0.05	0.06	1.76	0.36	4.14	1.07	0.30	195	505	54.17	201	40.50	10.02	43.70	6.55	44.40	9.07	24.80	4.04	22.00	3.72	60
97SMC08CB05	CM2		Ot	0.80	0.42	0.03	27.70	13.62	0.15	0.05	0.89	0.05	0.06	1.92	0.33	2.21	0.36	0.20	276	642	49.05	191	42.60	9.23	39.60	6.85	41.20	8.81	27.50	3.94	24.70	3.98	13
97SMC08CB05	CM3		In	0.32	0.48	0.07	28.36	17.01	0.07	0.08	0.79	0.06	0.07	1.47	0.31	2.64	0.45	0.40	283	465	55.40	203	41.70	10.09	45.70	7.57	42.50	8.68	25.20	3.61	23.30	3.51	30
97SMC08CB05	CM4		Im	0.23	0.33	0.05	21.05	10.47	0.06	0.06	0.65	0.05	0.05	0.96	0.20	11.69	3.93	0.40	253	788	45.35	169	32.10	7.88	38.90	5.86	35.60	7.60	22.70	3.42	21.80	3.47	20
97SMC08CB05	CM5	Cc	Bk	0.41	0.42	0.07	23.90	16.35	0.06	0.06	0.98	0.05	0.06	2.34	0.61	4.64	1.34	0.40	247	494	44.00	169	33.10	8.17	37.90	5.51	38.90	8.40	22.90	3.83	21.50	3.67	50
97SMC08CB05	CM6		Ot	0.58	0.34	0.04	27.94	14.23	0.11	0.05	0.85	0.05	0.06	2.33	0.51	2.21	0.39	0.20	248	551	39.04	165	33.60	7.64	34.50	5.61	36.70	7.94	24.70	3.83	22.40	3.90	15
97SMC08CB05	CM7		In	0.40	0.39	0.08	23.26	18.94	0.06	0.07	1.32	0.04	0.06	3.13	0.87	2.05	0.36	0.40	228	495	42.94	161	32.90	7.95	34.20	5.05	34.30	6.94	18.80	3.16	17.50	2.98	13
97SMC08CB05	CM8		Im	0.27	0.42	0.08	23.17	17.84	0.10	0.08	0.74	0.06	0.07	1.71	0.53	5.52	1.70	0.50	312	613	50.36	197	40.70	9.18	41.70	7.16	44.40	9.87	32.20	4.45	27.80	4.84	30
97SMC08CB05	CM9	Nd	Bk	0.42	0.37	0.07	24.08	17.50	0.06	0.06	1.22	0.04	0.06	3.53	1.03	2.21	0.39	0.30	237	474	45.13	165	34.40	8.41	37.10	5.64	37.80	7.76	21.70	3.58	20.40	3.49	30
97SMC08CB05	CM10		Sf	0.40	0.37	0.07	22.77	17.21	0.05	0.06	1.20	0.03	0.05	3.62	1.06	2.10	0.36	0.30	231	477	43.89	165	34.20	8.20	36.80	5.46	36.80	7.63	20.50	3.41	19.10	3.24	30
97SMC08CB05	CM11		Rv	0.42	0.34	0.06	23.69	16.87	0.12	0.06	1.17	0.03	0.05	3.63	1.04	2.16	0.40	0.30	263	643	43.77	178	37.70	7.92	36.30	5.94	35.80	7.77	23.80	3.51	21.60	3.55	28
97SMC08CB06	CM1	Cr	Bk	0.51	0.35	0.10	30.26	13.03	0.11	0.05	1.09	0.03	0.05	1.69	0.32	2.39	0.29	0.60	288	655	51.95	203	45.20	9.32	40.40	7.09	41.20	8.86	27.40	3.98	25.40	3.99	25
97SMC08CB07	CM1	Cr	Bk	0.30	0.27	0.05	22.67	17.43	0.06	0.05	0.98	0.03	0.06	4.67	0.84	2.05	0.36	0.10	259	459	50.55	197	39.70	10.31	48.30	7.94	49.00	10.00	29.80	4.52	28.60	4.50	10
97SMC08CB07	CM2	Cc	Bk	0.51	0.31	0.04	25.45	16.38	0.11	0.05	0.82	0.04	0.05	3.05	0.51	2.19	0.39	0.10	279	631	56.55	228	52.50	11.00	46.90	7.86	45.50	9.31	27.10	3.91	24.70	3.81	1
97SMC08CB08	CM1	Cc	Bk	0.22	0.31	0.09	18.62	14.46	0.03	0.06	0.83	0.03	0.06	2.76	0.74	9.11	3.02	0.40	234	516	46.35	170	35.00	8.47	38.30	6.28	36.50	7.75	23.30	3.40	22.70	3.61	60
97SMC08CB08	CM2		Ot	0.36	0.29	0.05	24.79	17.22	0.06	0.06	1.09	0.05	0.06	3.43	0.62	2.23	0.41	0.10	187	450	53.33	201	41.90	10.50	46.20	7.20	47.80	9.99	26.90	4.40	25.20	4.16	20
97SMC08CB08	CM3		In	0.44	0.34	0.14	24.38	17.42	0.04	0.09	1.26	0.04	0.06	3.17	0.80	2.18	0.33	0.50	245	538	53.91	196	41.60	9.58	39.20	5.86	37.80	7.17	18.50	3.01	16.80	2.67	20
97SMC08CB08	CM4		Im	0.13	0.24	0.10	15.94	13.18	0.02	0.06	0.58	0.03	0.06	2.04	0.53	13.65	4.89	0.40	261	619	45.88	170	33.60	8.16	38.20	5.35	36.90	8.24	22.80	3.74	21.40	3.73	22
97SMC08CB08	CM5	Cc	Bk	0.29	0.31	0.10	20.70	16.73	0.09	0.07	1.03	0.03	0.05	3.55	1.00	4.59	1.38	0.50	191	572	52.22	197	40.10	9.22	42.90	7.45	40.00	8.44	25.00	3.61	23.60	3.72	35
97SMC08CB08	CM6		Sf	0.33	0.37	0.09	21.01	16.94	0.03	0.07	1.14	0.04	0.06	3.84	1.09	2.79	0.63	0.40	225	476	49.17	180	36.90	8.98	39.30	5.89	40.20	8.07	22.10	3.60	19.80	3.40	35
97SMC08CB08	CM7		Rv	0.33	0.34	0.09	21.57	17.05	0.04	0.07	1.15	0.03	0.06	3.73	1.04	2.75	0.61	0.40	227	482	48.78	181	37.50	8.99	40.20	5.97	40.70	8.48	22.60	3.72	21.20	3.58	35
97SMC08CB09	CM1	Cr	Bk	0.23	0.20	0.07	23.80	17.42	0.05	0.06	1.12	0.03	0.06	3.17	0.67	2.10	0.36	0.20	195	476	57.27	214	43.40	10.80	46.80	6.97	47.40	9.32	25.20	4.11	22.40	3.74	35
97SMC08CB09	CM2		Ot	0.28	0.34	0.10	23.14	16.45	0.08	0.06	1.09	0.03	0.05	4.63	1.15	2.06	0.33	0.10	204	430	45.77	175	36.80	8.56	39.30	7.15	37.50	7.91	23.20	3.33	21.90	3.33	18
97SMC08CB09	CM3		In	0.25	0.28	0.12	19.96	18.98	0.04	0.08	1.32	0.03	0.06	4.33	1.14	2.06	0.34	0.20	237	447	48.44	177	37.00	8.78	37.20	5.66	37.10	7.41	19.80	3.22	18.30	3.01	18
97SMC08CB10	CM1	Cr	Bk	0.49	0.33	0.08	24.17	16.66	0.10	0.05	1.15	0.04	0.06	3.11	0.68	2.12	0.36	0.40	180	585	50.47	195	40.10	9.43	43.30	7.60	41.90	8.65	25.80	3.79	24.30	3.71	28
97SMC08CB10	CM2	Nd	Bk	0.34	0.31	0.10	24.63	14.78	0.04	0.06	1.16	0.03	0.06	3.81	1.23	2.04	0.34	0.30	171	432	31.04	117	23.90	5.87	26.90	3.88	26.20	5.51	15.00	2.55	14.20	2.42	10
97SMC08CB10	CM3	Nd	Bk	0.37	0.45	0.12	23.56	16.79	0.04	0.07	1.23	0.04	0.06	3.86	1.23	2.00	0.36	0.30	167	465	32.23	122	25.40	6.21	29.40	4.74	27.30	5.77	16.80	2.54	16.70	2.62	10
97SMC08CB11	CM1	Cr	Bk	0.59	0.38	0.06	26.55	15.14	0.12	0.05	0.96	0.04	0.05	2.99	0.57	2.26	0.35	0.30	179	540	51.05	198	41.10	9.69	45.00	7.90	43.40	8.92	26.40	3.96	25.50	3.93	8
97SMC08CB12	CM1	Cc	Bk	0.25	0.33	0.13	19.31	16.99	0.07	0.06	0.96	0.03	0.05	3.98	1.30	5.71	1.90	0.60	231	524	58.57	220	43.50	10.04	48.60	8.32	45.00	9.75	28.80	4.13	26.50	4.09	35
97SMC08CB12	CM2		Ot	0.27	0.36	0.11	22.46	17.40	0.03	0.07	1.00	0.03	0.06	3.71	1.11	2.75	0.63	0.50	250	407	54.61	203	43.10	10.22	43.70	7.85	44.20	9.13	27.20	3.83	25.60	3.90	20

Appendix Table 3 (3) Results of chemical analysis for manganese crusts

Sampling location No.	Code	Crust Type	layer	Co (%)	Ni (%)	Cu (%)	Mn (%)	Fe (%)	Pb (%)	Zn (%)	Ti (%)	Mo (%)	V (%)	Si (%)	Al (%)	Ca (%)	P (%)	Pt (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Thick (mm)
97SMC08CB12	CM3		In	0.09	0.13	0.08	12.64	12.96	0.03	0.05	0.88	0.02	0.05	2.91	0.95	12.01	4.34	0.70	356	741	79.22	293	53.70	12.86	64.70	9.07	63.30	14.40	39.60	6.32	35.00	5.93	18
97SMC08CB12	CM4	Cc	Bk	0.27	0.29	0.14	25.44	14.42	0.12	0.06	1.04	0.05	0.07	2.29	0.63	4.94	1.35	0.50	122	1131	21.28	73	13.90	3.10	18.40	2.64	14.10	3.02	9.57	1.46	9.77	1.69	18
97SMC08CB12	CM5	Cc	Bk	0.30	0.29	0.09	24.04	16.61	0.06	0.06	1.00	0.05	0.06	3.12	0.67	2.48	0.44	0.60	159	878	30.57	110	23.20	5.45	27.50	3.64	23.90	4.91	13.30	2.19	12.30	2.09	13
97SMC08CB12	CM6	Nd	Bk	0.37	0.39	0.14	24.76	14.84	0.10	0.07	0.98	0.04	0.05	3.33	0.94	3.40	0.83	0.40	241	483	47.03	175	36.00	8.66	39.70	7.01	38.30	7.81	23.50	3.39	21.40	3.43	11
97SMC08CB13	CM1	Cr	Bk	0.50	0.31	0.05	25.99	16.31	0.06	0.05	0.98	0.04	0.06	2.55	0.42	2.13	0.36	0.10	214	567	68.60	256	55.70	13.24	55.50	8.59	56.00	11.00	28.50	4.61	25.60	4.03	9
97SMC08CB13	CM2	Cr	Bk	0.71	0.41	0.06	29.51	13.61	0.10	0.05	1.32	0.04	0.05	2.05	0.38	2.26	0.30	0.30	199	845	67.24	247	54.60	12.74	54.40	9.67	51.00	9.75	27.80	4.01	25.80	3.90	20
97SMC08CB14	CM1	Cr	Bk	0.31	0.27	0.09	21.15	18.58	0.09	0.06	1.05	0.04	0.06	3.07	0.86	2.97	0.74	0.50	227	512	41.30	181	35.90	7.66	33.70	5.56	34.10	7.07	22.10	3.40	20.10	3.45	40
97SMC08CB14	CM2		Ot	0.42	0.37	0.07	25.44	16.53	0.06	0.05	1.25	0.04	0.05	3.17	0.75	2.17	0.36	0.40	242	522	50.35	189	39.90	9.63	39.70	7.14	41.90	8.54	25.90	3.84	25.10	4.04	15
97SMC08CB14	CM3		In	0.30	0.36	0.11	22.58	20.06	0.02	0.08	1.05	0.03	0.08	2.72	0.85	2.22	0.45	0.70	203	401	40.47	150	31.20	7.44	31.50	5.63	33.10	6.81	21.10	3.15	21.10	3.45	25
97SMC08CB14	CM4	Cr	Bk	0.51	0.31	0.06	25.66	16.38	0.11	0.05	1.18	0.04	0.05	2.98	0.66	2.22	0.38	0.40	261	663	47.80	202	40.20	8.80	37.00	6.51	40.00	8.00	26.70	3.85	22.90	4.03	30
97SMC08CB15	CM1	Cr	Bk	0.55	0.43	0.09	26.37	14.71	0.06	0.05	1.25	0.04	0.05	2.91	0.65	2.57	0.29	0.60	266	563	48.56	180	37.10	9.20	40.90	6.32	43.70	8.96	24.90	4.16	23.60	3.94	32
97SMC08LC16	CM1	Cr	Bk	0.24	0.20	0.05	22.60	16.89	0.03	0.06	1.16	0.02	0.06	3.87	1.11	2.18	0.35	0.30	251	454	50.90	191	40.30	9.62	41.20	6.32	41.90	8.44	22.70	3.64	20.80	3.39	65
97SMC08CB19	CM1	Cr	Bk	0.37	0.23	0.06	23.49	17.62	0.11	0.05	0.80	0.04	0.06	3.60	0.51	2.11	0.41	0.10	303	625	65.27	282	58.70	13.06	53.00	9.37	55.90	10.50	33.40	4.69	27.10	4.59	4
97SMC08CB19	CM2	Cc	Bk	0.22	0.22	0.12	26.51	15.59	0.07	0.06	1.04	0.03	0.07	3.05	0.62	2.16	0.31	0.20	221	565	47.77	179	37.50	8.92	38.70	5.70	38.20	7.56	19.90	3.30	17.80	2.88	9
97SMC09CB02	CM1	Cr	Bk	0.44	0.27	0.02	26.65	14.64	0.08	0.05	1.06	0.03	0.05	2.76	0.55	2.20	0.31	0.20	217	504	44.15	168	35.70	8.83	37.80	6.97	41.10	8.57	26.00	3.90	25.80	4.04	8
97SMC09CB03	CM1	Cr	Bk	0.93	0.38	0.03	32.27	12.47	0.06	0.05	0.68	0.06	0.06	1.05	0.30	2.31	0.43	0.30	178	478	32.26	126	25.90	6.56	29.90	4.48	32.30	6.98	19.80	3.42	18.70	3.24	8
97SMC09CB03	CM2	Cr	Bk	0.89	0.37	0.02	31.96	12.79	0.05	0.05	0.68	0.06	0.06	1.16	0.29	2.31	0.41	0.20	183	467	32.53	127	25.90	6.54	30.50	4.47	32.30	7.07	19.40	3.35	18.40	3.13	8
97SMC09CB04	CM1	Cr	Bk	0.51	0.34	0.05	23.86	16.32	0.06	0.06	1.02	0.03	0.05	3.67	1.00	2.04	0.34	0.20	232	515	44.65	172	35.10	8.81	40.10	5.95	41.50	8.47	23.30	3.99	22.10	3.68	8
97SMC09CB06	CM1	Cr	Bk	0.63	0.37	0.06	27.31	14.65	0.12	0.05	0.98	0.05	0.05	2.12	0.37	2.15	0.32	0.10	299	673	60.76	266	54.30	11.59	50.50	8.41	51.00	10.10	30.10	4.56	25.70	4.23	15
97SMC09CB07	CM1	Cc	Bk	0.31	0.22	0.04	22.68	16.31	0.08	0.05	0.79	0.03	0.05	4.06	0.83	2.10	0.37	0.10	217	462	39.22	173	36.10	7.78	36.00	6.18	37.80	8.32	25.60	3.80	23.00	3.77	9
97SMC09CB07	CM2	Cc	Bk	0.46	0.34	0.05	23.10	16.36	0.12	0.06	0.87	0.04	0.06	3.75	0.80	2.00	0.37	0.10	218	511	40.63	177	36.90	7.75	36.10	6.19	37.80	8.07	25.10	3.72	22.60	3.71	9
97SMC09CB08	CM1	Cc	Bk	0.32	0.21	0.05	24.07	16.65	0.05	0.05	0.93	0.03	0.05	3.65	0.80	2.11	0.36	0.10	257	475	54.72	209	44.50	10.91	46.50	7.09	48.50	9.65	25.50	4.24	23.30	3.81	6
97SMC09CB08	CM2		Sf	0.30	0.20	0.04	24.10	16.98	0.07	0.05	0.91	0.02	0.05	3.56	0.70	2.24	0.37	0.10	214	463	57.78	219	46.70	11.35	48.80	7.43	50.40	9.93	26.30	4.36	24.10	3.89	7
97SMC09CB08	CM3		Rv	0.59	0.33	0.05	24.88	15.87	0.11	0.05	1.01	0.03	0.05	3.38	0.76	2.15	0.38	0.20	245	647	51.06	214	46.30	9.80	42.20	7.62	44.20	9.06	28.50	4.07	25.20	4.22	4
97SMC09CB08	CM4	Cr	Bk	0.38	0.25	0.06	23.37	17.14	0.10	0.05	0.85	0.04	0.06	3.46	0.57	2.10	0.38	0.10	269	528	49.53	224	44.00	9.75	45.50	7.48	48.40	10.20	30.40	4.69	27.20	4.52	12
97SMC09CB09	CM1	Cr	Bk	0.50	0.31	0.06	25.00	16.47	0.06	0.05	1.06	0.04	0.05	2.90	0.58	2.04	0.34	0.10	210	577	68.22	250	53.50	13.24	54.70	8.45	55.30	10.50	28.10	4.51	24.90	4.07	8
97SMC09CB10	CM1	Cr	Bk	0.52	0.34	0.04	25.77	15.89	0.12	0.05	0.79	0.05	0.06	2.63	0.40	2.25	0.39	0.10	248	502	46.45	209	42.40	9.02	40.90	6.96	42.70	9.08	27.70	4.17	24.90	4.12	8
97SMC09CB11	CM1	Cc	Bk	0.49	0.29	0.05	27.65	15.12	0.06	0.06	0.94	0.03	0.05	2.65	0.59	2.39	0.35	0.20	188	470	58.54	215	47.90	11.50	47.30	7.42	48.60	9.65	25.90	4.13	23.80	3.88	10
97SMC09CB11	CM2		Sf	0.43	0.41	0.05	26.35	15.39	0.10	0.05	0.84	0.04	0.06	2.65	0.46	2.20	0.36	0.10	247	411	58.36	222	49.00	11.63	47.60	9.03	50.00	10.10	29.30	4.14	28.30	4.23	10
97SMC09CB11	CM3		Rv	0.66	0.39	0.06	27.06	13.50	0.11	0.05	1.00	0.04	0.05	2.43	0.55	2.71	0.33	0.20	285	605	53.71	231	47.60	10.28	44.20	7.34	45.60	9.12	29.10	4.32	25.00	4.31	10
97SMC09CB12	CM1	Cr	Bk	0.30	0.19	0.04	24.28	15.61	0.09	0.04	0.83	0.03	0.05	3.01	0.48	2.11	0.36	0.10	299	543	55.12	237	50.60	10.67	47.80	8.17	49.50	10.40	32.20	4.71	28.50	4.65	11
97SMC09CB12	CM2	Cc	Bk	0.33	0.34	0.05	22.94	16.59	0.07	0.05	0.93	0.03	0.06	4.39	0.93	2.06	0.36	0.20	201	392	43.77	167	36.40	8.91	37.80	7.05	40.80	8.30	25.10	3.65	24.70	3.90	5
97SMC09CB13	CM1	Cc	Bk	0.45	0.28	0.05	23.11	16.29	0.10	0.05	0.92	0.04	0.05	3.51	0.77	2.09	0.36	0.10	283	611	57.69	236	53.40	11.09	46.80	8.32	46.80	9.61	29.70	4.12	25.70	4.25	7
97SMC09CB13	CM2		Sf	0.37	0.24	0.05	23.19	17.12	0.09	0.05	0.90	0.03	0.05	3.66	0.71	2.11	0.37	0.10	305	623	60.96	249	54.30	11.46	48.20	8.72	49.90	10.20	33.10	4.47	27.90	4.60	8
97SMC09CB13	CM3		Rv	0.25	0.13	0.03	23.75	12.71	0.03	0.03	0.97	0.02	0.05	3.31	0.62	2.19	0.24	0.20	294	690	59.76	255	55.00	11.32	48.80	8.10	48.10	9.58	29.10	4.23	25.40	4.05	6
97SMC09CB13	CM4	Cr	Bk	0.45	0.30	0.05	25.09	16.64	0.11	0.05	0.89	0.04	0.05	3.01	0.52	2.15	0.38	0.10	312	602	59.46	254	54.30	11.50	50.80	8.31	50.10	10.10	31.10	4.57	26.70	4.36	6
97SMC10CB02	CM1	Cc	Bk	0.28	0.22	0.03	22.84	15.31	0.08	0.04	0.70	0.03	0.05	4.36	0.81	2.32	0.41	0.20	295	486	54.51	232	47.70	10.62	44.40	7.41	46.10	9.01	29.50	4.20	24.30	4.28	7
97SMC10CB02	CM2	Cr	Bk	0.41	0.29	0.05	20.25	16.43	0.10	0.05	0.87	0.03	0.04	5.43	1.35	2.69	0.44	0.20	192	515	29.49	131	26.80	5.76	27.20	4.44	29.00	6.37	20.70	3.13	19.10	3.46	28
97SMC10CB04	CM1	Cr	Bk	0.21	0.18	0.08	16.33	12.73	0.09	0.04	0.69	0.03	0.05	2.65	0.64	11.66	4.20	0.40	306	762	51.65	212	41.30	8.93	39.50	6.32	40.20	8.12	26.50	3.85	22.10	3.98	70
97SMC10CB04	CM2		Ot	0.27	0.27	0.07	18.91	17.04	0.03	0.04	0.77	0.03	0.05	5.00	1.21	3.39	0.38	0.20	210	367	48.75	185	41.80	9.80	40.90	7.49	41.20	8.32	24.30	3.49	23.90	3.68	12
97SMC10CB04	CM3		In	0.44	0.30	0.08	23.45	16.26	0.11	0.05	1.00	0.04	0.05	3.40	0.74	2.12	0.37	0.10	293	599	52.81	218	46.30	9.75	42.60	7.38	43.90	9.29	29.00	4.13	25.30	4.22	20
97SMC10CB04	CM4		Im	0.19	0.16	0.09	16.73	12.22	0.10	0.05	0.75	0.04	0.06	1.89	0.41	13.81	4.99	0.50	310	1150	54.57	205	39.40	8.00	33.30	5.75	33.70	6.83	23.20	3.25	20.00	3.53	70
97SMC10CB04	CM5	Cr	Bk	0.26	0.28	0.06	22.94	17.99	0.05	0.05	0.88	0.04	0.05	3.79	0.74	2.24	0.40	0.10	258	412	55.75	212	44.90	11.05	46.30	8.54	49.40	9.91	29.80	4.32	28.20	4.37	32
97SMC10CB04	CM6		Ot	0.20	0.21	0.06	19.00	17.75	0.08	0.05	0.65	0.03	0.05	5.18	1.07	2.65	0.43	0.10	259	464	53.65	216	49.80	10.28	42.90	7.47	43.00	8.55	27.20	3.71	22.50	3.77	9
97SMC10CB04	CM7		In	0.33	0.23	0.06	23.85	17.70	0.10	0.06	0.92	0.04	0.06	2.93	0.52	2.14	0.40	0.10	310	566	57.56	236	49.30	10.61	46.10	8.18	48.60	9.95	32.40	4.43	26.80	4.47	23
97SMC10CB04	CM8	Cr	Bk	0.43	0.26	0.05	26.58	14.69	0.11	0.06	1.26	0.02	0.04	2.76	0.60	2.41	0.28	0.40	254	662	57.32	212	46.90	10.88	46.80	8.52	47.80	9.79	28.50	4.17	28.30	4.28	23

Appendix Table 3 (4) Results of chemical analysis for manganese crusts

Sampling location No.	Code	Crust Type	layer	Co (%)	Ni (%)	Cu (%)	Mn (%)	Fe (%)	Pb (%)	Zn (%)	Ti (%)	Mo (%)	V (%)	Si (%)	Al (%)	Ca (%)	P (%)	Pt (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Thick (mm)
97SMC10CB05	CM1	Cc	Bk	0.44	0.45	0.10	26.58	14.41	0.10	0.07	0.74	0.04	0.06	3.24	1.00	2.10	0.38	0.30	184	459	29.57	125	26.20	5.60	26.40	4.47	28.50	6.47	21.10	3.15	20.40	3.53	5
97SMC10CB05	CM2	Nd	Bk	0.27	0.39	0.07	20.07	17.18	0.04	0.07	1.60	0.03	0.06	5.28	1.66	2.05	0.33	0.30	176	389	35.78	138	29.70	7.07	31.30	5.67	32.30	6.91	20.40	3.00	20.20	3.13	12
97SMC10CB06	CM1	Cr	Bk	0.27	0.22	0.07	14.77	18.87	0.03	0.07	1.88	0.02	0.05	7.06	2.11	2.57	0.50	0.30	188	395	38.64	148	32.20	7.63	34.00	6.14	35.30	7.45	21.70	3.18	21.70	3.34	90
97SMC10CB06	CM2		Ot	0.51	0.39	0.07	22.89	15.99	0.12	0.06	1.00	0.04	0.05	3.83	1.01	2.56	0.70	0.40	238	625	40.27	162	34.50	7.41	32.40	5.72	34.60	7.21	25.00	3.55	21.70	3.94	25
97SMC10CB06	CM3		In	0.20	0.16	0.08	12.82	21.53	0.08	0.08	2.07	0.02	0.05	6.44	1.98	2.54	0.65	0.60	259	473	44.06	179	36.10	8.13	35.30	5.99	37.90	7.58	25.60	3.71	21.50	3.88	65
97SMC10CB07	CM1	Cc	Bk	0.23	0.19	0.05	17.82	17.10	0.12	0.07	1.38	0.02	0.06	4.25	1.17	4.89	1.47	0.20	220	431	44.48	169	35.40	8.76	36.80	6.72	39.40	7.96	23.70	3.41	22.20	3.42	140
97SMC10CB07	CM2		Ot	0.49	0.35	0.06	24.41	16.05	0.12	0.05	0.92	0.05	0.06	3.29	0.68	2.16	0.37	0.20	311	646	54.72	228	46.00	10.15	43.10	7.17	45.20	8.93	28.90	4.19	24.10	4.21	15
97SMC10CB07	CM3		In-1	0.19	0.15	0.07	13.40	21.22	0.04	0.10	2.48	0.02	0.05	6.23	1.81	2.09	0.36	0.10	196	486	42.65	162	34.10	8.27	33.90	6.42	36.90	7.12	20.30	2.97	19.10	2.87	35
97SMC10CB07	CM4		In-2	0.09	0.13	0.07	10.35	18.71	0.04	0.07	0.78	0.02	0.05	4.67	1.57	8.61	2.61	0.30	231	209	36.99	150	30.90	6.77	29.90	5.37	32.80	7.02	23.70	3.26	19.80	3.46	35
97SMC10CB07	CM5		Im-1	0.18	0.25	0.07	16.05	11.76	0.11	0.05	0.59	0.03	0.04	1.93	0.61	13.89	4.94	0.40	223	470	30.65	138	23.40	5.91	29.40	4.52	28.50	6.08	20.20	3.04	17.10	3.16	20
97SMC10CB07	CM6		Im-2	0.12	0.21	0.07	11.22	9.90	0.08	0.04	0.49	0.02	0.04	1.84	0.64	18.75	6.63	0.70	269	455	39.19	170	30.60	7.62	35.80	5.81	34.30	7.44	25.40	3.46	20.60	3.67	35
97SMC10CB07	CM7	Cr	Bk	0.42	0.43	0.07	25.44	15.33	0.07	0.06	0.95	0.04	0.05	3.61	0.91	2.11	0.36	0.30	199	422	41.17	162	34.30	8.17	36.20	6.42	38.00	7.92	23.50	3.54	23.40	3.65	12
97SMC10CB09	CM1	Nd	Bk	0.37	0.26	0.16	21.16	17.69	0.12	0.06	1.13	0.04	0.06	5.01	1.27	2.04	0.37	0.30	196	548	37.70	143	29.50	7.00	31.60	5.44	29.20	5.93	17.10	2.57	16.60	2.56	8
97SMC10CB11	CM1	Cr	Bk	0.33	0.28	0.05	21.98	14.98	0.07	0.04	0.85	0.03	0.05	3.79	0.89	4.33	0.38	0.30	219	407	50.67	196	42.80	9.92	43.00	7.76	40.70	8.42	24.40	3.48	22.80	3.51	8
97SMC10CB12	CM1	Nd	Bk	0.30	0.33	0.05	22.27	15.32	0.06	0.05	0.81	0.03	0.05	3.86	0.92	1.94	0.36	0.20	178	369	35.88	141	30.40	7.18	32.90	5.93	34.20	7.41	22.20	3.32	22.30	3.47	6
97SMC10CB14	CM1	Cr	Bk	0.57	0.35	0.04	26.46	16.22	0.15	0.05	0.79	0.05	0.05	2.11	0.41	2.25	0.47	0.30	233	537	43.19	168	34.50	8.47	38.30	6.78	38.10	7.93	24.00	3.60	23.00	3.71	12
97SMC10CB15	CM1	Cr	Bk	0.42	0.23	0.05	23.75	15.76	0.08	0.04	1.31	0.02	0.05	3.08	0.67	2.21	0.32	0.50	198	684	61.42	227	49.00	11.42	49.00	9.07	47.90	9.42	28.10	3.97	26.10	4.07	27
97SMC10CB15	CM2	Nd	Bk	0.26	0.28	0.08	23.07	14.86	0.06	0.05	0.90	0.03	0.05	4.22	1.19	2.09	0.31	0.20	221	457	43.40	169	35.10	8.29	37.50	6.64	36.00	7.34	21.60	3.17	20.50	3.24	9
97SMC10CB16	CM1	Cr	Bk	0.36	0.34	0.05	23.14	16.68	0.12	0.06	0.98	0.04	0.05	3.68	0.91	2.06	0.38	0.30	190	487	33.99	130	26.40	6.53	29.90	5.32	29.50	6.13	18.80	2.75	18.10	2.90	10
97SMC10CB19	CM1	Cr	Bk	0.31	0.44	0.08	26.13	15.75	0.09	0.06	0.84	0.05	0.06	3.21	0.74	2.17	0.37	0.20	212	366	43.09	164	34.90	8.52	37.10	6.76	39.40	8.11	24.70	3.57	23.80	3.71	25
97SMC10CB19	CM2	Nd	Bk	0.26	0.27	0.06	25.70	14.50	0.06	0.04	0.77	0.03	0.05	3.49	0.86	2.19	0.34	0.30	215	401	47.47	182	38.50	8.97	40.20	7.37	39.10	8.17	24.30	3.51	23.20	3.53	11
97SMC10CB19	CM3	Nd	Bk	0.34	0.30	0.08	25.68	15.33	0.09	0.05	0.73	0.04	0.06	3.60	0.86	2.16	0.38	0.20	217	375	42.03	159	34.20	8.01	36.60	6.65	35.60	7.56	22.60	3.32	21.80	3.44	6
97SMC10CB20	CM1	Cr	Bk	0.29	0.25	0.06	21.85	17.01	0.08	0.05	0.89	0.03	0.05	4.25	0.88	2.07	0.38	0.20	174	452	49.88	196	40.90	9.72	44.60	7.88	42.40	9.02	26.40	3.84	25.20	3.81	25
97SMC10CB20	CM2	Nd	Bk	0.32	0.35	0.06	23.78	15.92	0.09	0.05	0.74	0.04	0.05	4.19	0.89	2.19	0.39	0.20	191	379	48.49	187	39.80	9.31	41.50	7.55	40.70	8.39	24.70	3.59	23.50	3.66	15
97SMC10CB20	CM3	Nd	Bk	0.26	0.30	0.07	22.87	16.11	0.08	0.05	0.67	0.03	0.06	4.13	0.88	2.18	0.40	0.20	198	376	52.96	200	42.70	10.22	43.40	7.91	42.00	8.29	25.00	3.59	23.40	3.63	4

Legend Cr: Crust, Cc: Cobble crust, Nd: Nodule
Bk: Bulk (all), Ot: Outer, In: Inner, Im: Innermost, Sf: Upper surface, Rv: Reverse

Summary (average of bulk data)

Region	Co (%)	Ni (%)	Cu (%)	Mn (%)	Fe (%)	Pb (%)	Zn (%)	Ti (%)	Mo (%)	V (%)	Si (%)	Al (%)	Ca (%)	P (%)	Pt (ppm)	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)	Thick (mm)
MC02	0.35	0.33	0.08	19.67	17.44	0.02	0.07	1.26	0.02	0.06	5.69	1.82	2.02	0.37	0.50	185	500	36.11	133	28.63	7.02	32.08	5.26	30.65	6.51	19.25	2.83	18.73	3.00	35
MC03	0.48	0.36	0.05	24.21	15.95	0.05	0.07	0.87	0.03	0.06	3.10	0.82	2.74	0.44	0.33	220	529	46.10	172	37.33	9.27	41.45	6.99	40.93	8.73	26.06	3.82	25.16	3.95	9
MC04	0.47	0.32	0.03	27.13	14.46	0.07	0.05	0.76	0.04	0.06	2.56	0.64	2.40	0.39	0.23	190	461	42.00	165	34.69	8.57	38.26	6.63	39.16	8.18	25.06	3.77	24.00	3.87	6
MC06	0.47	0.36	0.04	24.88	16.25	0.06	0.06	0.83	0.04	0.06	3.27	0.81	2.28	0.43	0.28	186	462	40.88	159	33.25	8.26	38.05	6.43	37.81	7.96	24.08	3.60	23.36	3.75	6
MC07	0.48	0.31	0.04	26.15	15.16	0.07	0.06	0.97	0.03	0.06	3.19	0.69	2.30	0.37	0.19	197	473	47.07	181	38.81	9.40	41.73	7.32	42.87	8.83	26.84	3.96	25.60	4.02	6
MC08	0.36	0.32	0.09	23.67	15.96	0.07	0.06	1.02	0.04	0.06	3.32	0.87	3.17	0.75	0.37	212	616	47.67	181	37.80	8.86	39.43	6.44	38.48	7.78	22.71	3.43	20.85	3.38	26
MC09	0.49	0.30	0.05	25.57	15.62	0.08	0.05	0.89	0.04	0.05	2.99	0.61	2.15	0.36	0.14	238	519	49.23	201	42.31	9.65	42.44	6.99	44.03	9.07	26.56	4.09	24.13	3.96	9
MC10	0.33	0.30	0.07	22.67	15.92	0.08	0.05	0.97	0.03	0.05	3.96	0.97	2.82	0.59	0.27	214	468	44.72	174	36.70	8.61	38.02	6.77	38.30	7.91	23.88	3.49	22.62	3.59	25
Total	0.41	0.32	0.06	24.12	15.83	0.07	0.06	0.95	0.04	0.06	3.40	0.85	2.69	0.54	0.29	212	527	45.79	177	37.37	8.89	39.57	6.69	39.56	8.18	24.34	3.64	22.88	3.67	17

Appendix Table 4 (1) Summary results of chemical analysis for manganese crusts

Region	Classification		No. of sample	Co (%)			Ni (%)			Cu (%)			Mn (%)			Fe (%)			Mn/Fe			Thick (mm)	
				Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
MC02	Crust layer	Bulk	4	0.48	0.20	0.35	0.40	0.26	0.33	0.13	0.04	0.08	21.65	16.35	19.67	18.35	16.82	17.44	1.24	0.96	1.13	50	35
		Outer	2	0.66	0.58	0.62	0.40	0.38	0.39	0.03	0.03	0.03	28.22	25.41	26.82	15.93	13.91	14.92	1.83	1.77	1.80	15	10
		Inner	2	0.28	0.26	0.27	0.34	0.30	0.32	0.06	0.05	0.06	17.18	16.59	16.89	19.68	19.12	19.40	0.87	0.87	0.87	35	29
		Innermost	0																				
	Water depth	1,000-1,500m	1	0.41	0.41	0.41	0.40	0.40	0.40	0.13	0.13	0.13	19.85	19.85	19.85	17.59	17.59	17.59	1.13	1.13	1.13	25	22
		1,500-2,000m	7	0.66	0.20	0.39	0.40	0.26	0.33	0.07	0.03	0.05	28.22	16.35	20.89	19.68	13.91	17.26	1.83	0.87	1.25	50	28
		2,000m <	0																				
MC03	Crust layer	Bulk	13	0.85	0.24	0.46	0.49	0.21	0.35	0.14	0.02	0.06	28.05	18.12	23.84	17.87	14.10	16.32	1.99	1.12	1.48	47	11
		Outer	1	0.49	0.49	0.49	0.31	0.31	0.31	0.06	0.06	0.06	23.93	23.93	23.93	16.82	16.82	16.82	1.42	1.42	1.42	15	10
		Inner	1	0.39	0.39	0.39	0.35	0.35	0.35	0.06	0.06	0.06	19.90	19.90	19.90	17.84	17.84	17.84	1.12	1.12	1.12	35	25
		Innermost	0																				
	Cobble layer	Bulk	3	0.64	0.50	0.56	0.39	0.35	0.37	0.03	0.02	0.03	28.60	21.80	25.82	15.23	12.57	14.33	1.88	1.73	1.80	10	2
		Layer divided	0																				
	All sample layer	Bulk	16	0.85	0.24	0.48	0.49	0.21	0.36	0.14	0.02	0.05	28.60	18.12	24.21	17.87	12.57	15.95	1.99	1.12	1.54	47	9
		Outer	1	0.49	0.49	0.49	0.31	0.31	0.31	0.06	0.06	0.06	23.93	23.93	23.93	16.82	16.82	16.82	1.42	1.42	1.42	15	10
		Inner	1	0.39	0.39	0.39	0.35	0.35	0.35	0.06	0.06	0.06	19.90	19.90	19.90	17.84	17.84	17.84	1.12	1.12	1.12	35	25
		Innermost	0																				
	Water depth	1,000-1,500m	5	0.64	0.41	0.54	0.39	0.28	0.34	0.03	0.02	0.03	28.60	21.80	26.43	15.23	12.57	14.26	1.99	1.73	1.85	10	3
		1,500-2,000m	6	0.85	0.39	0.54	0.49	0.31	0.40	0.14	0.06	0.09	26.71	18.12	21.79	17.84	15.68	16.63	1.70	1.12	1.32	47	16
		2,000-2,500m	6	0.47	0.24	0.37	0.41	0.21	0.33	0.07	0.03	0.05	25.56	22.08	23.45	17.87	15.56	17.00	1.63	1.24	1.38	25	11
		2,500-3,000m	1	0.48	0.48	0.48	0.34	0.34	0.34	0.05	0.05	0.05	22.23	22.23	22.23	17.87	17.87	17.87	1.24	1.24	1.24	15	12
		3,000m <	0																				
MC04	Crust layer	Bulk	3	0.52	0.31	0.41	0.32	0.22	0.26	0.04	0.02	0.03	30.48	22.85	26.17	16.54	12.75	15.05	2.39	1.38	1.79	20	10
		Layer divided	0																				
	Cobble layer	Bulk	4	0.64	0.36	0.51	0.46	0.28	0.37	0.05	0.02	0.04	29.62	26.11	27.85	15.22	12.18	14.02	2.43	1.80	2.01	8	3
		Layer divided	0																				
	All sample layer	Bulk	7	0.64	0.31	0.47	0.46	0.22	0.32	0.05	0.02	0.03	30.48	22.85	27.13	16.54	12.18	14.46	2.43	1.38	1.91	20	6
		Outer	0																				
		Inner	0																				
		Innermost	0																				
	Water depth	1,000-1,500m	0																				
		1,500-2,000m	10	0.61	0.35	0.46	0.60	0.21	0.38	0.07	0.03	0.04	29.07	16.66	25.55	20.96	14.34	15.98	2.00	0.79	1.64	20	5
		2,000m <	0																				

Appendix Table 4 (2) Summary results of chemical analysis for manganese crusts

Region	Classification		No. of sample	Co (%)			Ni (%)			Cu (%)			Mn (%)			Fe (%)			Mn/Fe			Thick (mm)	
				Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
MC06	Crust layer	Bulk	3	0.61	0.43	0.50	0.33	0.27	0.31	0.07	0.04	0.05	24.93	16.66	21.85	20.96	15.46	17.58	1.61	0.79	1.29	20	5
		Layer divided	0																				
	Cobble crust layer	Bulk	3	0.55	0.35	0.44	0.39	0.21	0.30	0.04	0.03	0.04	25.99	24.66	25.30	17.24	15.38	16.11	1.69	1.46	1.57	12	4
		Upper-Bulk	1	0.46	0.46	0.46	0.48	0.48	0.48	0.04	0.04	0.04	27.82	27.82	27.82	15.37	15.37	15.37	1.81	1.81	1.81	7	4
		Reverse-Bulk	1	0.39	0.39	0.39	0.39	0.39	0.39	0.04	0.04	0.04	28.63	28.63	28.63	14.47	14.47	14.47	1.98	1.98	1.98	6	3
		Layer divided	0																				
	Nodule layer	Bulk	2	0.54	0.44	0.49	0.60	0.44	0.52	0.04	0.03	0.04	29.07	28.52	28.80	14.55	14.34	14.45	2.00	1.99	1.99	7	5
		Layer divided	0																				
	All sample layer	Bulk	8	0.61	0.35	0.47	0.60	0.21	0.36	0.07	0.03	0.04	29.07	16.66	24.88	20.96	14.34	16.25	2.00	0.79	1.57	20	6
		Upper-Bulk	1	0.46	0.46	0.46	0.48	0.48	0.48	0.04	0.04	0.04	27.82	27.82	27.82	15.37	15.37	15.37	1.81	1.81	1.81	7	4
		Reverse-Bulk	1	0.39	0.39	0.39	0.39	0.39	0.39	0.04	0.04	0.04	28.63	28.63	28.63	14.47	14.47	14.47	1.98	1.98	1.98	6	3
		Outer	0																				
		Inner	0																				
		Innermost	0																				
	Water depth	1,000-1,500m	0																				
		1,500-2,000m	2	0.51	0.51	0.51	0.43	0.28	0.36	0.05	0.04	0.05	27.58	26.16	26.87	15.65	15.33	15.49	1.76	1.71	1.73	12	6
		2,000-2,500m	1	0.57	0.57	0.57	0.28	0.28	0.28	0.04	0.04	0.04	27.37	27.37	27.37	14.52	14.52	14.52	1.88	1.88	1.88	11	9
		2,500-3,000m	4	0.74	0.25	0.44	0.41	0.23	0.30	0.04	0.03	0.03	32.99	21.38	25.48	17.20	11.07	15.15	2.98	1.27	1.79	14	6
		3,000m <	0																				
MC07	Crust layer	Bulk	6	0.74	0.25	0.47	0.41	0.23	0.29	0.04	0.03	0.04	32.99	21.38	26.15	17.20	11.07	15.13	2.98	1.27	1.80	14	7
		Layer divided	0																				
	Nodule layer	Bulk	1	0.51	0.51	0.51	0.43	0.43	0.43	0.05	0.05	0.05	26.16	26.16	26.16	15.33	15.33	15.33	1.71	1.71	1.71	7	3
		Layer divided	0																				
	All sample layer	Bulk	7	0.74	0.25	0.48	0.43	0.23	0.31	0.05	0.03	0.04	32.99	21.38	26.15	17.20	11.07	15.16	2.98	1.27	1.79	14	6
		Outer	0																				
		Inner	0																				
		Innermost	0																				
	Water depth	1,000-1,500m	0																				
		1,500-2,000m	2	0.51	0.51	0.51	0.43	0.28	0.36	0.05	0.04	0.05	27.58	26.16	26.87	15.65	15.33	15.49	1.76	1.71	1.73	12	6
		2,000-2,500m	1	0.57	0.57	0.57	0.28	0.28	0.28	0.04	0.04	0.04	27.37	27.37	27.37	14.52	14.52	14.52	1.88	1.88	1.88	11	9
		2,500-3,000m	4	0.74	0.25	0.44	0.41	0.23	0.30	0.04	0.03	0.03	32.99	21.38	25.48	17.20	11.07	15.15	2.98	1.27	1.79	14	6
		3,000m <	0																				

Appendix Table 4 (3) Summary results of chemical analysis for manganese crusts

Region	Classification		No. of sample	Co (%)			Ni (%)			Cu (%)			Mn (%)			Fe (%)			Mn/Fe			Thick (mm)	
				Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
MC08	Crust layer	Bulk	14	0.71	0.16	0.42	0.43	0.20	0.32	0.18	0.05	0.08	30.26	20.36	24.99	18.58	13.03	15.81	2.32	1.14	1.61	70	23
		Outer	2	0.42	0.28	0.35	0.37	0.34	0.36	0.10	0.07	0.09	25.44	23.14	24.29	16.53	16.45	16.49	1.54	1.41	1.47	25	17
		Inner	2	0.30	0.25	0.28	0.36	0.28	0.32	0.12	0.11	0.12	22.58	19.96	21.27	20.06	18.98	19.52	1.13	1.05	1.09	45	22
		Innermost	0																				
	Cobble crust layer	Bulk	12	0.51	0.16	0.29	0.42	0.22	0.31	0.15	0.04	0.10	26.51	15.61	21.97	20.88	12.92	16.17	1.76	0.83	1.38	90	31
		Upper-Bulk	1	0.33	0.33	0.33	0.37	0.37	0.37	0.09	0.09	0.09	21.01	21.01	21.01	16.94	16.94	16.94	1.24	1.24	1.24	40	35
		Reverse-Bulk	1	0.33	0.33	0.33	0.34	0.34	0.34	0.09	0.09	0.09	21.57	21.57	21.57	17.05	17.05	17.05	1.27	1.27	1.27	40	35
		Outer	4	0.80	0.27	0.50	0.42	0.29	0.35	0.11	0.03	0.06	27.94	22.46	25.72	17.40	13.62	15.62	2.03	1.29	1.68	28	17
		Outer-Upper	1	0.41	0.41	0.41	0.30	0.30	0.30	0.05	0.05	0.05	23.97	23.97	23.97	17.06	17.06	17.06	1.41	1.41	1.41	32	30
		Inner	4	0.44	0.09	0.31	0.48	0.13	0.34	0.14	0.07	0.09	28.36	12.64	22.16	18.94	12.96	16.58	1.67	0.98	1.32	35	20
		Inner-Upper	1	0.25	0.25	0.25	0.25	0.25	0.25	0.10	0.10	0.10	23.17	23.17	23.17	19.45	19.45	19.45	1.19	1.19	1.19	17	15
		Inner-Reverse	1	0.26	0.26	0.26	0.27	0.27	0.27	0.13	0.13	0.13	19.25	19.25	19.25	12.89	12.89	12.89	1.49	1.49	1.49	15	13
		Innermost	3	0.27	0.13	0.21	0.42	0.24	0.33	0.10	0.05	0.08	23.17	15.94	20.05	17.84	10.47	13.83	2.01	1.21	1.51	45	24
		Innermost-Upper	1	0.14	0.14	0.14	0.29	0.29	0.29	0.11	0.11	0.11	27.89	27.89	27.89	16.11	16.11	16.11	1.73	1.73	1.73	25	20
		Innermost-Reverse	1	0.17	0.17	0.17	0.28	0.28	0.28	0.15	0.15	0.15	17.10	17.10	17.10	14.70	14.70	14.70	1.16	1.16	1.16	45	40
	Nodule layer	Bulk	6	0.42	0.22	0.34	0.45	0.21	0.35	0.14	0.07	0.11	25.01	21.84	23.98	17.50	14.48	15.88	1.73	1.29	1.52	35	19
		Upper-Bulk	1	0.40	0.40	0.40	0.37	0.37	0.37	0.07	0.07	0.07	22.77	22.77	22.77	17.21	17.21	17.21	1.32	1.32	1.32	35	30
		Reverse-Bulk	1	0.42	0.42	0.42	0.34	0.34	0.34	0.06	0.06	0.06	23.69	23.69	23.69	16.87	16.87	16.87	1.40	1.40	1.40	30	28
		Layer divided	0																				
	All sample layer	Bulk	32	0.71	0.16	0.36	0.45	0.20	0.32	0.18	0.04	0.09	30.26	15.61	23.67	20.88	12.92	15.96	2.32	0.83	1.51	90	26
		Upper-Bulk	2	0.40	0.33	0.37	0.37	0.37	0.37	0.09	0.07	0.08	22.77	21.01	21.89	17.21	16.94	17.08	1.32	1.24	1.28	40	33
		Reverse-Bulk	2	0.42	0.33	0.38	0.34	0.34	0.34	0.09	0.06	0.08	23.69	21.57	22.63	17.05	16.87	16.96	1.40	1.27	1.33	40	32
		Outer	6	0.80	0.27	0.45	0.42	0.29	0.35	0.11	0.03	0.07	27.94	22.46	25.25	17.40	13.62	15.91	2.03	1.29	1.61	28	17
		Outer-Upper	1	0.41	0.41	0.41	0.30	0.30	0.30	0.05	0.05	0.05	23.97	23.97	23.97	17.06	17.06	17.06	1.41	1.41	1.41	32	30
		Inner	6	0.44	0.09	0.30	0.48	0.13	0.33	0.14	0.07	0.10	28.36	12.64	21.86	20.06	12.96	17.56	1.67	0.98	1.24	45	21
		Inner-Upper	1	0.25	0.25	0.25	0.25	0.25	0.25	0.10	0.10	0.10	23.17	23.17	23.17	19.45	19.45	19.45	1.19	1.19	1.19	17	15
		Inner-Reverse	1	0.26	0.26	0.26	0.27	0.27	0.27	0.13	0.13	0.13	19.25	19.25	19.25	12.89	12.89	12.89	1.49	1.49	1.49	15	13
		Innermost	3	0.27	0.13	0.21	0.42	0.24	0.33	0.10	0.05	0.08	23.17	15.94	20.05	17.84	10.47	13.83	2.01	1.21	1.51	45	24
		Innermost-Upper	1	0.14	0.14	0.14	0.29	0.29	0.29	0.11	0.11	0.11	27.89	27.89	27.89	16.11	16.11	16.11	1.73	1.73	1.73	25	20
		Innermost-Reverse	1	0.17	0.17	0.17	0.28	0.28	0.28	0.15	0.15	0.15	17.10	17.10	17.10	14.70	14.70	14.70	1.16	1.16	1.16	45	40
	Water depth	1,000-1,500m	0																				
		1,500-2,000m	14	0.80	0.23	0.42	0.48	0.31	0.38	0.12	0.03	0.07	28.36	21.05	24.46	18.94	10.47	15.92	2.03	1.23	1.57	90	26
		2,000-2,500m	19	0.59	0.13	0.35	0.43	0.20	0.32	0.14	0.05	0.09	30.26	15.61	23.02	20.06	12.92	15.89	2.32	1.13	1.47	83	30
		2,500-3,000m	17	0.51	0.09	0.27	0.39	0.13	0.29	0.15	0.04	0.10	27.89	12.64	22.21	19.45	12.89	16.37	1.76	0.98	1.36	70	22
		3,000-3,500m	3	0.37	0.21	0.27	0.27	0.22	0.24	0.14	0.06	0.11	26.51	17.40	22.47	20.88	15.59	18.03	1.70	0.83	1.29	13	5
		3,500m <	3	0.71	0.16	0.46	0.41	0.31	0.36	0.18	0.05	0.10	29.51	20.36	25.29	16.31	13.61	14.72	2.17	1.43	1.73	23	13

Appendix Table 4 (4) Summary results of chemical analysis for manganese crusts

Region	Classification		No. of sample	Co (%)			Ni (%)			Cu (%)			Mn (%)			Fe (%)			Mn/Fe			Thick (mm)	
				Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
MC09	Crust layer	Bulk	10	0.93	0.30	0.56	0.38	0.19	0.31	0.06	0.02	0.04	32.27	23.37	26.56	17.14	12.47	15.26	2.59	1.36	1.78	23	9
		Layer divided	0																				
	Cobble crust layer	Bulk	6	0.49	0.31	0.39	0.34	0.21	0.28	0.05	0.04	0.05	27.65	22.68	23.93	16.65	15.12	16.22	1.83	1.38	1.48	13	8
		Upper-Bulk	3	0.43	0.30	0.37	0.41	0.20	0.28	0.05	0.04	0.05	26.35	23.19	24.55	17.12	15.39	16.50	1.71	1.35	1.50	13	8
		Reverse-Bulk	3	0.66	0.25	0.50	0.39	0.13	0.28	0.06	0.03	0.05	27.06	23.75	25.23	15.87	12.71	14.03	2.00	1.57	1.81	13	7
		Layer divided	0																				
	All sample layer	Bulk	16	0.93	0.30	0.49	0.38	0.19	0.30	0.06	0.02	0.05	32.27	22.68	25.57	17.14	12.47	15.62	2.59	1.36	1.67	23	9
		Upper-Bulk	3	0.43	0.30	0.37	0.41	0.20	0.28	0.05	0.04	0.05	26.35	23.19	24.55	17.12	15.39	16.50	1.71	1.35	1.50	13	8
		Reverse-Bulk	3	0.66	0.25	0.50	0.39	0.13	0.28	0.06	0.03	0.05	27.06	23.75	25.23	15.87	12.71	14.03	2.00	1.57	1.81	13	7
		Outer	0																				
		Inner	0																				
		Innermost	0																				
	Water depth	1,000-1,500m	2	0.93	0.89	0.91	0.38	0.37	0.38	0.03	0.02	0.03	32.27	31.96	32.12	12.79	12.47	12.63	2.59	2.50	2.54	12	8
		1,500-2,000m	0																				
		2,000-2,500m	3	0.52	0.44	0.48	0.34	0.27	0.31	0.04	0.02	0.03	26.65	25.77	26.21	15.89	14.64	15.27	1.82	1.62	1.72	12	8
		2,500-3,000m	11	0.66	0.25	0.41	0.41	0.13	0.28	0.06	0.03	0.05	27.65	22.68	24.47	17.12	12.71	15.60	2.00	1.35	1.59	15	8
		3,000-3,500m	6	0.63	0.30	0.45	0.37	0.20	0.28	0.06	0.04	0.05	27.31	23.37	24.79	17.14	14.65	16.29	1.86	1.36	1.53	23	9
		3,500m <	0																				
MC10	Crust layer	Bulk	14	0.57	0.20	0.34	0.44	0.18	0.29	0.08	0.04	0.06	26.58	14.77	22.32	18.87	12.73	16.28	1.81	0.78	1.39	120	28
		Outer	2	0.51	0.27	0.39	0.39	0.27	0.33	0.07	0.07	0.07	22.89	18.91	20.90	17.04	15.99	16.52	1.43	1.11	1.27	30	19
		Inner	2	0.44	0.20	0.32	0.30	0.16	0.23	0.08	0.08	0.08	23.45	12.82	18.14	21.53	16.26	18.90	1.44	0.60	1.02	75	43
		Innermost	1	0.19	0.19	0.19	0.16	0.16	0.16	0.09	0.09	0.09	16.73	16.73	16.73	12.22	12.22	12.22	1.37	1.37	1.37	90	70
	Cobble crust layer	Bulk	3	0.44	0.23	0.34	0.45	0.19	0.32	0.10	0.05	0.08	26.58	17.82	22.20	17.10	14.41	15.76	1.84	1.04	1.44	155	51
		Outer	1	0.49	0.49	0.49	0.35	0.35	0.35	0.06	0.06	0.06	24.41	24.41	24.41	16.05	16.05	16.05	1.52	1.52	1.52	20	15
		Inner	2	0.19	0.09	0.14	0.15	0.13	0.14	0.07	0.07	0.07	13.40	10.35	11.88	21.22	18.71	19.97	0.63	0.55	0.59	50	35
		Innermost	2	0.18	0.12	0.15	0.25	0.21	0.23	0.07	0.07	0.07	16.05	11.22	13.64	11.76	9.90	10.83	1.36	1.13	1.25	45	28
	Nodule layer	Bulk	8	0.37	0.26	0.30	0.39	0.26	0.31	0.16	0.05	0.08	25.70	20.07	23.08	17.69	14.50	15.86	1.77	1.17	1.47	20	9
		Layer divided	0																				
	All sample layer	Bulk	25	0.57	0.20	0.33	0.45	0.18	0.29	0.16	0.03	0.07	26.58	14.77	22.57	18.87	12.73	16.06	1.84	0.78	1.42	155	25
		Outer	3	0.51	0.27	0.42	0.39	0.27	0.34	0.07	0.06	0.07	24.41	18.91	22.07	17.04	15.99	16.36	1.52	1.11	1.35	30	17
		Inner	4	0.44	0.09	0.23	0.30	0.13	0.19	0.08	0.07	0.08	23.45	10.35	15.01	21.53	16.26	19.43	1.44	0.55	0.81	75	39
		Innermost	3	0.19	0.12	0.16	0.25	0.16	0.21	0.09	0.07	0.08	16.73	11.22	14.67	12.22	9.90	11.29	1.37	1.13	1.29	90	42
	Water depth	1,000-1,500m	0																				
		1,500-2,000m	4	0.57	0.27	0.41	0.45	0.34	0.38	0.10	0.04	0.07	26.58	20.07	24.06	17.18	14.41	16.12	1.84	1.17	1.51	15	10
		2,000-2,500m	20	0.51	0.09	0.29	0.44	0.13	0.28	0.08	0.03	0.06	26.13	10.35	20.13	21.53	9.90	16.16	1.77	0.55	1.28	155	30
		2,500-3,000m	11	0.44	0.19	0.31	0.30	0.16	0.24	0.16	0.05	0.08	26.58	16.33	21.43	17.99	12.22	15.88	1.81	1.07	1.36	120	28
		3,000m <	0																				

Appendix Table 4 (5) Summary results of chemical analysis for manganese crusts

Region	Classification		No. of sample	Co (%)			Ni (%)			Cu (%)			Mn (%)			Fe (%)			Mn/Fe			Thick (mm)	
				Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
All	Crust layer	Bulk	67	0.93	0.16	0.44	0.49	0.18	0.31	0.18	0.02	0.06	32.99	14.77	24.14	20.96	11.07	16.01	2.98	0.78	1.55	120	18
		Outer	7	0.66	0.27	0.46	0.40	0.27	0.35	0.10	0.03	0.06	28.22	18.91	23.99	17.04	13.91	16.10	1.83	1.11	1.50	30	14
		Inner	7	0.44	0.20	0.30	0.36	0.16	0.30	0.12	0.05	0.08	23.45	12.82	18.93	21.53	16.26	19.07	1.44	0.60	1.01	75	30
		Innermost	1	0.19	0.19	0.19	0.16	0.16	0.16	0.09	0.09	0.09	16.73	16.73	16.73	12.22	12.22	12.22	1.37	1.37	1.37	90	70
	Cobble crust layer	Bulk	31	0.49	0.23	0.36	0.45	0.19	0.28	0.10	0.03	0.05	27.65	17.82	23.57	17.10	14.41	15.92	1.84	1.04	1.49	155	19
		Upper-Bulk	5	0.46	0.30	0.38	0.48	0.20	0.34	0.09	0.04	0.05	27.82	21.01	24.49	17.12	15.37	16.36	1.81	1.24	1.51	40	13
		Reverse-Bulk	5	0.66	0.25	0.44	0.39	0.13	0.32	0.09	0.03	0.05	28.63	21.57	25.18	17.05	12.71	14.72	2.00	1.27	1.74	40	12
		Outer	5	0.80	0.23	0.44	0.45	0.19	0.32	0.11	0.03	0.06	27.94	17.82	24.10	17.40	13.62	15.93	2.03	1.04	1.54	28	17
		Outer-Upper	1	0.41	0.41	0.41	0.30	0.30	0.30	0.05	0.05	0.05	23.97	23.97	23.97	17.06	17.06	17.06	1.41	1.41	1.41	32	30
		Inner	6	0.44	0.09	0.26	0.48	0.13	0.27	0.14	0.07	0.09	28.36	10.35	18.73	21.22	12.96	17.71	1.67	0.55	1.08	50	25
		Inner-Upper	1	0.25	0.25	0.25	0.25	0.25	0.25	0.10	0.10	0.10	23.17	23.17	23.17	19.45	19.45	19.45	1.19	1.19	1.19	17	15
		Inner-Reverse	1	0.26	0.26	0.26	0.27	0.27	0.27	0.13	0.13	0.13	19.25	19.25	19.25	12.89	12.89	12.89	1.49	1.49	1.49	15	13
		Innermost	5	0.27	0.12	0.18	0.42	0.21	0.29	0.15	0.05	0.09	23.17	11.22	17.42	17.54	9.90	12.98	2.01	1.13	1.36	45	25
		Innermost-Upper	1	0.14	0.14	0.14	0.29	0.29	0.29	0.11	0.11	0.11	27.89	27.89	27.89	16.11	16.11	16.11	1.73	1.73	1.73	25	20
		Innermost-Reverse	1	0.17	0.17	0.17	0.28	0.28	0.28	0.15	0.15	0.15	17.10	17.10	17.10	14.70	14.70	14.70	1.16	1.16	1.16	45	40
	Nodule layer	Bulk	17	0.54	0.22	0.35	0.60	0.21	0.36	0.16	0.03	0.08	29.07	20.07	24.25	17.69	14.34	15.67	2.00	1.17	1.56	35	12
		Upper-Bulk	1	0.40	0.40	0.40	0.37	0.37	0.37	0.07	0.07	0.07	22.77	22.77	22.77	17.21	17.21	17.21	1.32	1.32	1.32	35	30
		Reverse-Bulk	1	0.42	0.42	0.42	0.34	0.34	0.34	0.06	0.06	0.06	23.69	23.69	23.69	16.87	16.87	16.87	1.40	1.40	1.40	30	28
		Outer	0																				
		Inner	0																				
		Innermost	0																				
	All sample layer	Bulk	115	0.93	0.16	0.41	0.60	0.18	0.32	0.18	0.02	0.06	32.99	14.77	24.08	20.96	11.07	15.86	2.98	0.78	1.55	155	17
		Upper-Bulk	6	0.46	0.30	0.38	0.48	0.20	0.35	0.09	0.04	0.06	27.82	21.01	24.21	17.21	15.37	16.50	1.81	1.24	1.48	40	16
		Reverse-Bulk	6	0.66	0.25	0.44	0.39	0.13	0.32	0.09	0.03	0.06	28.63	21.57	24.93	17.05	12.71	15.08	2.00	1.27	1.68	40	14
		Outer	12	0.80	0.27	0.48	0.42	0.27	0.35	0.11	0.03	0.06	28.22	18.91	24.60	17.40	13.62	15.93	2.03	1.11	1.56	30	15
		Outer-Upper	1	0.41	0.41	0.41	0.30	0.30	0.30	0.05	0.05	0.05	23.97	23.97	23.97	17.06	17.06	17.06	1.41	1.41	1.41	32	30
		Inner	13	0.44	0.09	0.28	0.48	0.13	0.29	0.14	0.05	0.08	28.36	10.35	18.84	21.53	12.96	18.44	1.67	0.55	1.04	75	28
		Inner-Upper	1	0.25	0.25	0.25	0.25	0.25	0.25	0.10	0.10	0.10	23.17	23.17	23.17	19.45	19.45	19.45	1.19	1.19	1.19	17	15
		Inner-Reverse	1	0.26	0.26	0.26	0.27	0.27	0.27	0.13	0.13	0.13	19.25	19.25	19.25	12.89	12.89	12.89	1.49	1.49	1.49	15	13
		Innermost	6	0.27	0.12	0.19	0.42	0.16	0.27	0.10	0.05	0.08	23.17	11.22	17.36	17.84	9.90	12.56	2.01	1.13	1.40	90	33
		Innermost-Upper	1	0.14	0.14	0.14	0.29	0.29	0.29	0.11	0.11	0.11	27.89	27.89	27.89	16.11	16.11	16.11	1.73	1.73	1.73	25	20
		Innermost-Reverse	1	0.17	0.17	0.17	0.28	0.28	0.28	0.15	0.15	0.15	17.10	17.10	17.10	14.70	14.70	14.70	1.16	1.16	1.16	45	40
	Water depth	1,000-1,500m	11	0.93	0.36	0.59	0.46	0.28	0.36	0.13	0.02	0.04	32.27	19.85	27.41	17.59	12.18	14.16	2.59	1.13	1.97	25	6
		1,500-2,000m	45	0.85	0.20	0.44	0.60	0.21	0.37	0.14	0.02	0.06	30.48	16.35	24.15	20.96	10.47	16.11	2.39	0.79	1.53	90	17
		2,000-2,500m	50	0.59	0.09	0.34	0.44	0.13	0.30	0.14	0.02	0.07	30.26	10.35	22.20	21.53	9.90	16.06	2.32	0.55	1.41	155	25
		2,500-3,000m	45	0.74	0.09	0.34	0.41	0.13	0.28	0.16	0.03	0.07	32.99	12.64	22.86	19.45	11.07	16.02	2.98	0.98	1.45	120	18
		3,000-3,500m	9	0.63	0.21	0.39	0.37	0.20	0.27	0.14	0.04	0.07	27.31	17.40	24.01	20.88	14.65	16.87	1.86	0.83	1.45	23	8
		3,500m <	3	0.71	0.16	0.46	0.41	0.31	0.36	0.18	0.05	0.10	29.51	20.36	25.29	16.31	13.61	14.72	2.17	1.43	1.73	23	13

Appendix Table 5 (1) Sample list of analysis and observations

Region	Sampling site No.	Sample	Manganese crust			Rock					Sediment	Core depth
			CM	P	B	CA	T	X	K	F	F	(cm)
MC02	97SMC02LC01	Ooze									F1	85-90
		Ooze									F2	140-145
		Ooze									F3	180-185
		Ooze									F4	210-215
	97SMC02CB03	Basalt				CA1	T1	X1	K1			
		Basalt				CA2	T2	X2				
		Mudstone					T3	X3				
	97SMC02CB04	Crust	CM1~3									
		Crust	CM4~6									
		Limestone								F1		
		Limestone								F2		
		Limestone								F3		
	97SMC02LC05	Crust	CM1									
	97SMC02LC06	Crust	CM1									
		Limestone								F1		
	97SMC02LC07	Sand									F1	-
MC03	97SMC03LC01	Ooze									F1	50-55
		Ooze									F2	115-120
		Ooze									F3	150-155
		Ooze									F4	205-210
		Ooze									F5	255-260
	97SMC03AD02	Crust	CM1									
		Crust	CM2									
	97SMC03AD05	Crust	CM1									
		Crust	CM2									
		Sandstone								F1		
		Coral								F2		
		Limestone					T1			F3		
	97SMC03CB06	Crust	CM1									
		Crust	CM2									
		Coral								F1		
		Limestone								F2		
	97SMC03CB07	Crust	CM1									
		Basalt					T1					
	97SMC03CB08	Crust	CM1									
	97SMC03CB09	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
		Basalt				CA1	T1	X1				
		Hyaloclastite					T2					
	97SMC03CB10	Crust	CM1									
		Basalt				CA1	T1	X1	K1			
		Basalt					T2	X2				
	97SMC03CB11	Crust	CM1~3									
		Crust	CM4									
		Sandstone								F1		
	97SMC03CB12	Crust	CM1									
	97SMC03CB13	Crust	CM1									
	97SMC03LC14	Sandstone								F1		
MC04	97SMC04LC01	Ooze									F1	55-60
		Ooze									F2	100-105
		Ooze									F3	150-155
	97SMC04CB04	Limestone								F1		
	97SMC04CB05	Coral								F1		
	97SMC04CB07	Basalt					T1					
	97SMC04CB08	Basalt				CA1	T1	X1	K1			
	97SMC04CB10	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
		Limestone								F1		

Appendix Table 5 (2) Sample list of analysis and observations

Region	Sampling site No.	Sample	Manganese crust			Rock					Sediment	Core depth (cm)
			CM	P	B	CA	T	X	K	F	F	
MC04	97SMC04CB10	Coral								F2		
	97SMC04CB11	Crust	CM1									
		Mudstone					T1	X1		F1		
	97SMC04CB13	Crust	CM1									
		Crust	CM2									
	97SMC04CB15	Limestone								F1		
	97SMC04CB16	Limestone					T1					
	97SMC04CB17	Crust	CM1									
	97SMC04CB18	Basalt				CA1	T1	X1	K1			
		Basalt					T2	X2				
		Hyaloclastite				CA2	T3	X3				
		Hyaloclastite					T4	X4				
	97SMC04CB19	Limestone								F1		
	97SMC04LC20	Sand									F1	85-90
		Sand									F2	145-150
MC05	97SMC05LC01	Ooze									F1	73-78
		Ooze									F2	152-157
		Ooze									F3	200-205
		Sand									F4	233-238
		Ooze									F5	243-248
		Ooze									F6	275-280
	97SMC05CB02	Basalt				CA1	T1	X1	K1			
		Basalt					T2					
	97SMC05CB03	Basalt				CA1	T1	X1				
		Hyaloclastite					T2	X2				
		Sandstone					T3					
	97SMC05CB04	Limestone								F1		
		Limestone								F2		
		Limestone					T1					
	97SMC05CB05	Conglomerate					T1					
	97SMC05CB07	Limestone								F1		
		Limestone								F2		
MC06	97SMC06CB02	Basalt					T1	X1				
		Hyaloclastite					T2	X2				
	97SMC06CB04	Crust	CM1									
		Limestone								F1		
	97SMC06CB05	Crust	CM1~3									
		Crust	CM4									
		Crust	CM5									
		Crust	CM6									
		Crust	CM7									
	97SMC06CB06	Basalt					T1					
		Altered rock					T2					
		Ooze									F1	
		Limestone								F2		
	97SMC06CB07	Crust	CM1									
		Limestone					T1					
	97SMC06CB08	Crust	CM1									
		Limestone								F1		
MC07	97SMC07LC01	Sand									F1	45-50
		Sand									F2	120-125
	97SMC07CB02	Crust	CM1									
	97SMC07CB03	Crust	CM1									
	97SMC07CB05	Sandstone								F1		
	97SMC07AD06	Crust	CM1									
		Basalt				CA1	T1	X1	K1			
	97SMC07AD07	Basalt				CA1	T1	X1	K1			
	97SMC07AD08	Crust	CM1									
	97SMC07AD09	Crust	CM1									

Appendix Table 5 (3) Sample list of analysis and observations

Region	Sampling site No.	Sample	Manganese crust			Rock					Sediment	Core depth
			CM	P	B	CA	T	X	K	F	F	(cm)
MC07	97SMC07LC11	Sand									F1	80-85
		Sand									F2	195-200
	97SMC07CB14	Crust	CM1									
		Basalt					T1					
		Basalt					T2					
	97SMC07CB15	Crust	CM1									
		Basalt					T1	X1				
MC08	97SMC08LC01	Crust	CM1									0-2
		Sand									F1	6-9
		Mud									F2	16-20
	97SMC08CB02	Crust	CM1-6		B1							
	97SMC08CB03	Crust	CM1									
		Basalt				CA1	T1	X1	K1			
		Conglomerate					T2					
	97SMC08CB04	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
		Crust	CM4									
		Crust		P1								
		Crust		P2								
		Hyaloclastite					T1	X1				
		Mudstone					T2			F1		
	97SMC08CB05	Crust	CM1-4									
		Crust	CM5-8									
		Crust	CM9-11									
	97SMC08CB06	Crust	CM1									
	97SMC08CB07	Crust	CM1									
		Crust	CM2									
		Basalt				CA1	T1	X1				
		Basalt					T2	X2				
		Basalt					T3					
	97SMC08CB08	Crust	CM1-4									
		Crust	CM5-7									
		Crust		P1								
	97SMC08CB09	Crust	CM1-3									
		Basalt				CA1	T1					
	97SMC08CB10	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
	97SMC08CB11	Crust	CM1									
	97SMC08CB12	Crust	CM1-3									
		Crust	CM4									
		Crust	CM5									
		Crust	CM6									
		Basalt					T1					
		Phosphorite								F1		
	97SMC08CB13	Crust	CM1									
		Crust	CM2									
		Basalt				CA1	T1	X1	K1			
	97SMC08CB14	Crust	CM1-3									
		Crust	CM4									
	97SMC08CB15	Crust	CM1									
	97SMC08LC16	Crust	CM1									
	97SMC08CB19	Crust	CM1									
		Crust	CM2									
MC09	97SMC09LC01	Mud									F1	30-35
	97SMC09CB02	Crust	CM1									
		Conglomerate								F1		
	97SMC09CB03	Crust	CM1									
		Crust	CM2									

Appendix Table 5 (4) Sample list of analysis and observations

Region	Sampling site No.	Sample	Manganese crust			Rock					Sediment	Core depth
			CM	P	B	CA	T	X	K	F	F	(cm)
MC09	97SMC09CB03	Basalt				CA1	T1	X1	K1			
	97SMC09CB04	Crust	CM1									
	97SMC09CB06	Crust	CM1									
		Basalt					T1					
	97SMC09CB07	Crust	CM1									
		Crust	CM2									
		Basalt					T1	X1				
	97SMC09CB08	Crust	CM1-3									
		Crust	CM4									
		Basalt				CA1	T1	X1	K1			
	97SMC09CB09	Crust	CM1									
	97SMC09CB10	Crust	CM1									
	97SMC09CB11	Crust	CM1-3									
	97SMC09CB12	Crust	CM1									
		Crust	CM2									
	97SMC09CB13	Crust	CM1-3									
		Crust	CM4									
MC10	97SMC10LC01	Mud									F1	10-14
		Mud									F2	35-40
		Mud									F3	80-85
	97SMC10CB02	Crust	CM1									
		Crust	CM2									
		Basalt				CA1	T1	X1	K1			
	97SMC10CB04	Crust	CM1-4									
		Crust	CM5-7									
		Crust	CM8									
		Sandstone								F1		
	97SMC10CB05	Crust	CM1									
		Crust	CM2									
	97SMC10CB06	Crust	CM1-3		B1							
	97SMC10CB07	Crust	CM1-6		B1							
		Crust	CM7									
		Phosphorite								F1		
	97SMC10CB09	Crust	CM1									
	97SMC10CB10	Conglomerate					T1					
	97SMC10CB11	Crust	CM1									
		Basalt				CA1	T1	X1	K1			
	97SMC10CB12	Crust	CM1									
		Mudstone								F1		
	97SMC10CB14	Crust	CM1									
	97SMC10CB15	Crust	CM1									
		Crust	CM2									
	97SMC10CB16	Crust	CM1									
	97SMC10CB19	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
	97SMC10CB20	Crust	CM1									
		Crust	CM2									
		Crust	CM3									
		Basalt					T1					
Total number of samples			163	3	3	19	52	30	13	32	32	

Legend CM: Chemical analysis, P: Polish observation, B: Be analysis,
CA: Chemical analysis, T: Thin section observation, X: X-ray diffraction analysis,
K: K-Ar dating, F: Fossil observation

Appendix Table 6(1) Sea-Water sound velocity for MBES

MC02		MC03		MC04	
Lat.	9° 14.967'N	Lat.	6° 13.953'N	Lat.	6° 01.531'N
Long.	141° 35.009'E	Long.	141° 51.982'E	Long.	144° 29.024'E
Water depth (m)	Sound verocity($m \cdot s^{-1}$)	Water depth (m)	Sound verocity($m \cdot s^{-1}$)	Water depth (m)	Sound verocity($m \cdot s^{-1}$)
5	1,543.5	6	1,541.6	10	1,541.6
10	1,543.7	13	1,541.7	15	1,541.3
15	1,543.7	18	1,541.7	20	1,541.4
20	1,543.8	20	1,541.9	30	1,541.7
25	1,543.8	25	1,541.9	50	1,539.1
30	1,543.8	30	1,542.1	70	1,525.0
50	1,539.7	51	1,538.8	100	1,517.2
70	1,535.9	74	1,527.3	150	1,502.1
100	1,527.3	101	1,520.9	200	1,493.3
150	1,511.7	153	1,502.9	300	1,489.5
200	1,501.6	201	1,494.1	500	1,486.9
300	1,489.0	304	1,490.6	600	1,485.4
500	1,486.2	501	1,489.0	750	1,484.8
750	1,484.8	703	1,486.4	1,000	1,484.3
1,000	1,483.9	1,004	1,484.3	1,500	1,486.1
1,500	1,485.5	1,502	1,486.3	2,000	1,491.4
2,000	1,491.2	2,006	1,491.5	2,500	1,498.3
2,500	1,498.6	2,503	1,498.1	3,000	1,506.2
3,000	1,507.2	3,002	1,506.2	3,500	1,514.6
3,214	1,511.0	3,462	1,514.2	3,817	1,520.1
Av.	1,494.3	Av.	1,495.5	Av.	1,497.1

Appendix Table 6(2) Sea-Water sound velocity for MBES

MC05		MC07		MC08	
Lat. 5 ° 25.939' N Long. 149 ° 32.029' E		Lat. 6 ° 07.862' N Long. 157 ° 17.968' E		Lat. 10 ° 19.986' N Long. 156 ° 26.940' E	
Water depth (m)	Sound verocity($m \cdot s^{-1}$)	Water depth (m)	Sound verocity($m \cdot s^{-1}$)	Water depth (m)	Sound verocity($m \cdot s^{-1}$)
10	1,541.6	10	1,541.5	10	1,541.5
15	1,541.7	15	1,541.7	15	1,541.6
20	1,542.0	20	1,542.1	20	1,542.0
30	1,541.8	30	1,541.9	30	1,542.3
50	1,541.8	50	1,537.8	50	1,542.4
70	1,535.2	70	1,533.5	70	1,536.0
100	1,525.4	100	1,527.0	100	1,529.0
150	1,511.5	150	1,510.5	150	1,509.0
200	1,495.9	200	1,500.4	200	1,497.4
300	1,491.0	300	1,493.2	300	1,490.2
500	1,488.0	500	1,487.9	500	1,486.2
600	1,485.8	750	1,484.5	700	1,484.8
750	1,485.4	1,000	1,483.9	1,000	1,484.5
1,000	1,484.8	1,500	1,486.4	1,500	1,485.6
1,500	1,486.4	2,000	1,491.6	2,000	1,491.3
2,000	1,491.4	2,500	1,498.9	2,500	1,498.4
2,500	1,498.5	3,000	1,507.6	3,000	1,506.2
3,000	1,506.1	3,500	1,514.6	4,000	1,523.0
3,500	1,514.6	4,000	1,523.2	5,000	1,541.0
4,007	1,523.4	4,007	1,523.4	5,153	1,543.8
Av.	1,498.8	Av.	1,499.1	Av.	1,506.3

Appendix Table 6(3) Sea-Water sound velocity for MBES

MC09		MC10	
lat.	8° 13.786'N	lat.	9° 51.343'N
Long.	154° 57.379'E	Long.	148° 40.666'E
Water depth (m)	Sound verocity(m・s^{-1})	Water depth (m)	Sound verocity(m・s^{-1})
10	1,542.1	10	1,542.3
20	1,542.2	20	1,542.4
30	1,541.6	30	1,542.6
50	1,540.8	50	1,541.1
70	1,529.4	70	1,536.6
100	1,518.1	100	1,525.0
150	1,500.9	150	1,505.4
200	1,493.5	200	1,496.1
300	1,490.6	300	1,488.7
500	1,488.0	500	1,486.7
700	1,485.2	700	1,485.3
1,000	1,483.6	1,000	1,484.2
1,500	1,485.3	1,500	1,484.9
2,000	1,491.3	2,000	1,490.8
2,500	1,498.4	2,500	1,498.0
3,000	1,506.2	3,000	1,505.9
3,500	1,514.4	3,500	1,514.5
4,000	1,523.1	4,000	1,523.1
4,500	1,531.9	4,356	1,529.4
5,153	1,543.8	5,153	1,543.8
Av.	1,506.0	Av.	1,506.0

Appendix Table 7 Weather and sea-state data

Monthly frequency distribution of wind direction in 1997

W.D	CALM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Not Clear	Total
July	0	4	3	0	1	4	2	4	3	7	22	81	65	78	31	28	3	0	336
%	0.00	1.19	0.89	0.00	0.30	1.19	0.60	1.19	0.89	2.08	6.55	24.11	19.35	23.21	9.23	8.33	0.89	0.00	100.00
Augast	8	10	18	8	13	8	1	28	34	58	141	110	76	32	9	24	19	0	597
%	1.34	1.68	3.02	1.34	2.18	1.34	0.17	4.69	5.70	9.72	23.62	18.43	12.73	5.36	1.51	4.02	3.18	0.00	100.00
September	20	12	22	23	20	17	1	7	1	2	9	78	160	122	31	11	2	0	538
%	3.72	2.23	4.09	4.28	3.72	3.16	0.19	1.30	0.19	0.37	1.67	14.50	29.74	22.68	5.76	2.04	0.37	0.00	100.00

Monthly frequency distribution of wind velocity in 1997

(W.V : m/sec)

W.V	CALM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
July	0	0	1	5	12	16	41	68	61	43	36	32	12	4	4	0	0	0	0	1	0	0	336
%	0.00	0.00	0.30	1.49	3.57	4.76	12.20	20.24	18.15	12.80	10.71	9.52	3.57	1.19	1.19	0.00	0.00	0.00	0.00	0.30	0.00	0.00	100.00
Augast	8	0	12	18	49	45	43	70	71	63	68	56	48	28	10	3	2	0	1	2	0	0	597
%	1.34	0.00	2.01	3.02	8.21	7.54	7.20	11.73	11.89	10.55	11.39	9.38	8.04	4.69	1.68	0.50	0.34	0.00	0.17	0.34	0.00	0.00	100.00
September	20	0	12	22	42	30	46	24	28	50	38	68	70	45	21	8	7	6	0	1	0	0	538
%	3.72	0.00	2.23	4.09	7.81	5.58	8.55	4.46	5.20	9.29	7.06	12.64	13.01	8.36	3.90	1.49	1.30	1.12	0.00	0.19	0.00	0.00	100.00

Monthly frequency distribution of weather in 1997

Weather	Fine	Cloudy	Rain	Not Clear	Total	Light rain
July	4	2	8	0	14	3
%	28.57	14.29	57.14	0.00	100.00	21.43
Augast	7	9	10	0	26	8
%	26.92	34.62	38.46	0.00	100.00	30.77
September	9	2	12	0	23	7
%	39.13	8.70	52.17	0.00	100.00	30.43

Monthly frequency distribution of atomospheric pressure(daily average) in 1997

(AP : hpa)

A.P	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	Not Clear	Total
July	0	0	0	0	10	23	25	38	60	82	57	32	9	0	0	0	0	0	0	0	336
%	0.00	0.00	0.00	0.00	2.98	6.85	7.41	11.31	17.65	24.40	16.96	9.52	2.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
August	0	0	0	0	0	0	3	17	58	126	161	129	77	19	7	0	0	0	0	0	597
%	0.00	0.00	0.00	0.00	0.00	0.00	0.50	2.85	9.72	21.11	26.97	21.61	12.90	3.18	1.17	0.00	0.00	0.00	0.00	0.00	100.00
September	0	0	0	0	1	19	34	68	100	109	108	71	27	1	0	0	0	0	0	0	538
%	0.00	0.00	0.00	0.00	0.19	3.53	6.32	12.64	18.59	20.26	20.07	13.20	5.02	0.19	0.00	0.00	0.00	0.00	0.00	0.00	100.00

Monthly frequency distribution of swell direction in 1997

S.D	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Not Clear	Total
July	1	0	3	0	0	0	4	0	0	6	10	48	30	35	13	9	177	336
%	0.30	0.00	0.89	0.00	0.00	0.00	1.19	0.00	0.00	1.79	2.98	14.29	8.93	10.42	3.87	2.68	52.68	100.00
August	0	9	7	0	0	0	0	31	49	49	44	28	39	22	18	9	292	537
%	0.00	1.51	1.17	0.00	0.00	0.00	0.00	5.19	8.21	8.21	7.37	4,69	6.53	3.69	3.02	1.51	48.91	100.00
September	0	12	45	3	0	0	0	0	3	16	55	110	40	1	2	0	251	538
%	0.00	2.23	8.36	0.56	0.00	0.00	0.00	0.00	0.56	2.97	10.22	20.45	7.43	0.19	0.37	0.00	46.65	100.00

Monthly frequency distribution of swell cycle in 1997

(W.V :m/sec)

S.C	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Not Clear	Total
July	0	0	0	3	0	32	98	46	3	0	0	0	0	0	0	0	154	336
%	0.00	0.00	0.00	0.89	0.00	9.52	29.17	13.69	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.83	100.00
August	0	0	0	0	32	202	53	20	0	0	0	0	0	0	0	0	290	597
%	0.00	0.00	0.00	0.00	5.36	33.84	8.88	3.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.58	100.00
September	0	0	0	3	30	157	86	11	0	0	0	0	0	0	0	0	251	538
%	0.00	0.00	0.00	9.56	5.58	29.18	15.99	2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.65	100.00

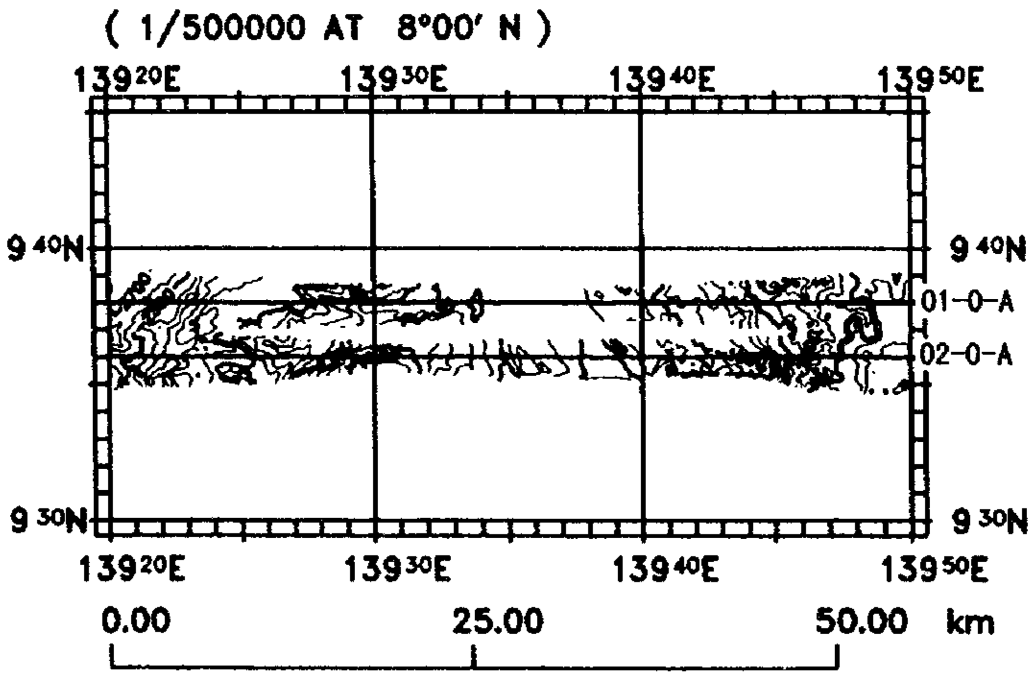
Monthly frequency distribution of swell height in 1997

(S.H :m)

S.H	0	1	2	3	4	5	6	7	8	9	10	Not clear	Total
July	0	4	130	23	23	2	0	0	0	0	0	154	336
%	0.00	1.19	38.69	6.85	6.85	0.60	0.00	0.00	0.00	0.00	0.00	45.83	100.00
Augast	0	92	117	50	42	6	0	0	0	0	0	290	597
%	0.00	15.41	19.60	8.38	7.04	1.01	0.00	0.00	0.00	0.00	0.00	48.58	100.00
September	0	113	107	67	0	0	0	0	0	0	0	251	538
%	0.00	21.00	19.89	12.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.65	100.00

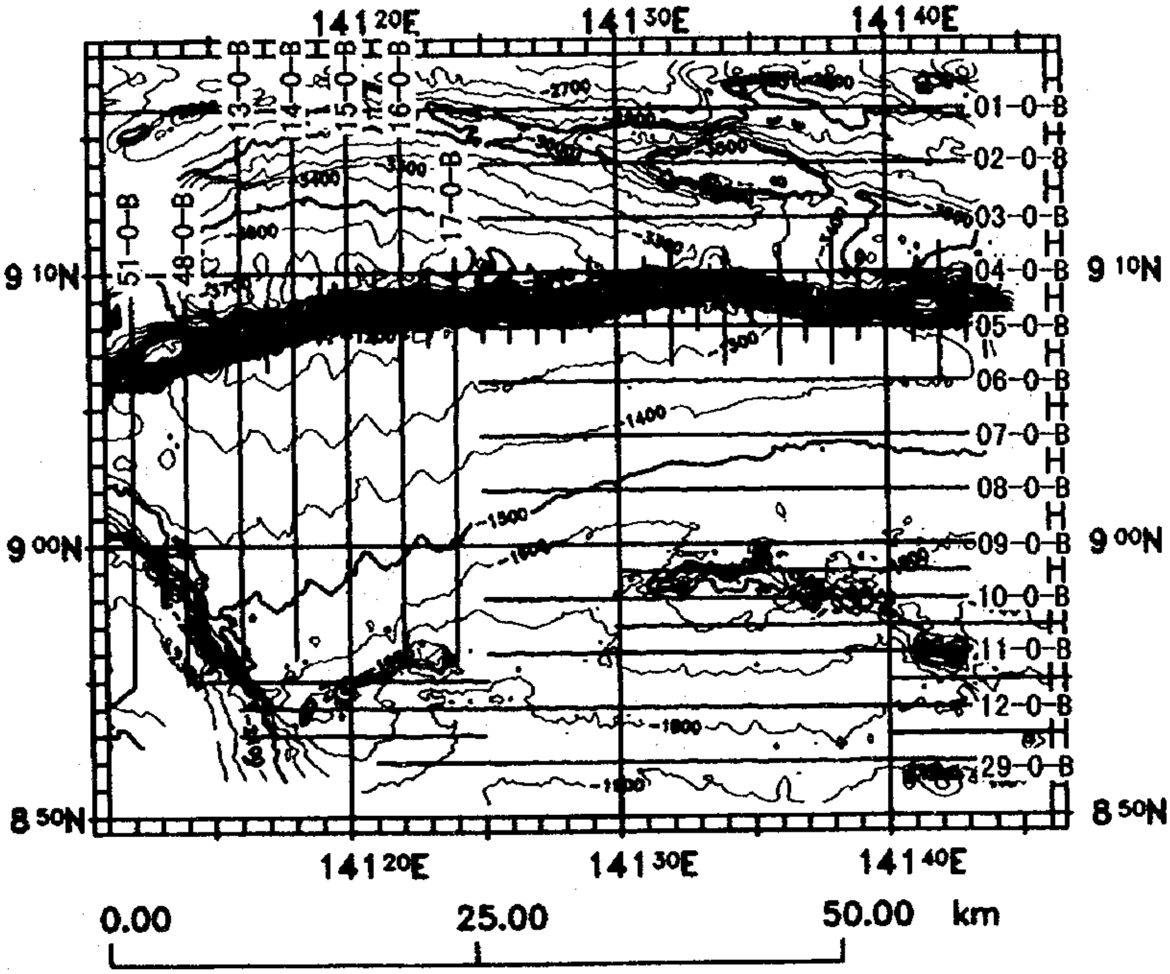
Monthly frequency distribution of degree of cloudiness in 1997

D.C	0	1	2	3	4	5	6	7	8	9	10	Not clear	Total
July	0	3	2	30	32	37	41	102	89	0	0	0	336
%	0.00	0.89	0.60	8.93	9.52	11.01	12.20	30.36	26.49	0.00	0.00	0.00	100.00
Augast	0	2	11	67	74	78	119	101	145	0	0	0	597
%	0.00	0.34	1.84	11.22	12.40	13.07	19.93	16.92	24.29	0.00	0.00	0.00	100.00
September	0	0	40	62	50	43	68	50	224	0	0	1	538
%	0.00	0.00	7.43	11.52	9.29	7.99	12.64	9.29	41.64	0.00	0.00	0.19	100.00

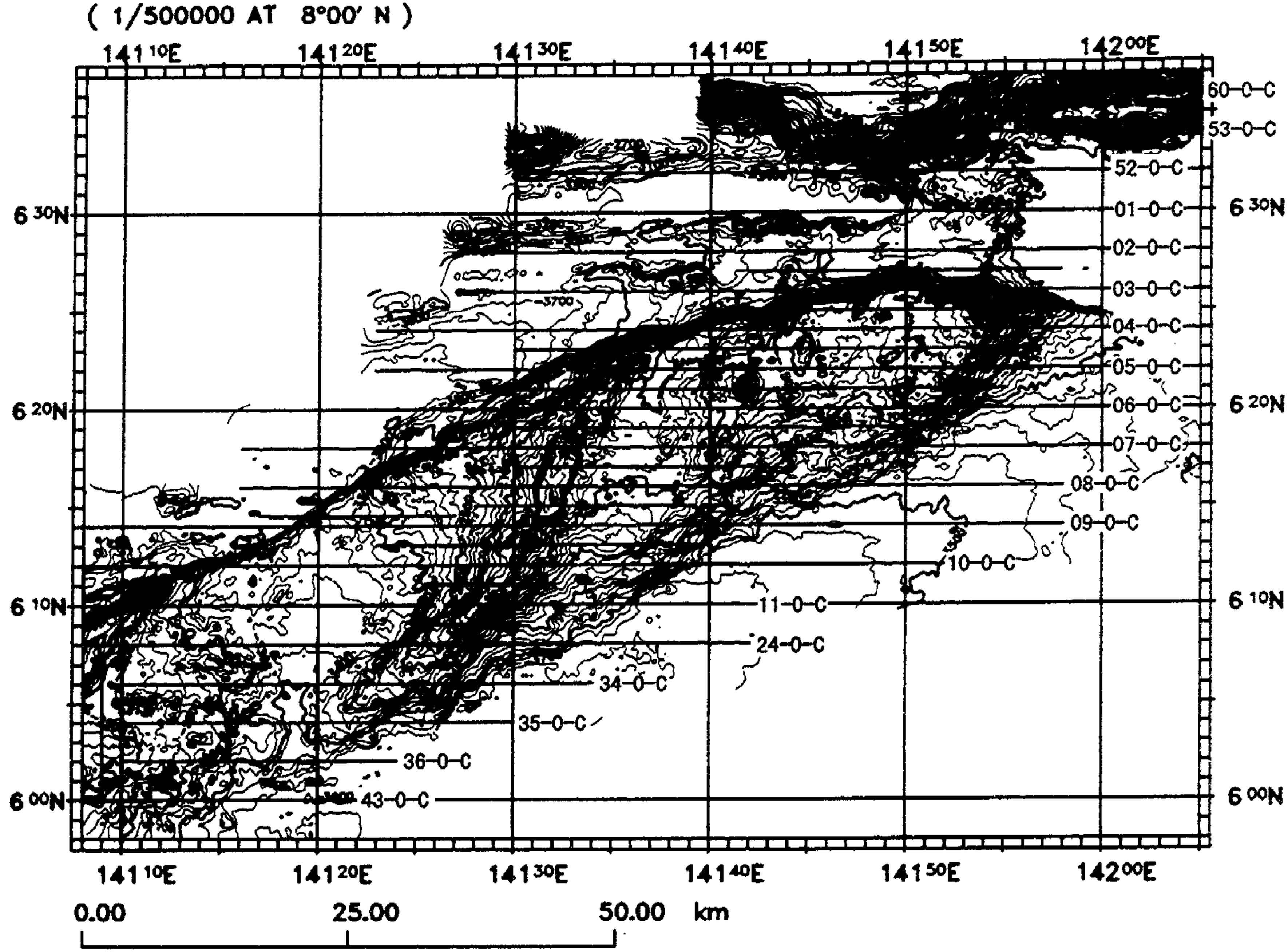


Appendix Fig. 1 (1) Location map of track line of MC01 area

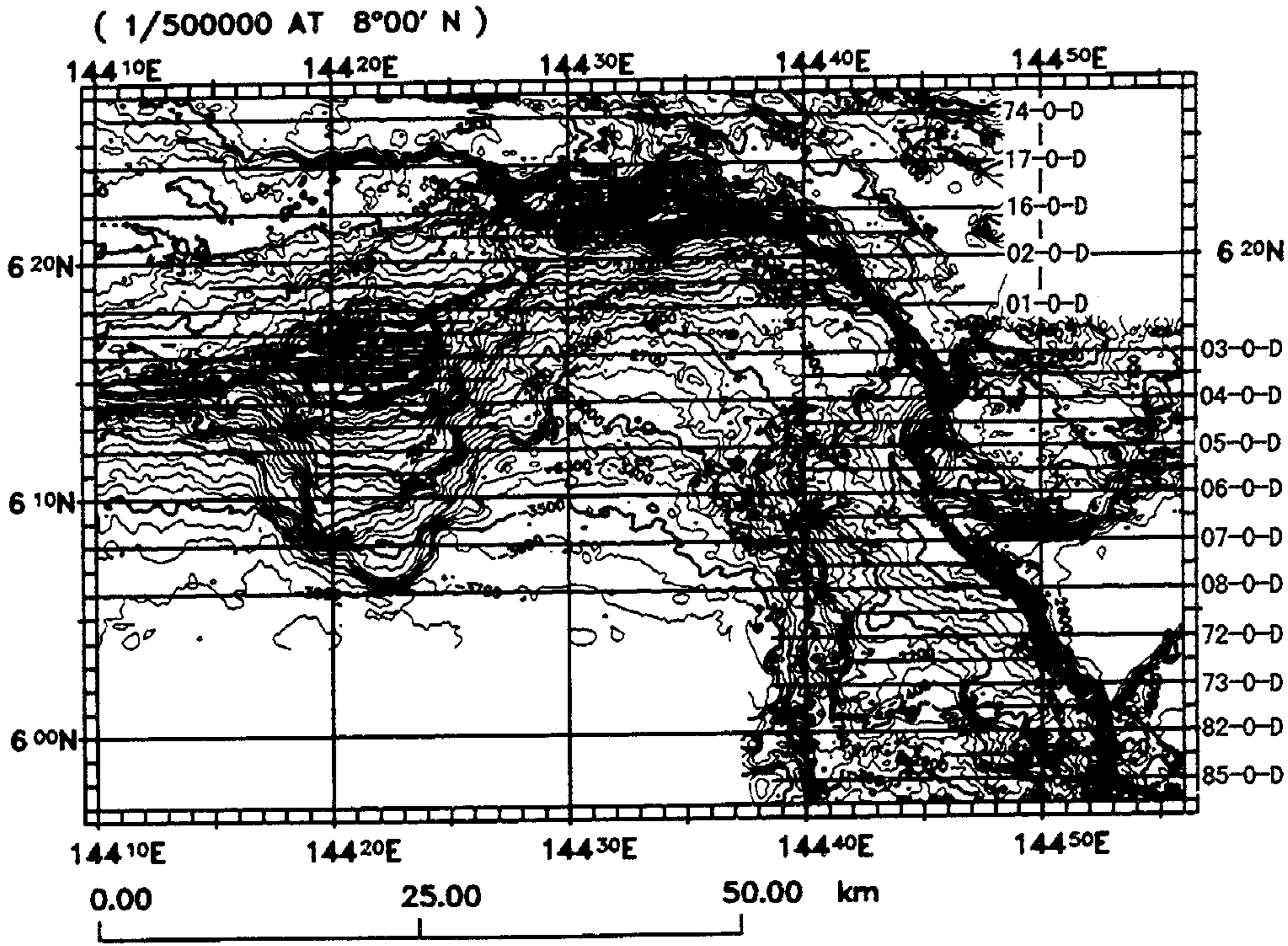
(1/500000 AT 8°00′ N)



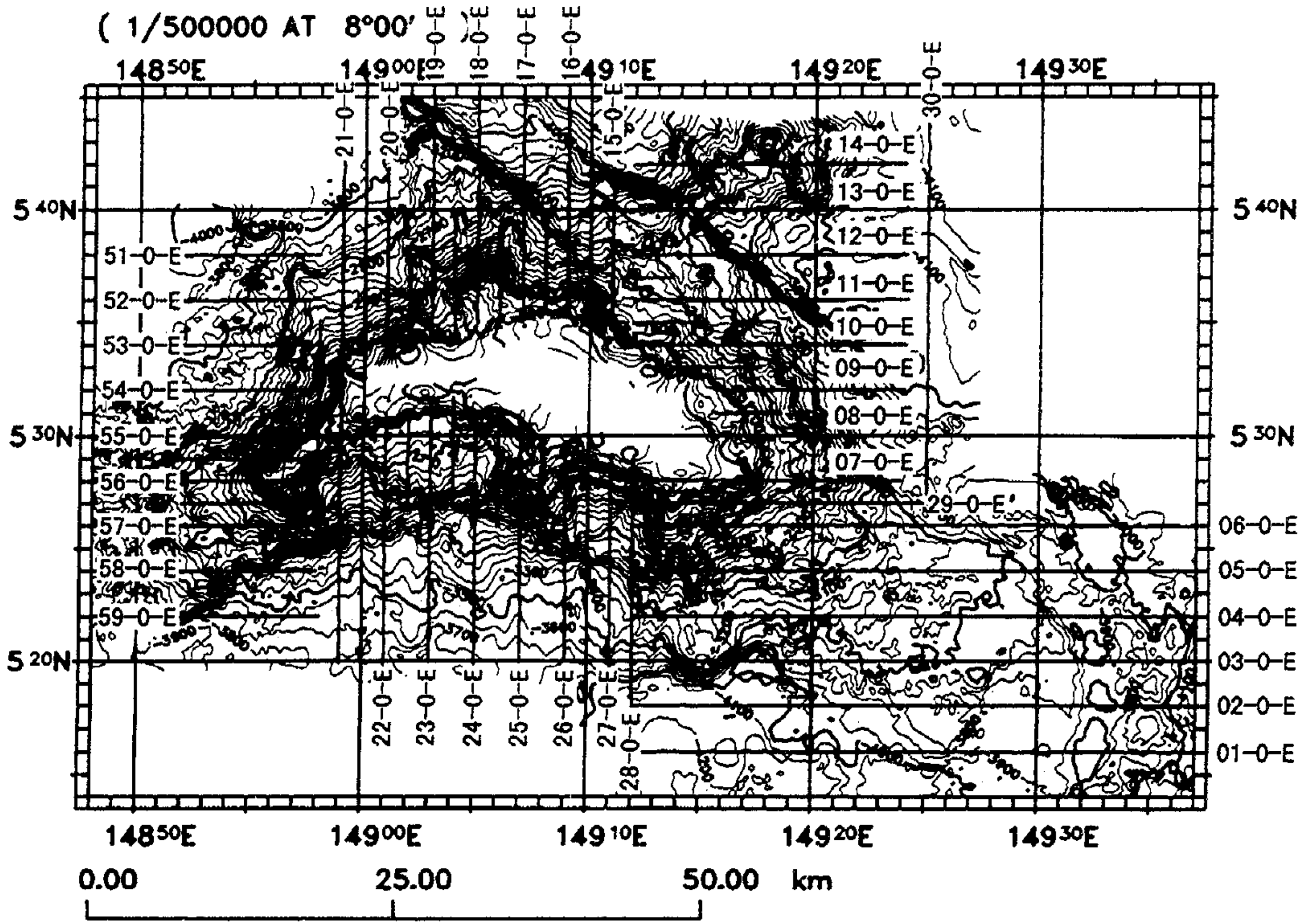
Appendix Fig. 1(2) Location map of track line of MC02 area



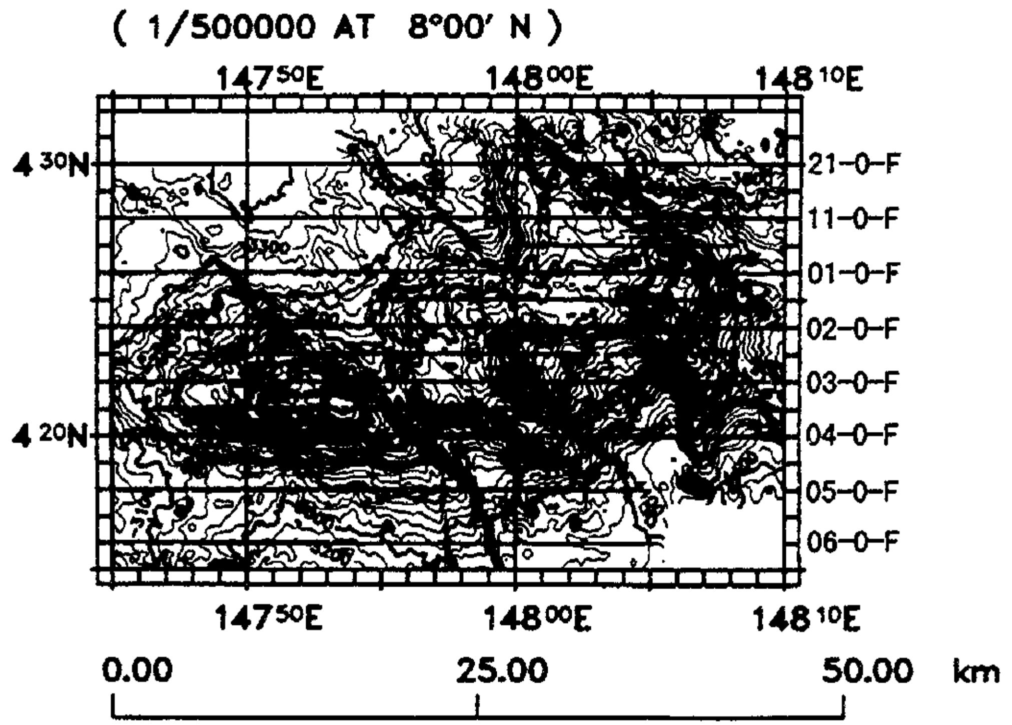
Appendix Fig. 1(3) Location map of track line of MC03 area



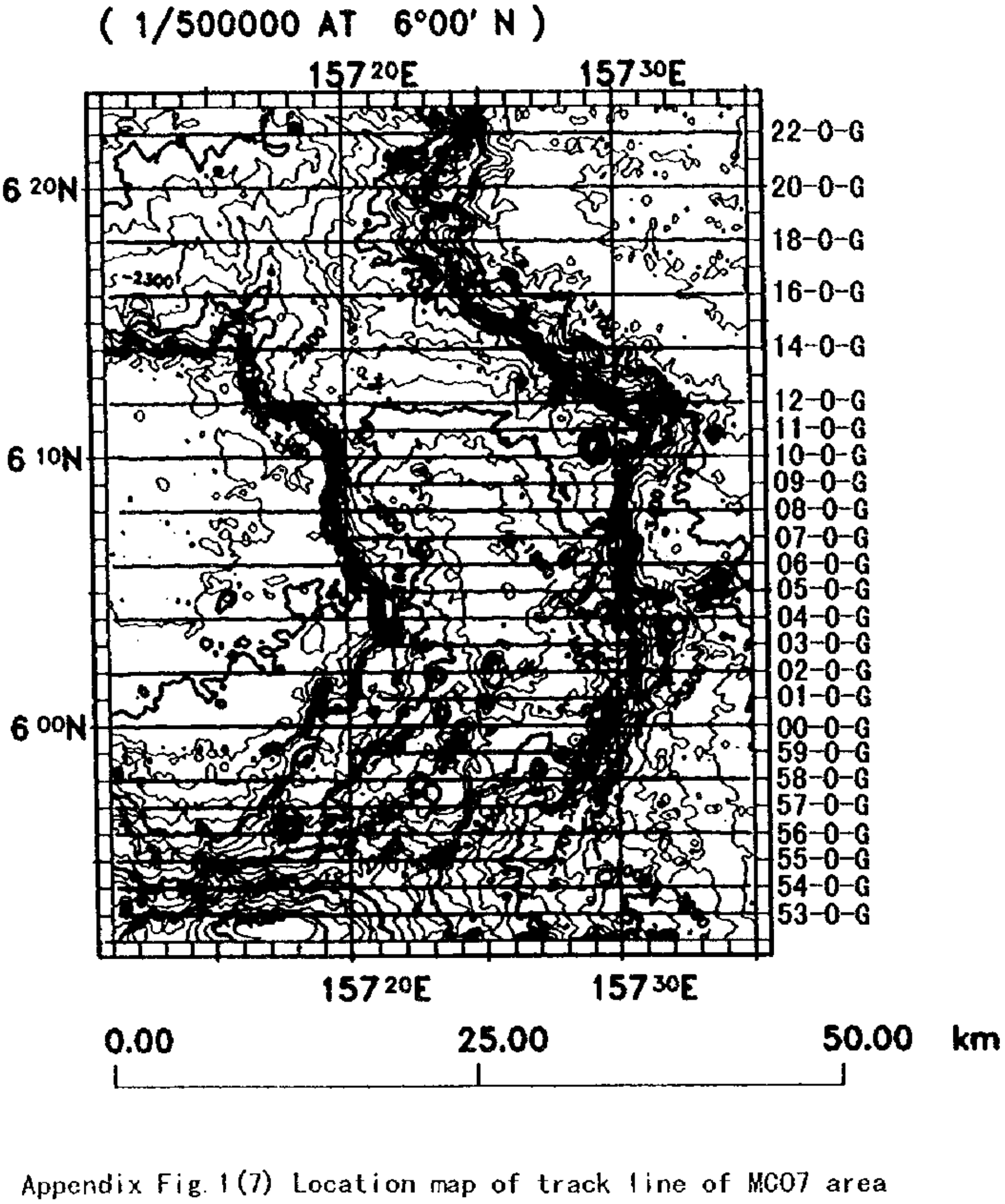
Appendix Fig. 1 (4) Location map of track line of MC04 area



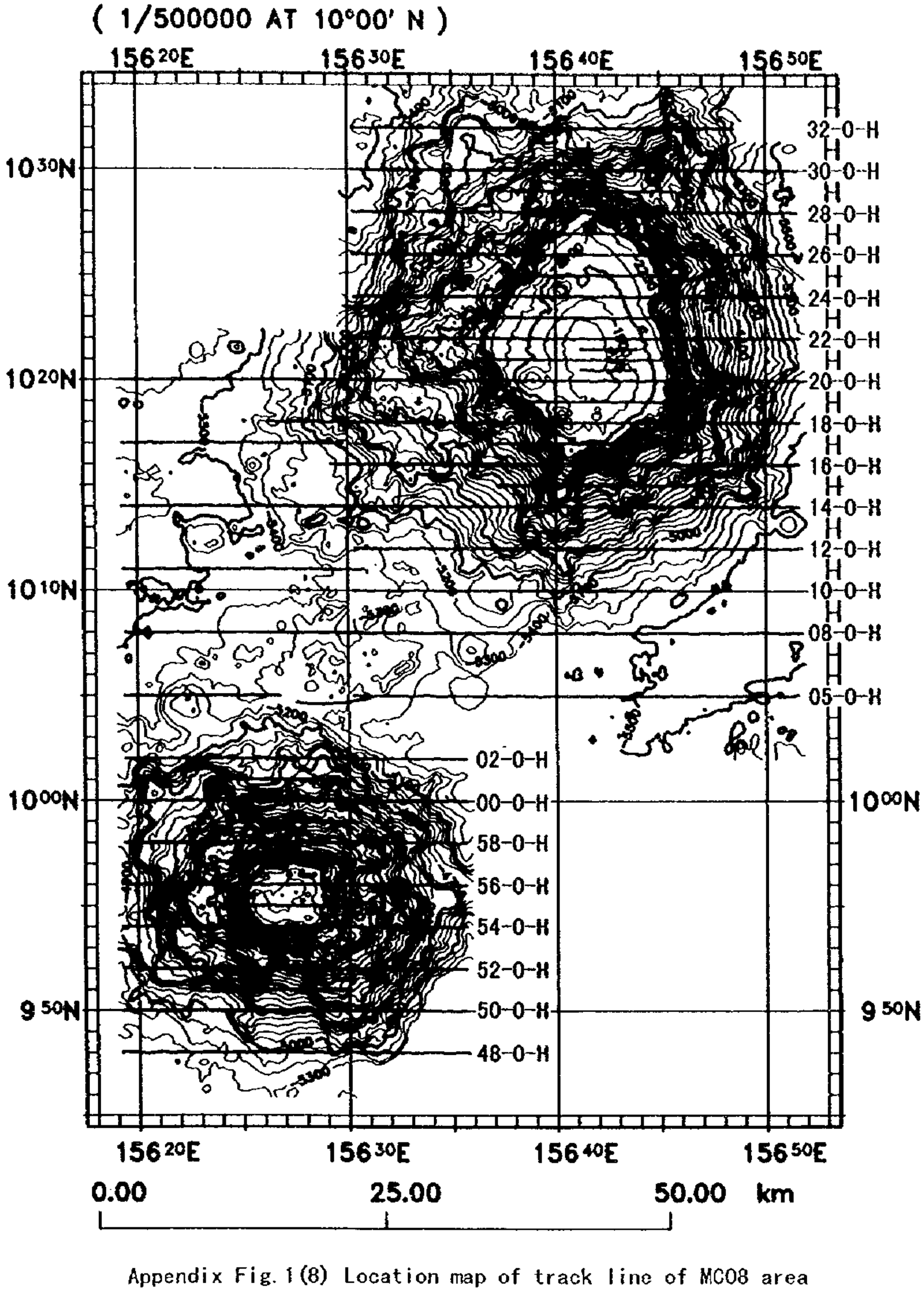
Appendix Fig. 1 (5) Location map of track line of MC05 area



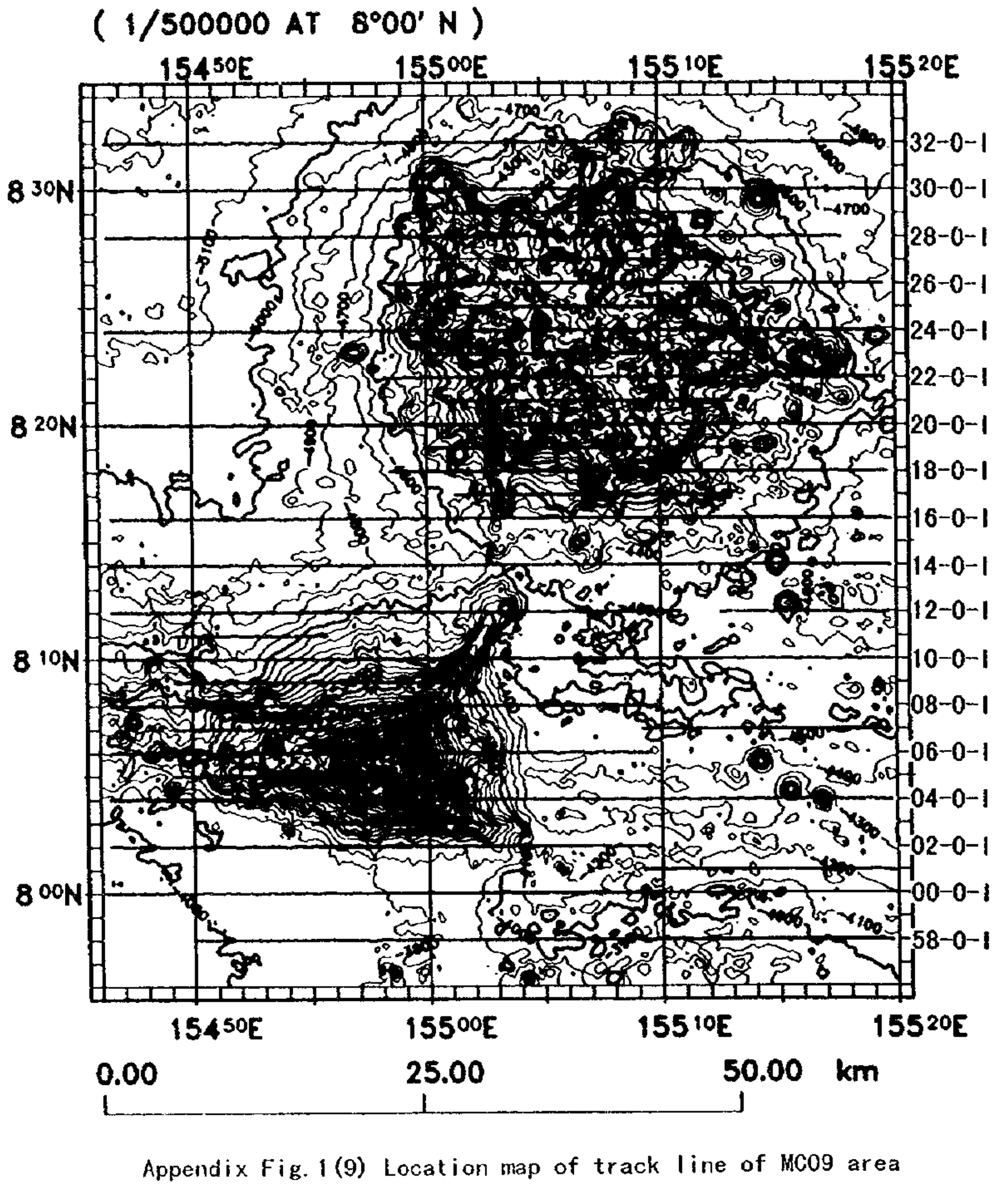
Appendix Fig. 1 (6) Location map of track line of MC06 area



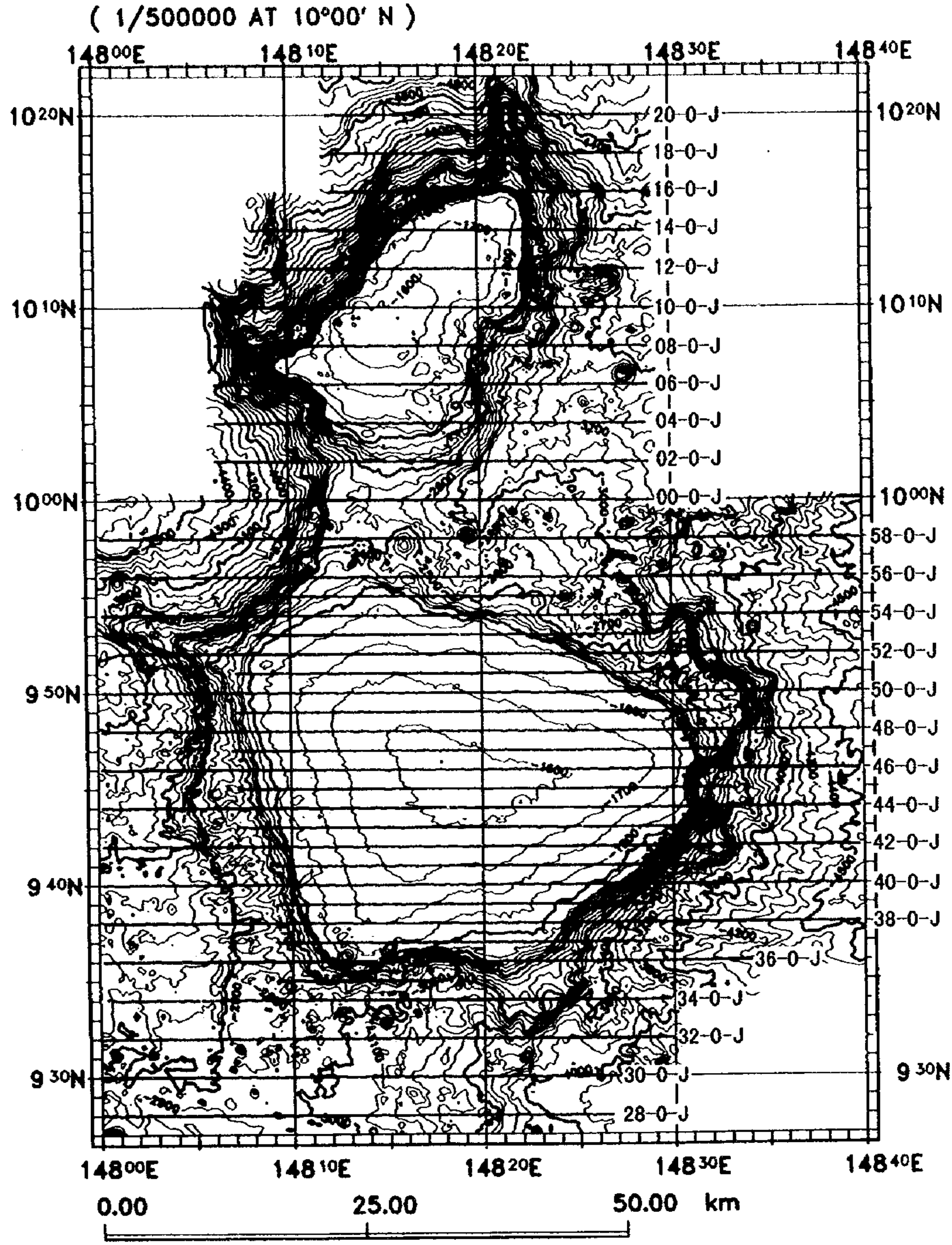
Appendix Fig. 1(7) Location map of track line of MC07 area



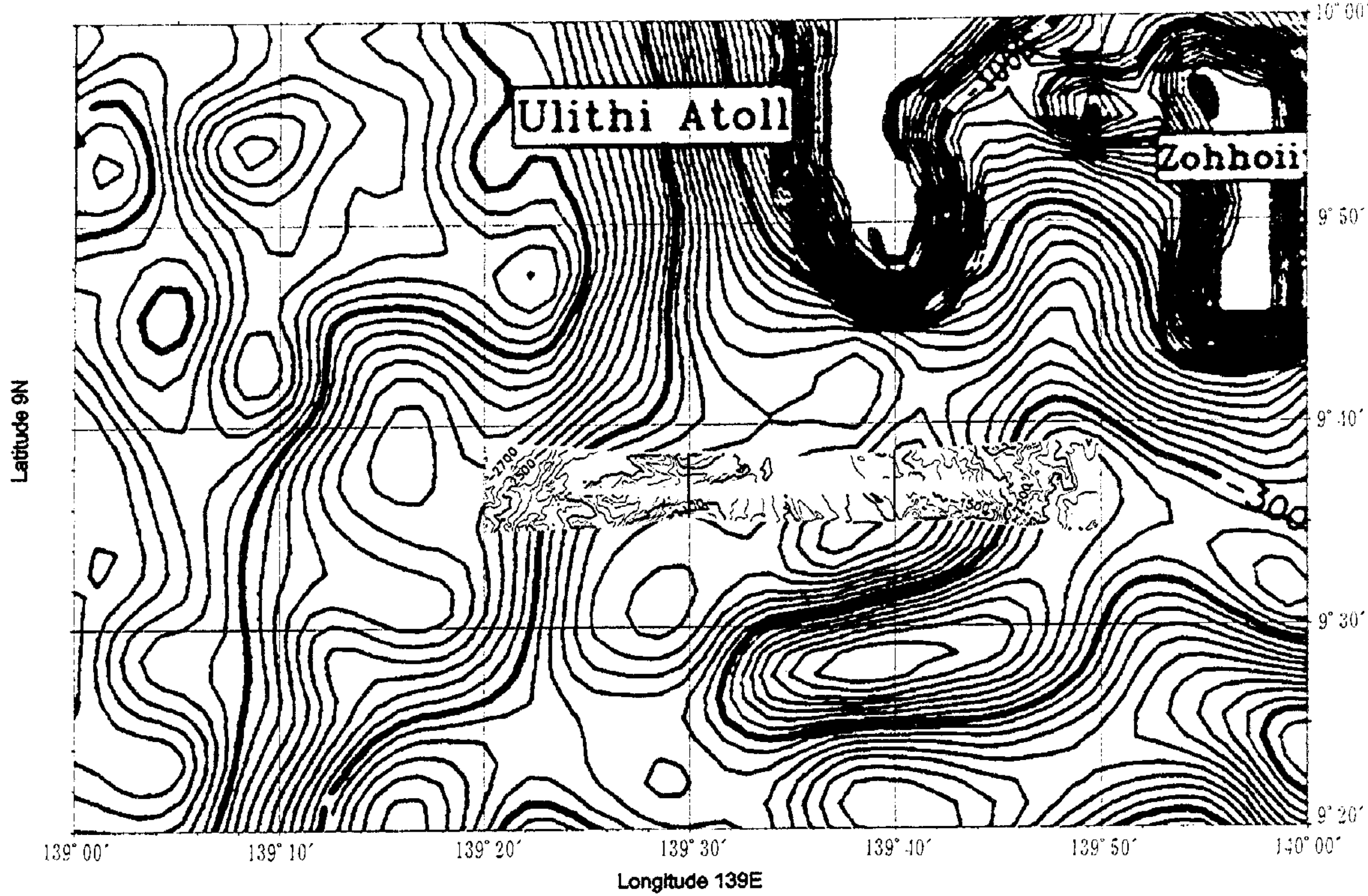
Appendix Fig. 1(8) Location map of track line of MC08 area



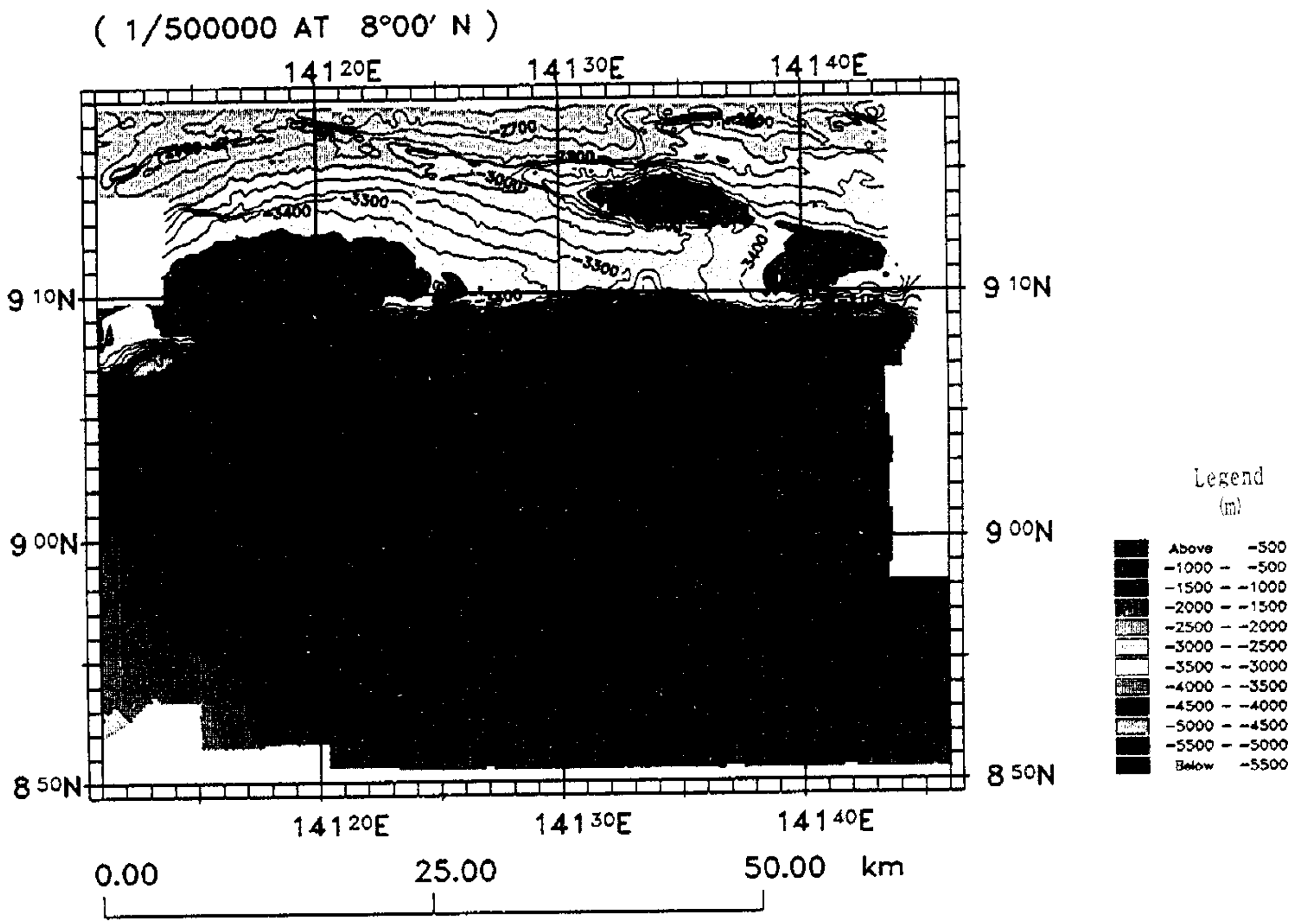
Appendix Fig. 1(9) Location map of track line of MC09 area



Appendix Fig. 1 (10) Location map of track line of MC10 area

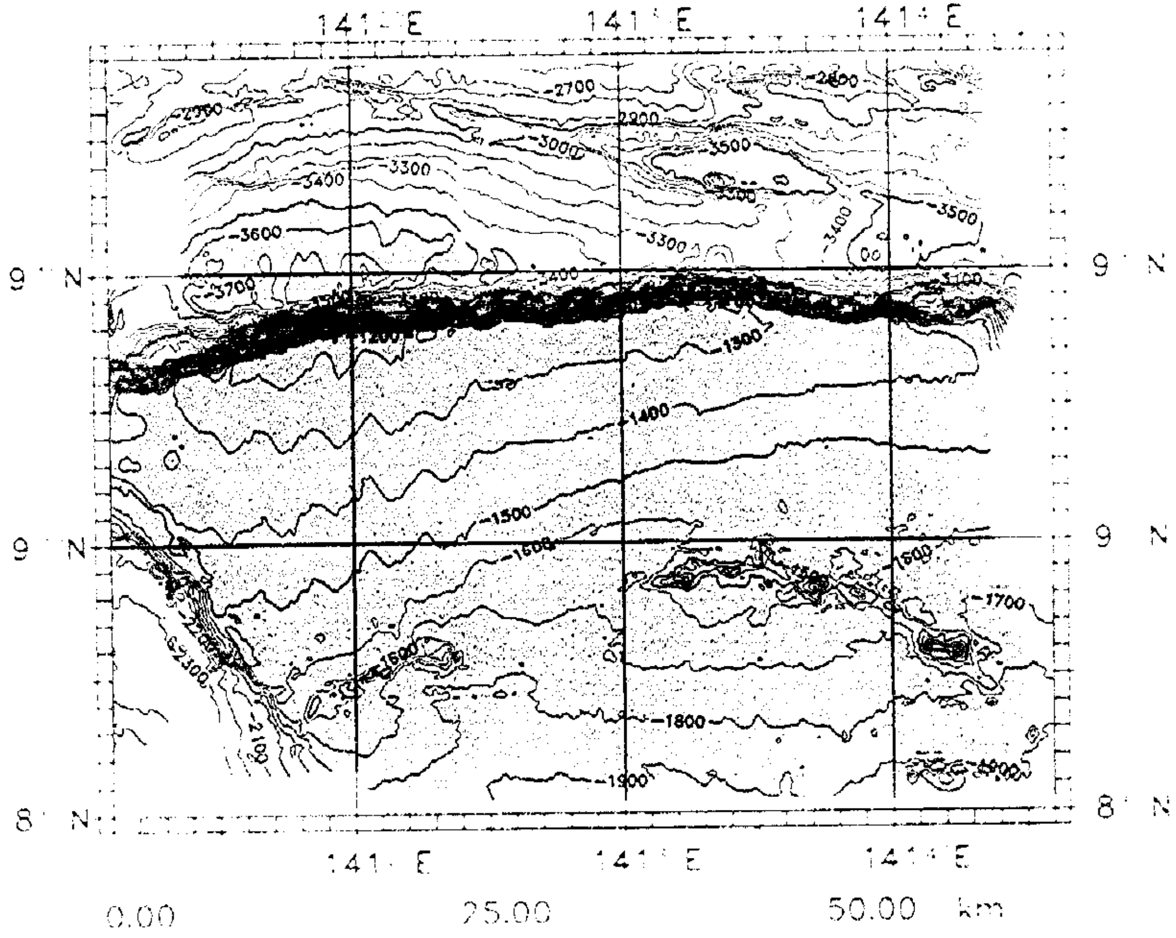


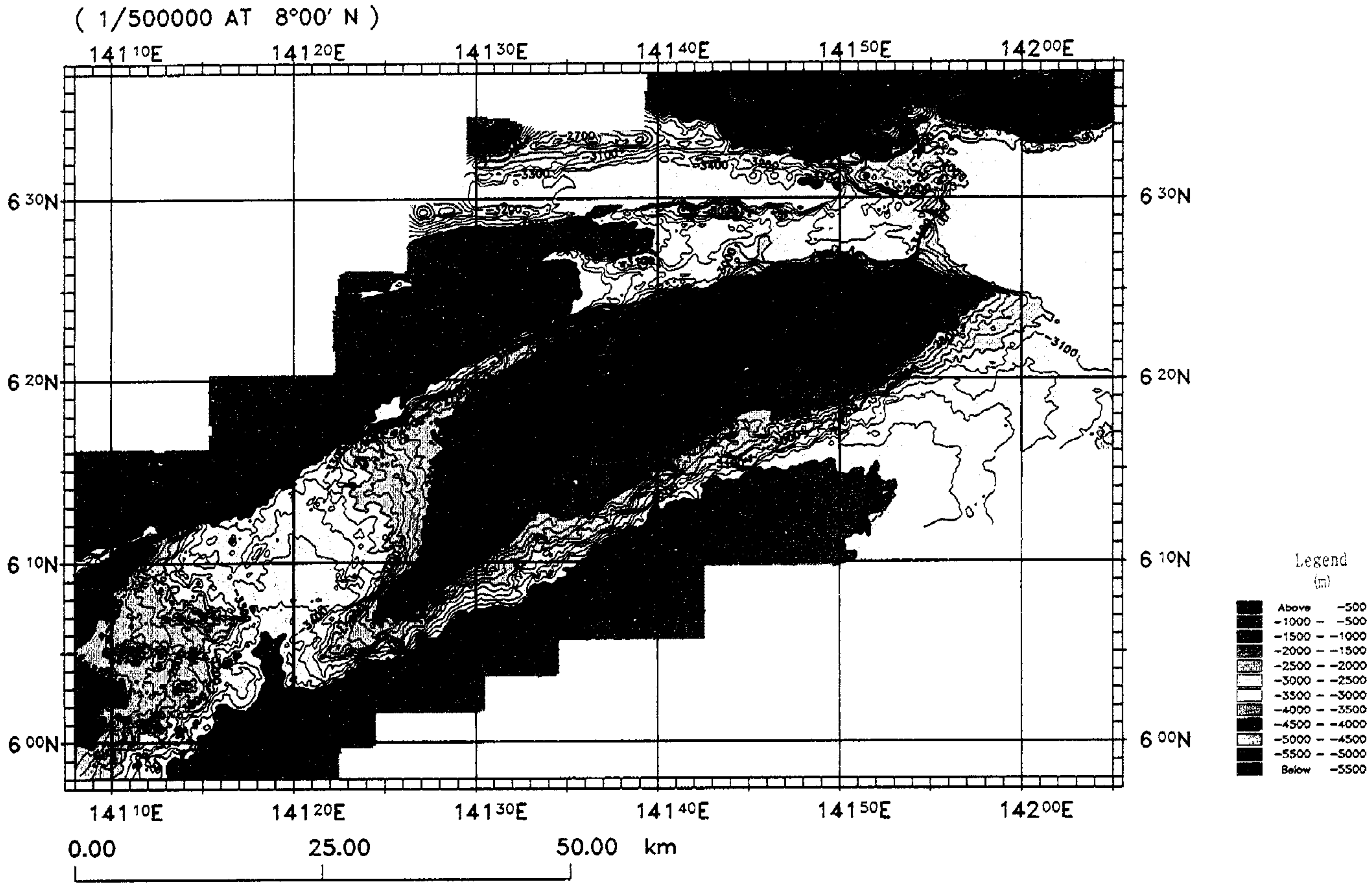
Appendix Fig. 2(1) Color-coded bathymetric map based on MBES of MC01 area.



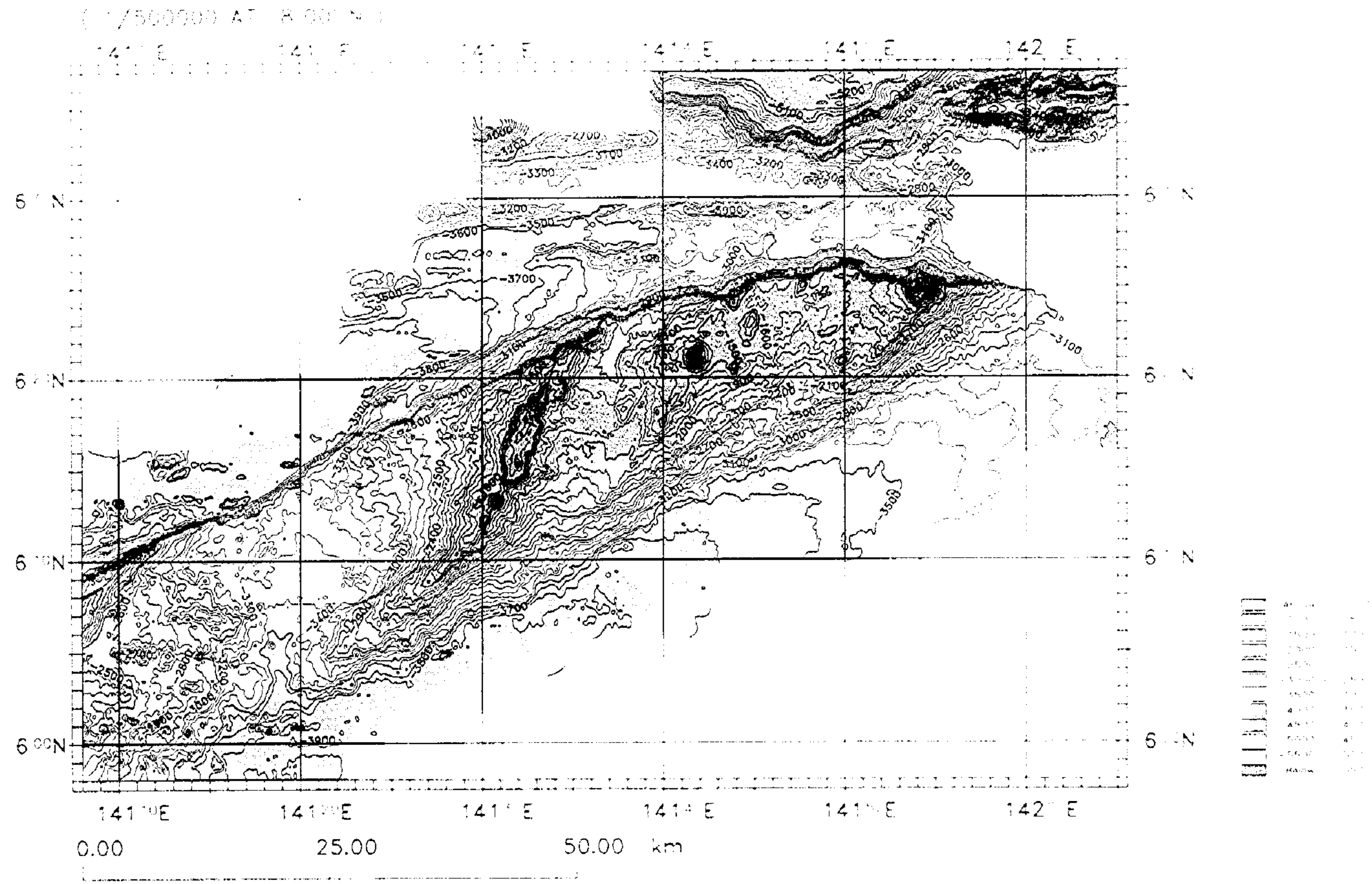
Appendix Fig. 2 (2) Color-coded bathymetric map based on MBES of MC02 area.

(1/500000 AT 8°00' N)

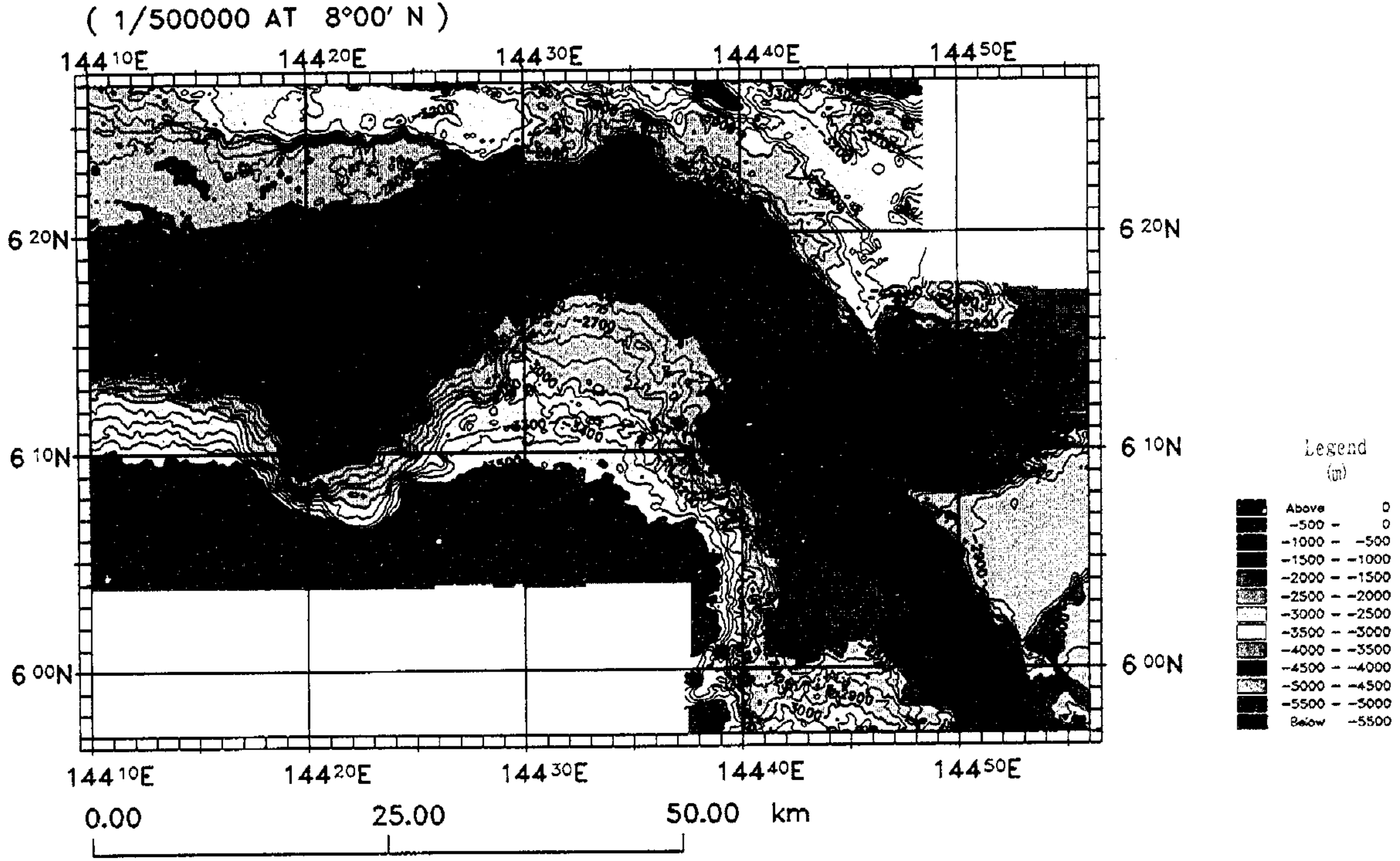




Appendix Fig. 2 (3) Color-coded bathymetric map based on MBES of MC03 area.

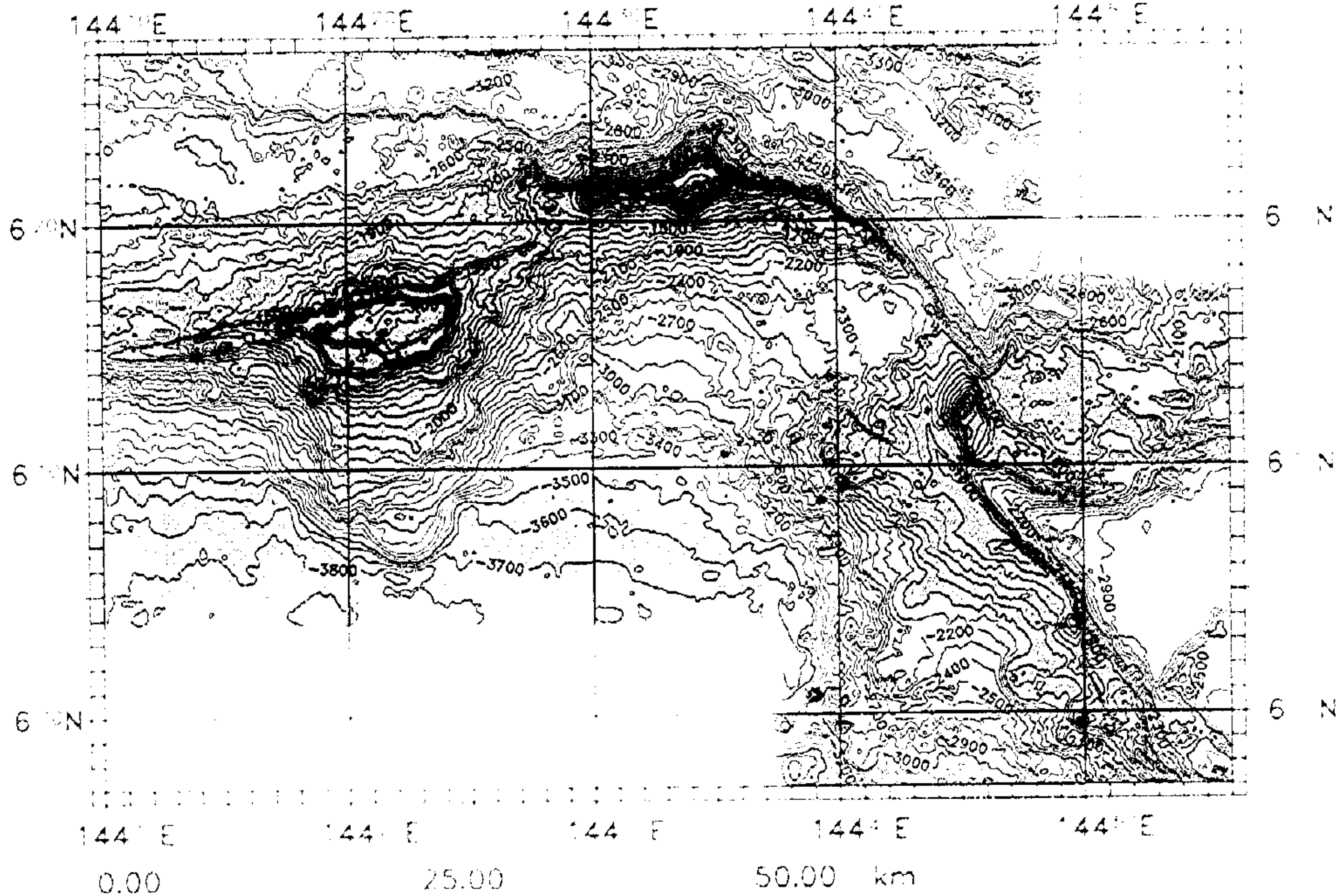


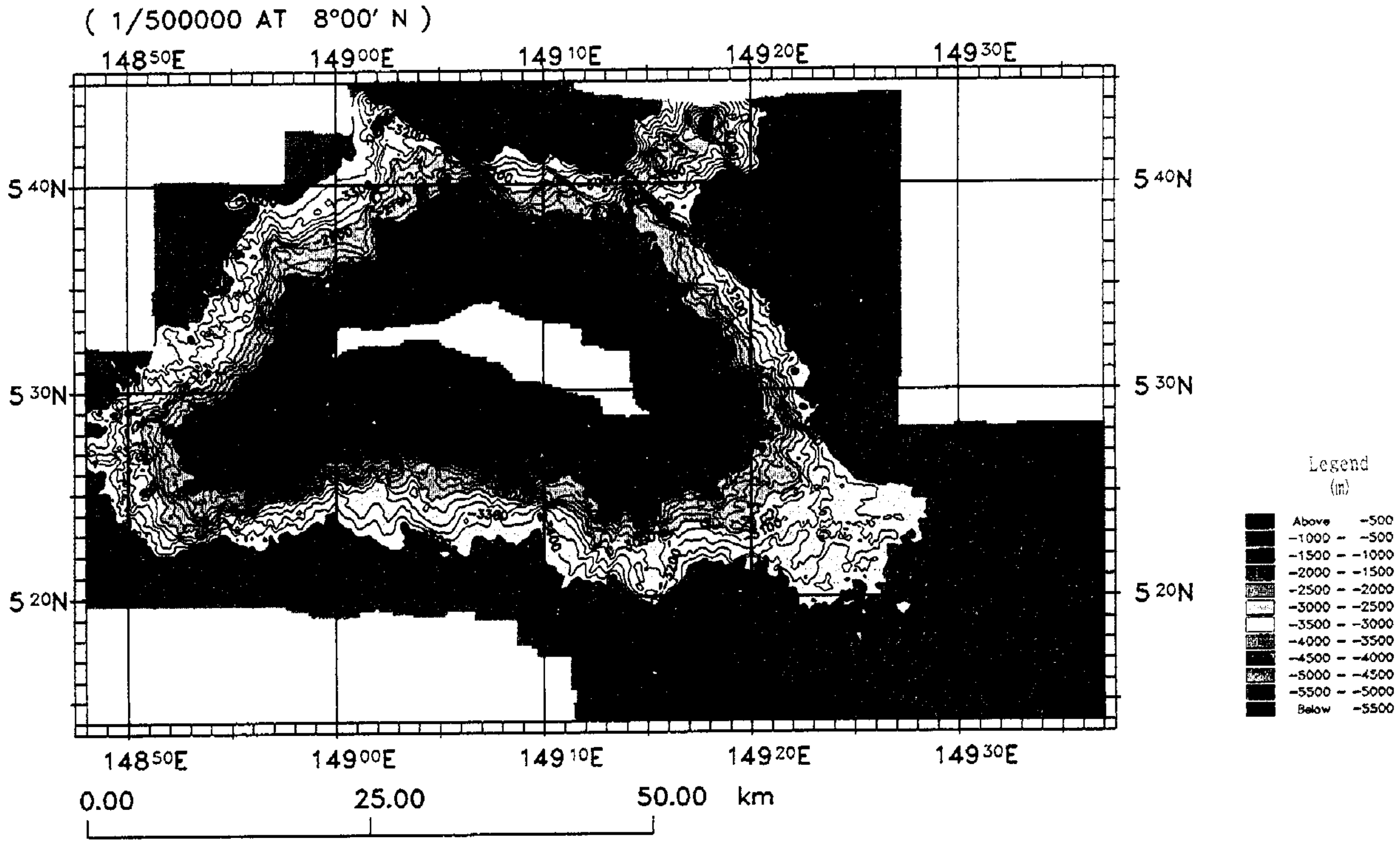
0.00
25.00
50.00 km
-3700
-3200
-3500
-3600
-3300
-2100
-2500
-3100
-3900



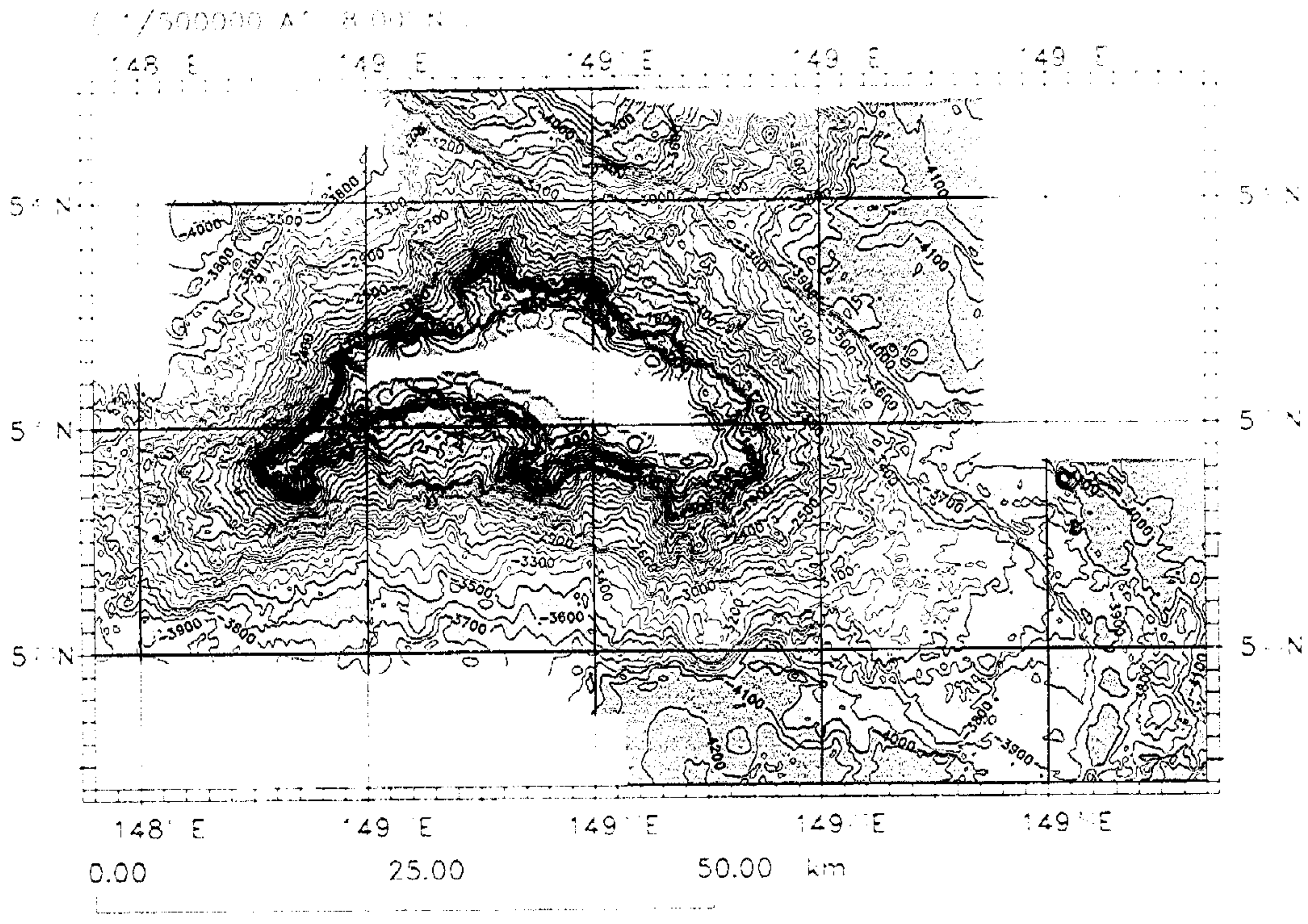
Appendix Fig. 2 (4) Color-coded bathymetric map based on MBES of MC04 area.

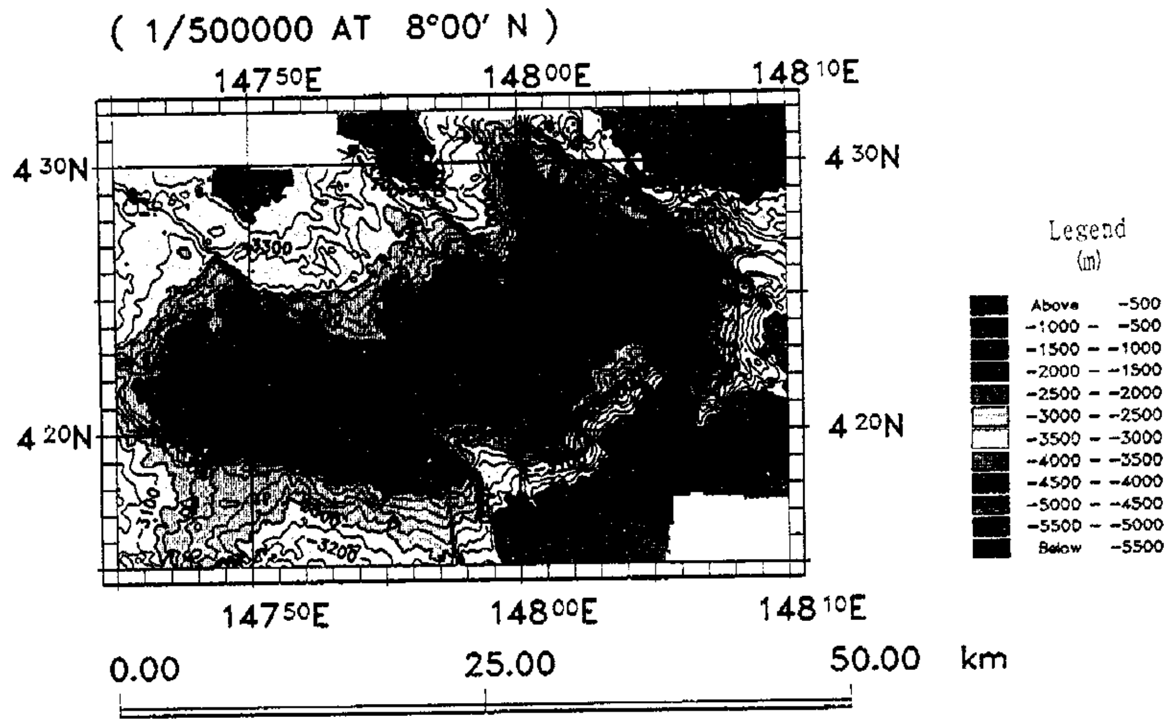
(1/500000 AT 8°00′ N)



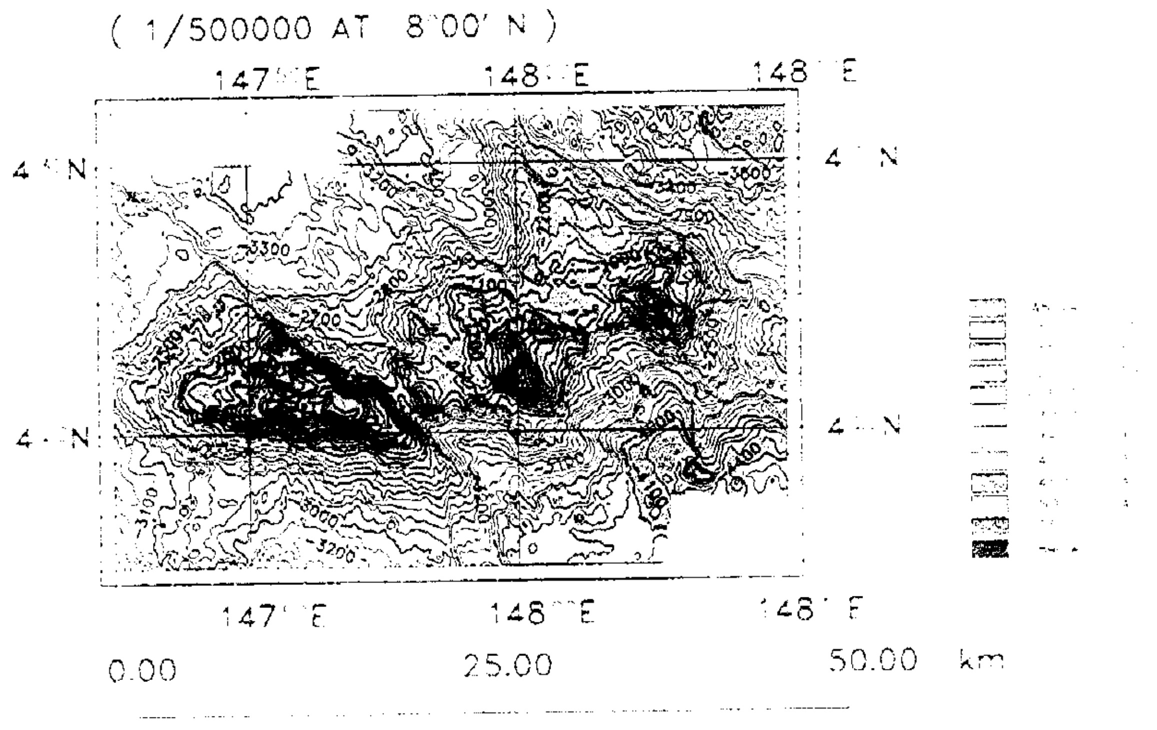


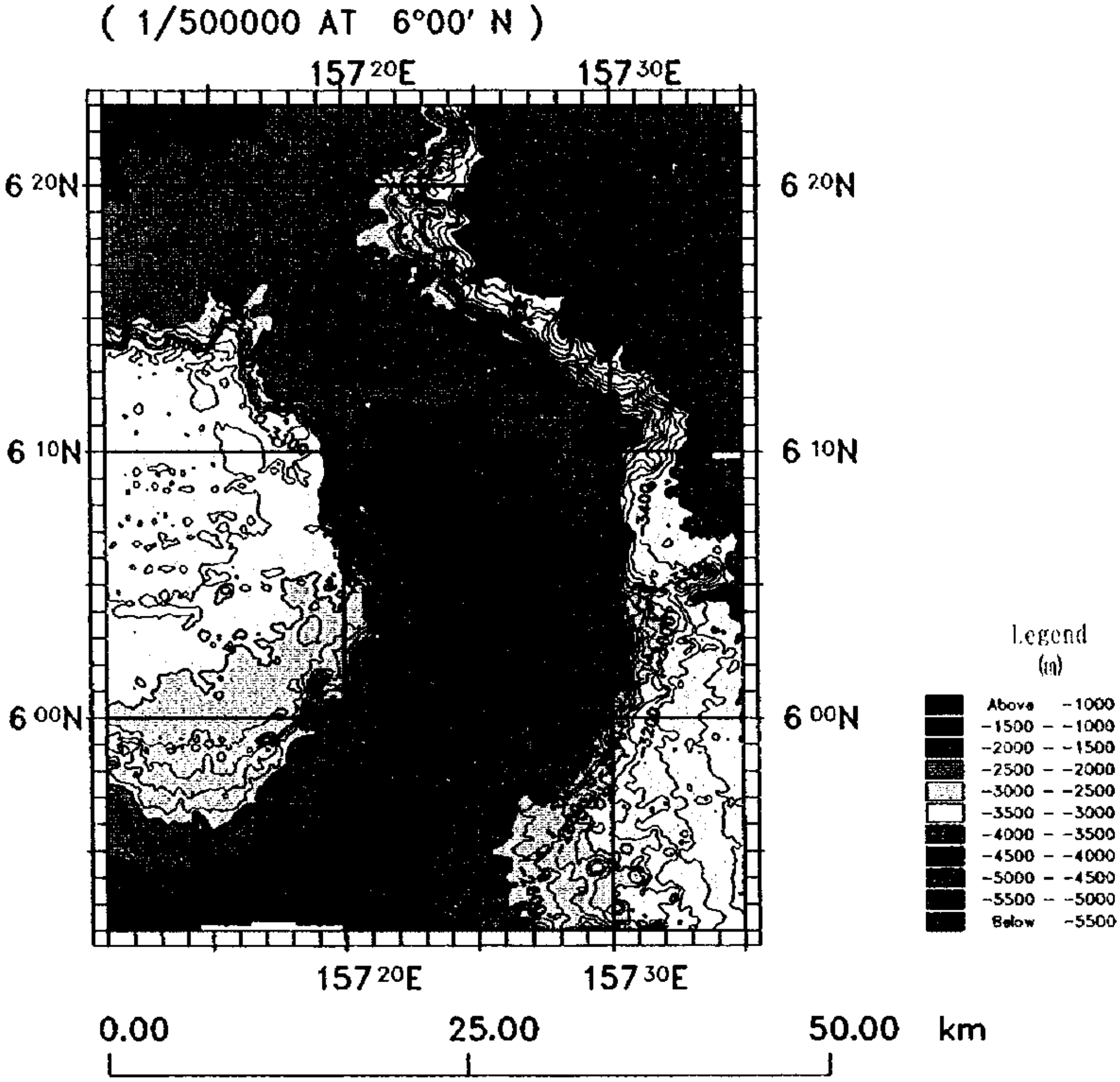
Appendix Fig. 2(5) Color-coded bathymetric map based on MBES of MC05 area.


1/500000
148 E
149 E
149 E
149 E
149 E
5 N
5 N
5 N
0.00
25.00
50.00 km



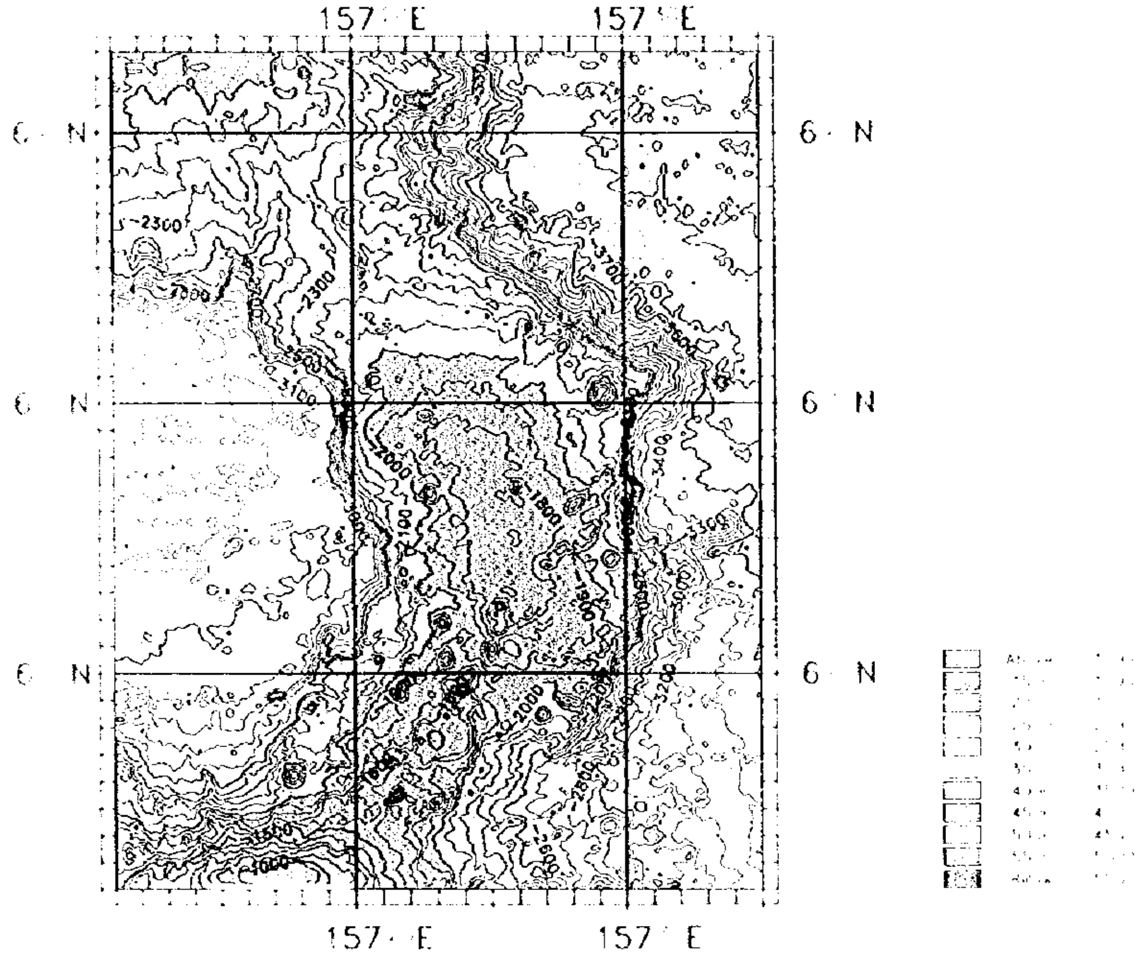
Appendix Fig. 2(6) Color-coded bathymetric map based on MBES of MC06 area.


(1/500000 AT 8°00' N)
-3300
-2700
-3600
-3400
-3000
-3200
0.00
25.00
50.00 km

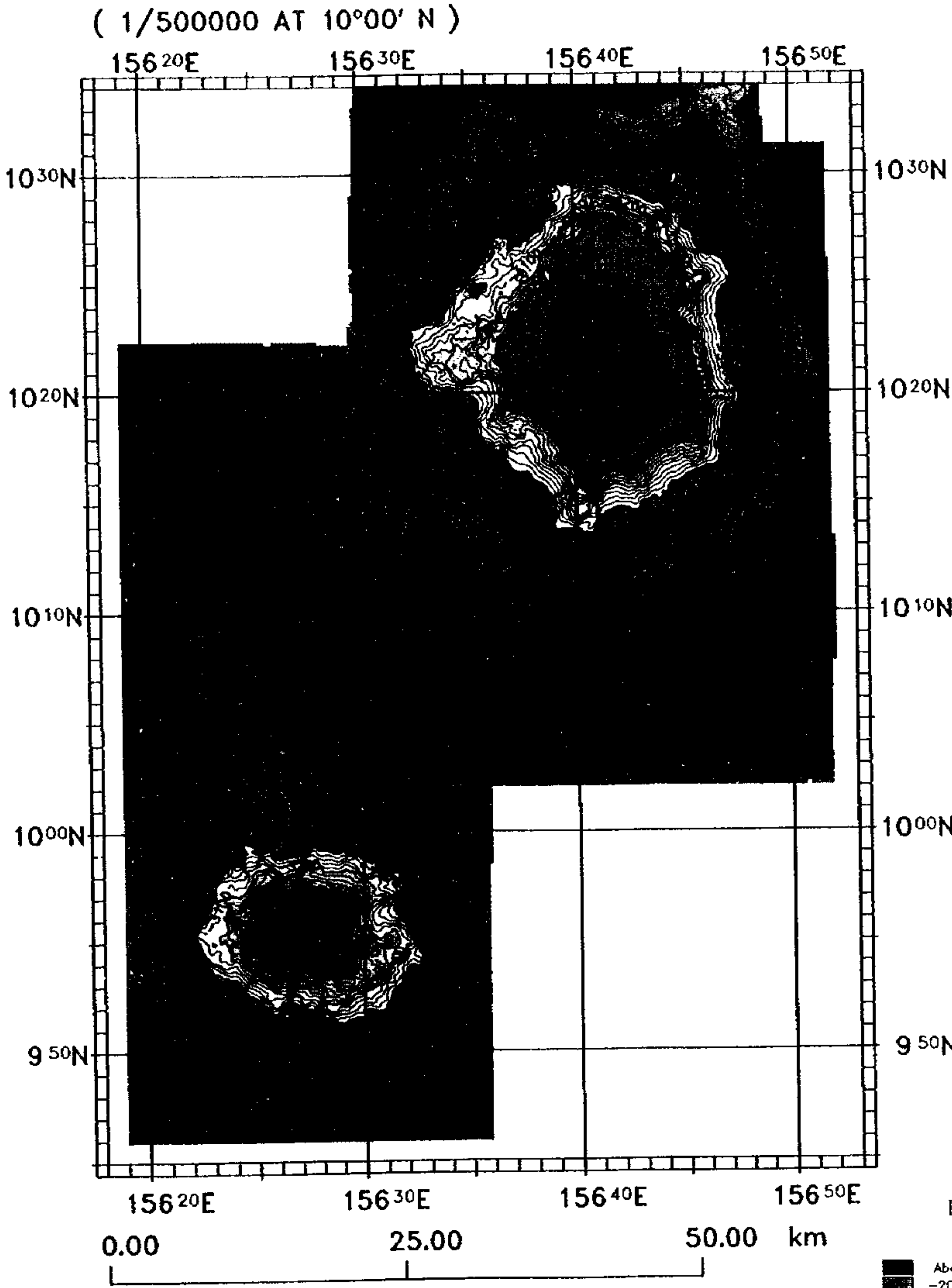


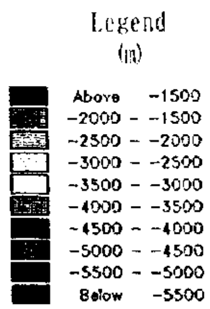
Appendix Fig. 2(7) Color-coded bathymetric map based on MBES of MC07 area.

(1/500000 AT 6°00' N)



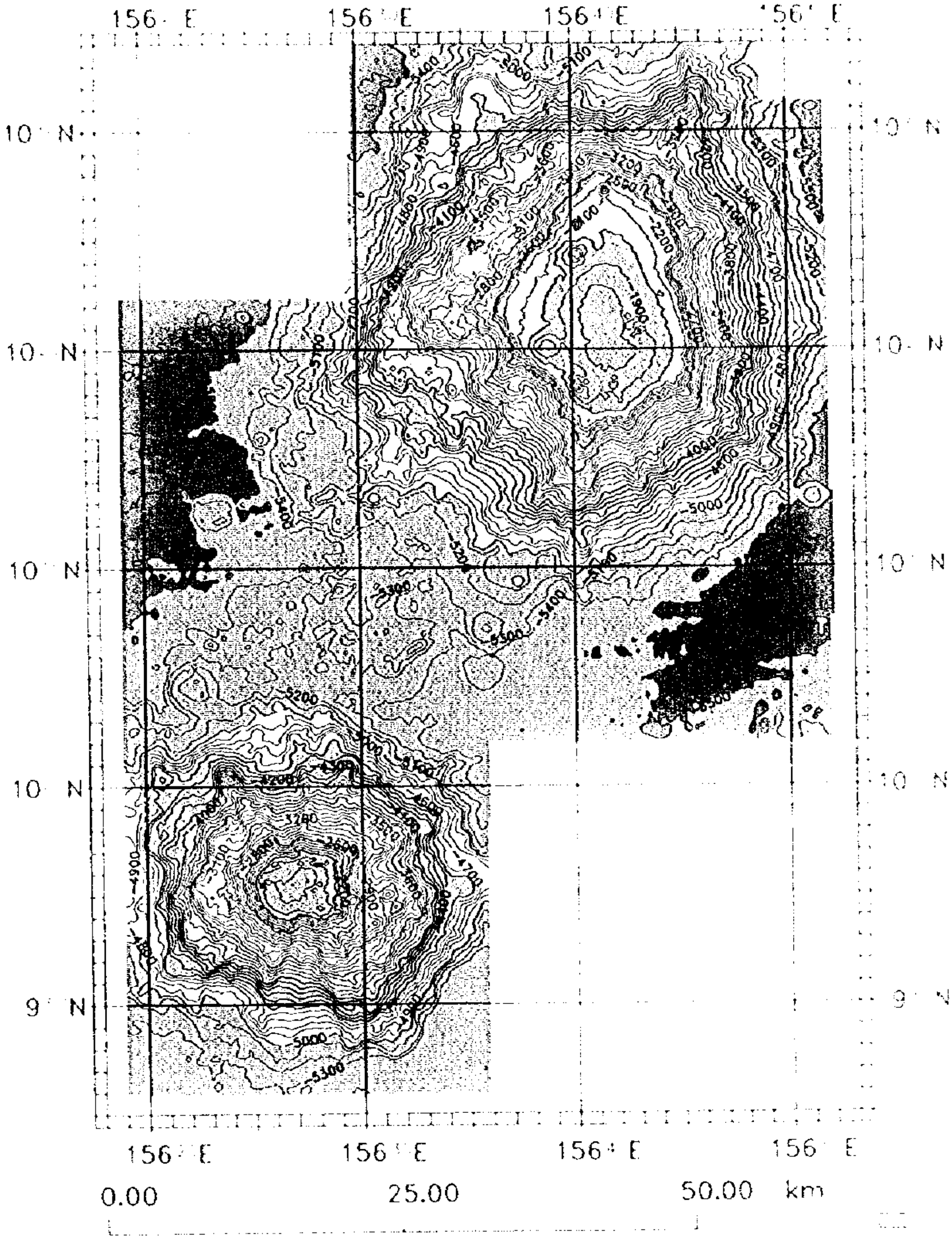
0.00 25.00 50.00 km

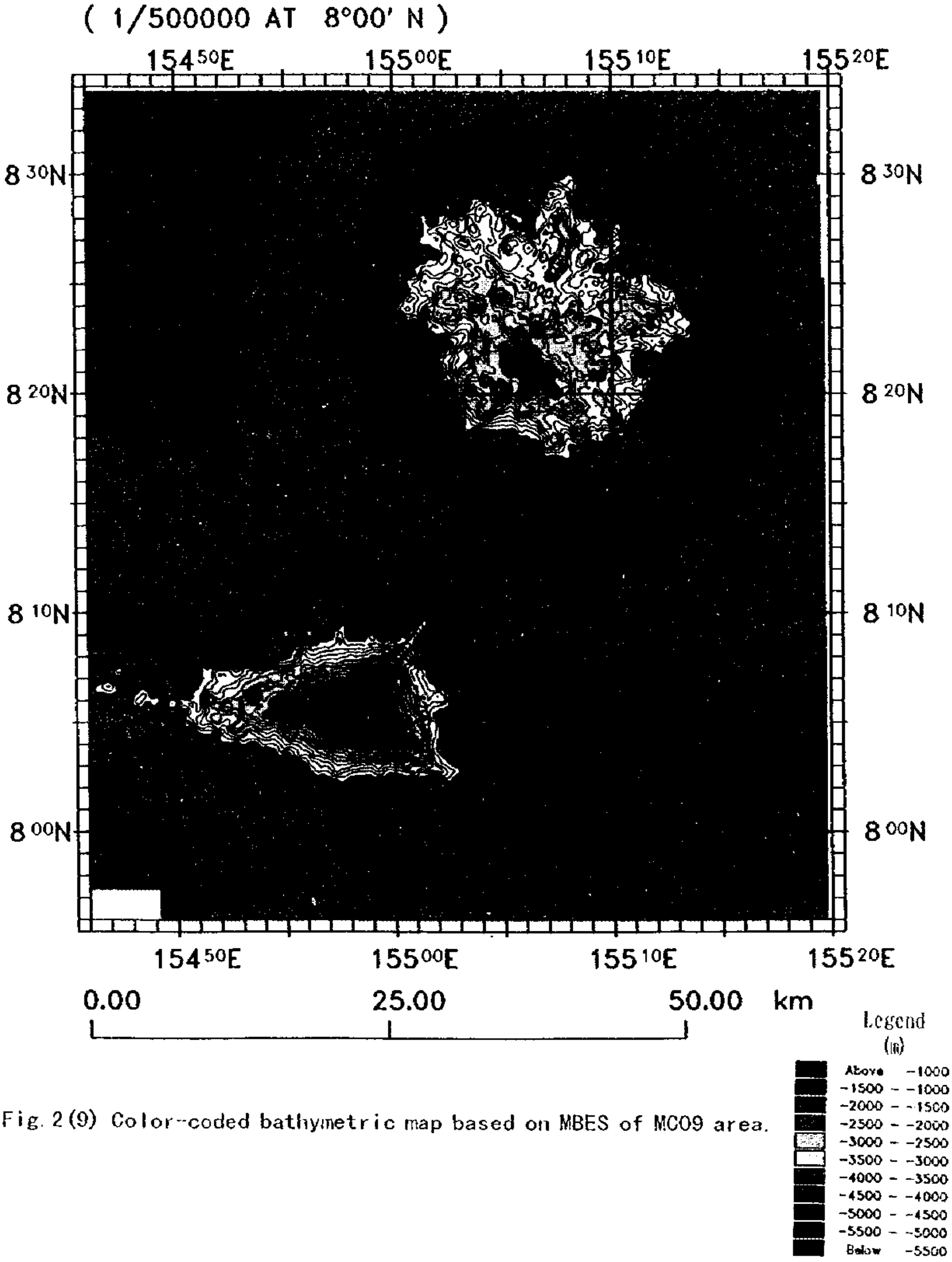




Appendix Fig. 2(8) Color-coded bathymetric map based on MBES of MC08 area.

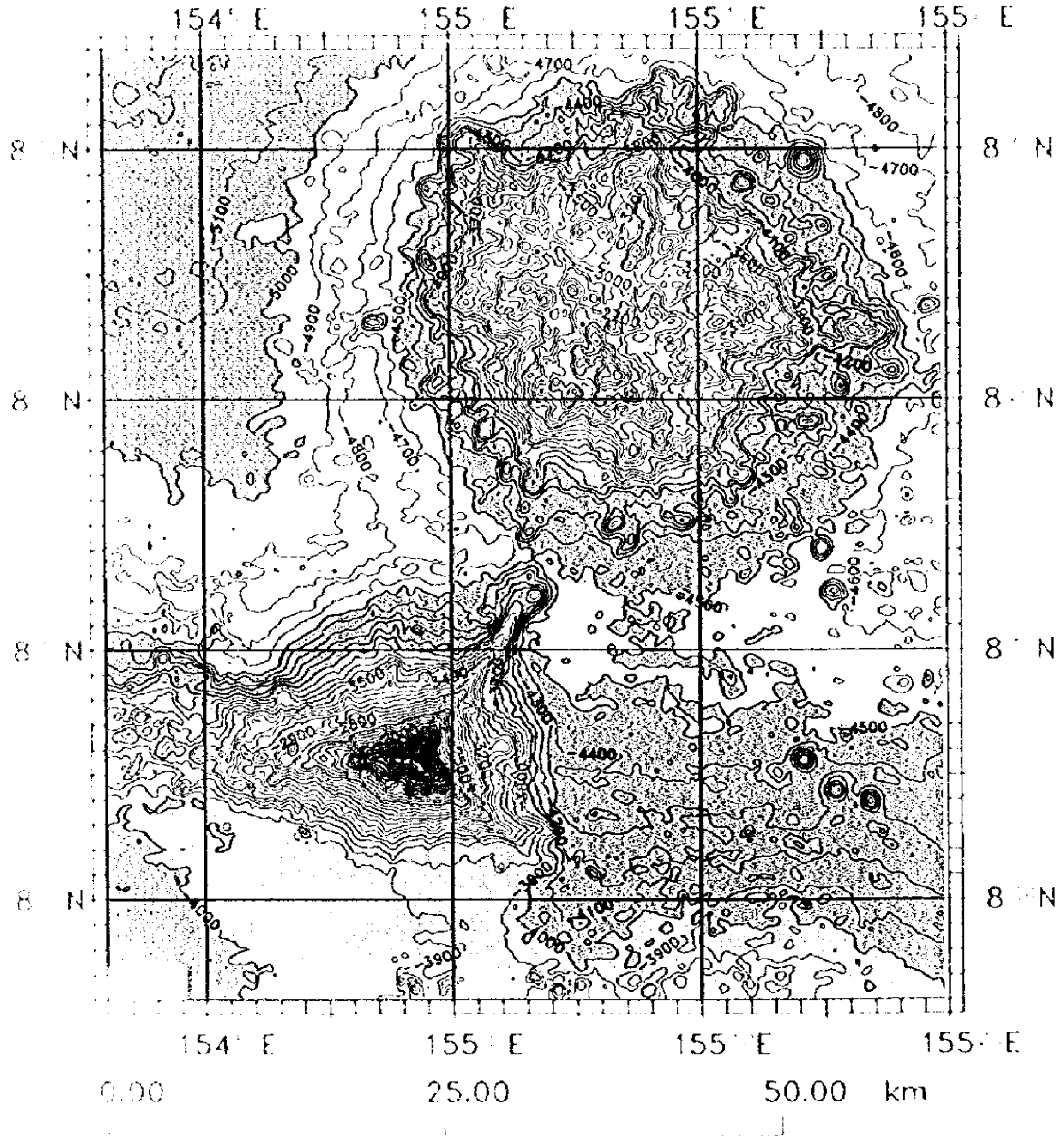
(1/500000 AT 10°00' N)

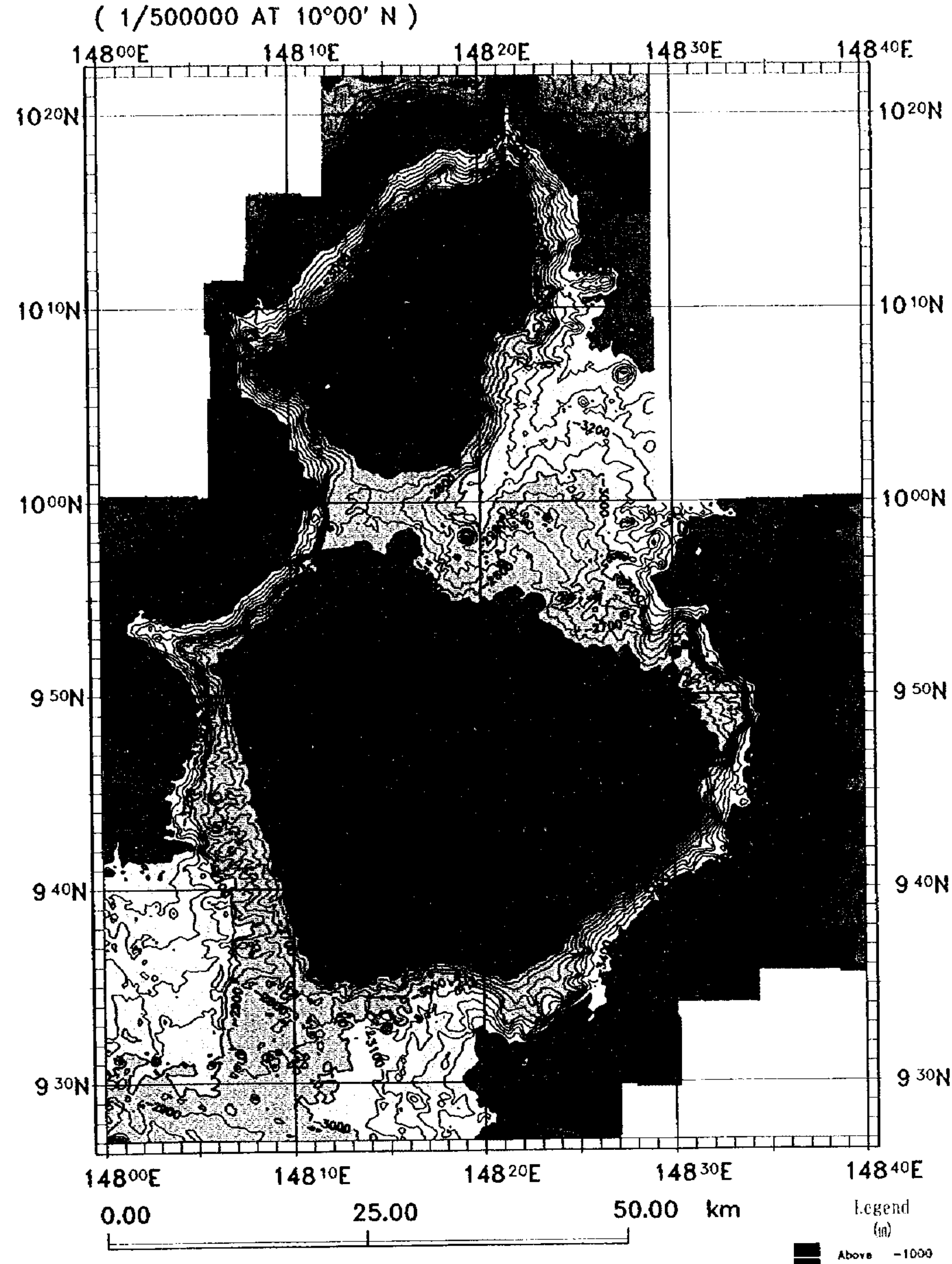




Appendix Fig. 2(9) Color-coded bathymetric map based on MBES of MC09 area.

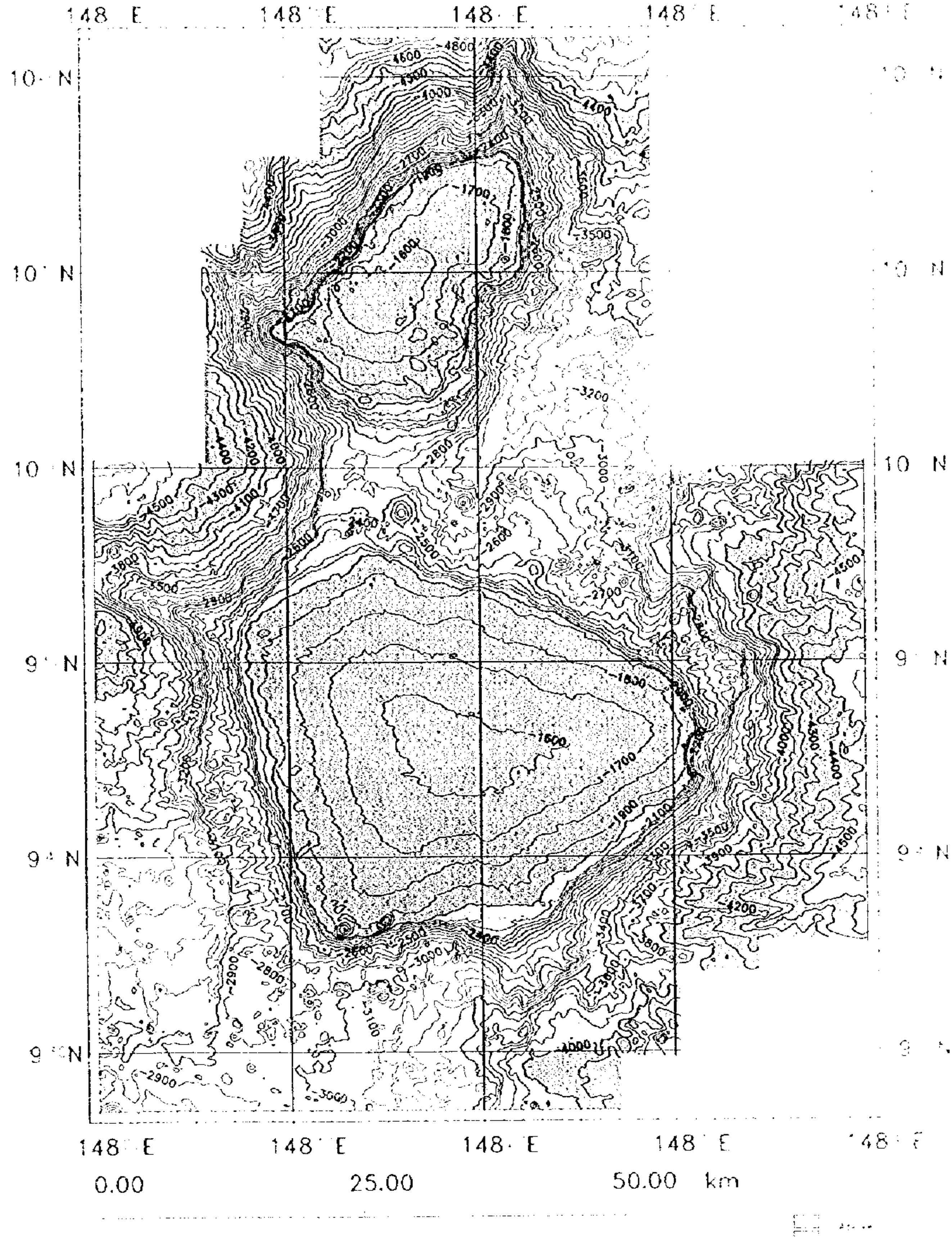
(1/500000 AT 8°00' N)

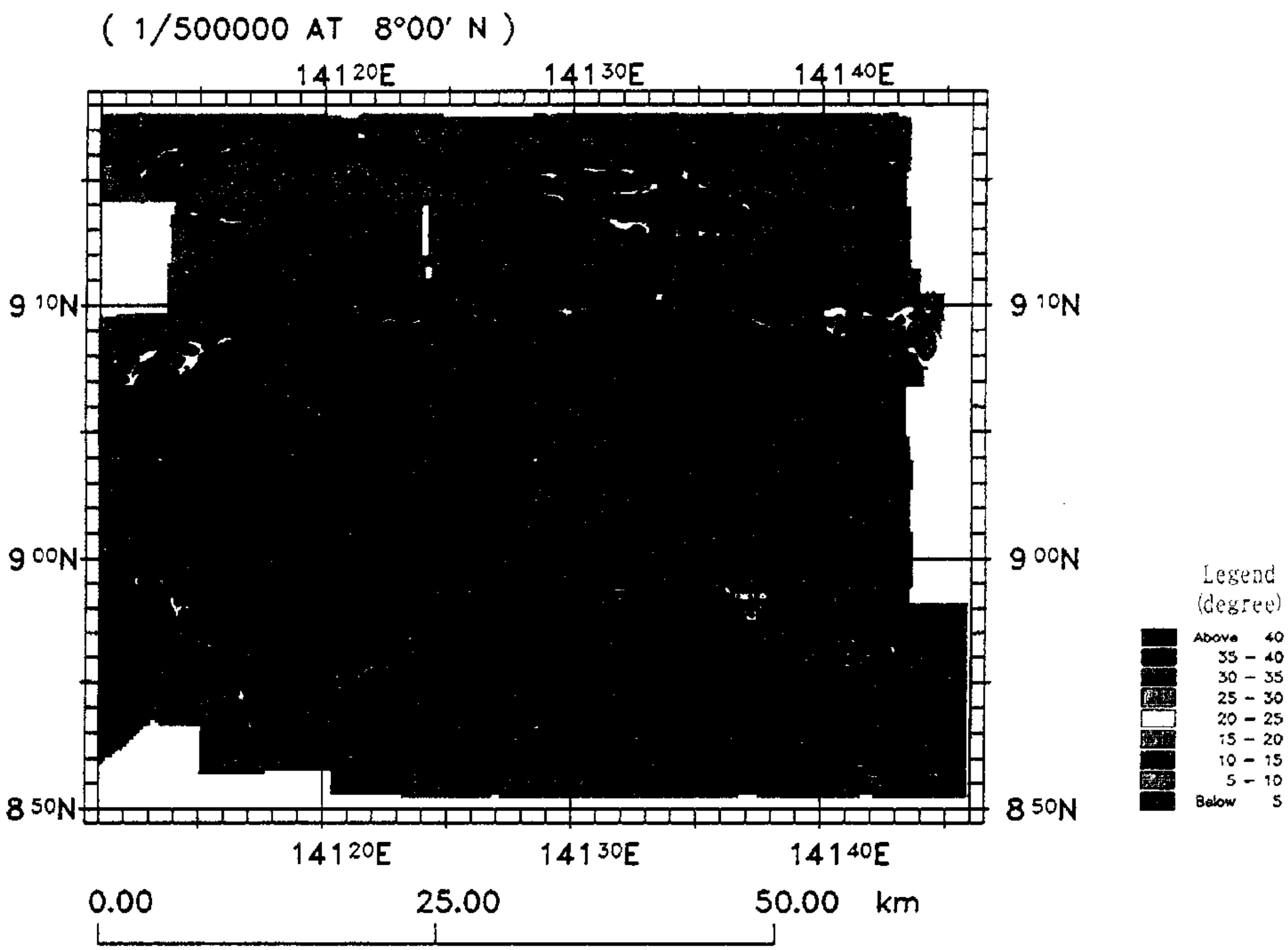




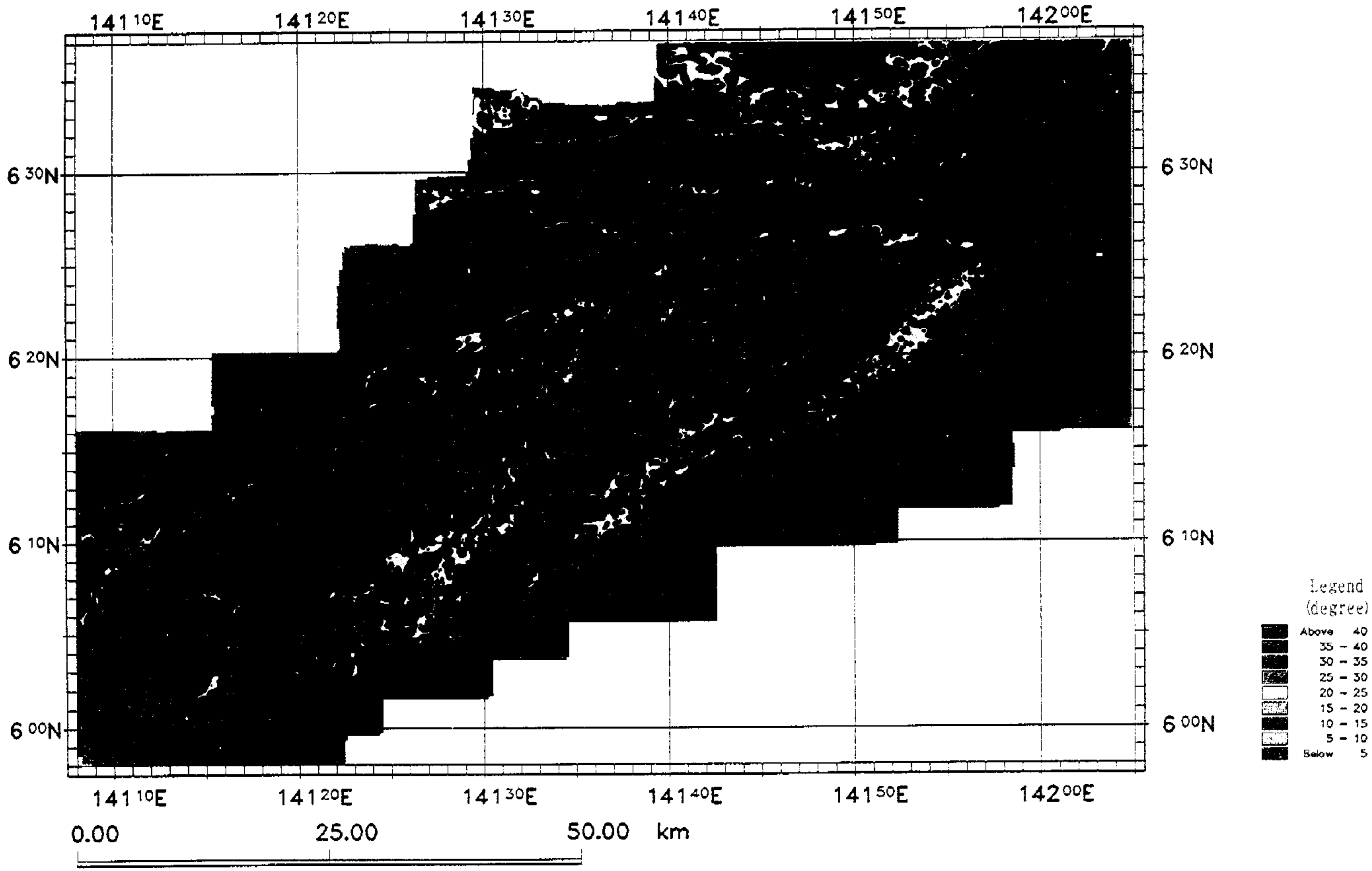
Appendix Fig. 2(10) Color-coded bathymetric map based on MBES of MC10 area.

(1/500000 AT 10°00' N)

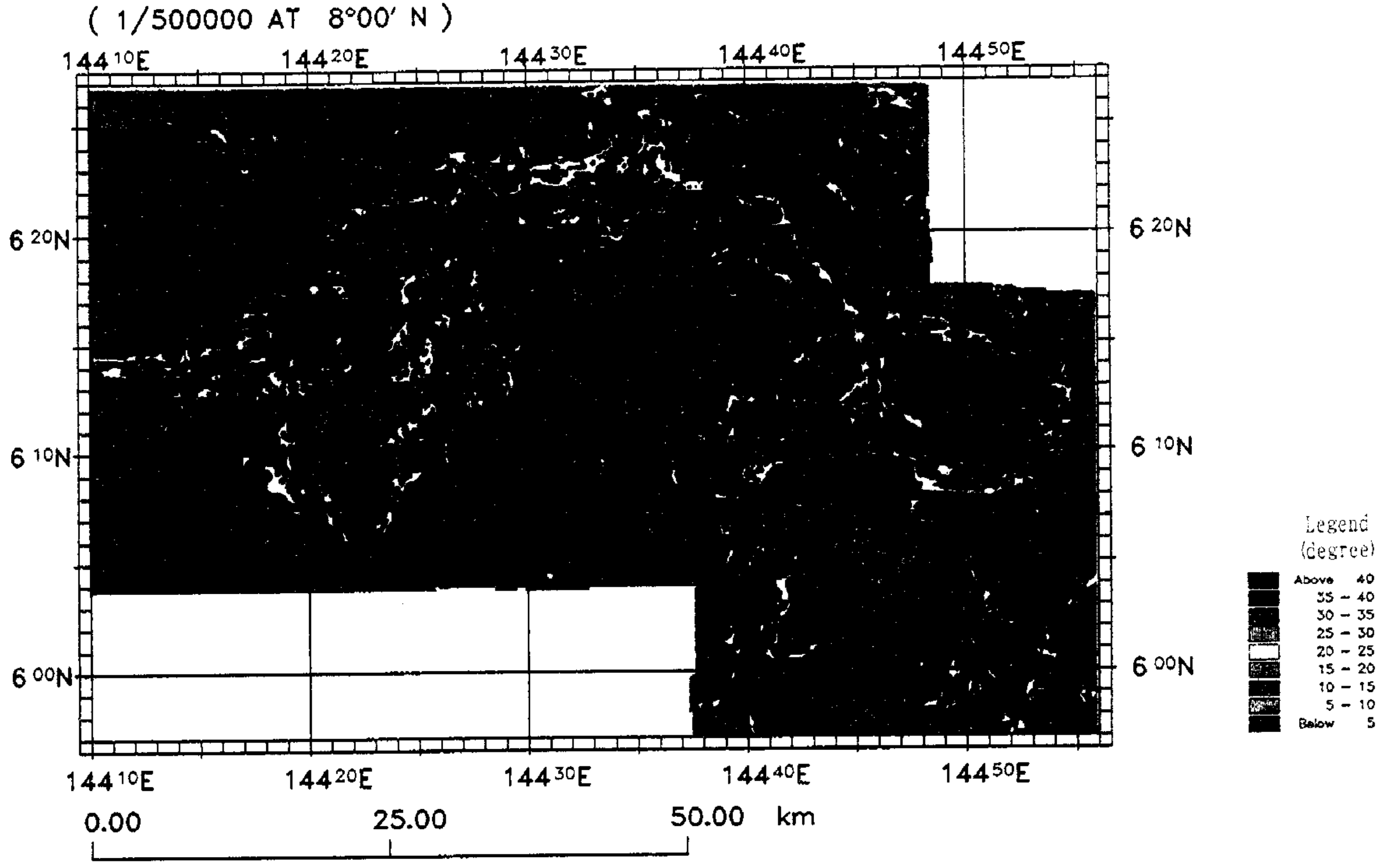




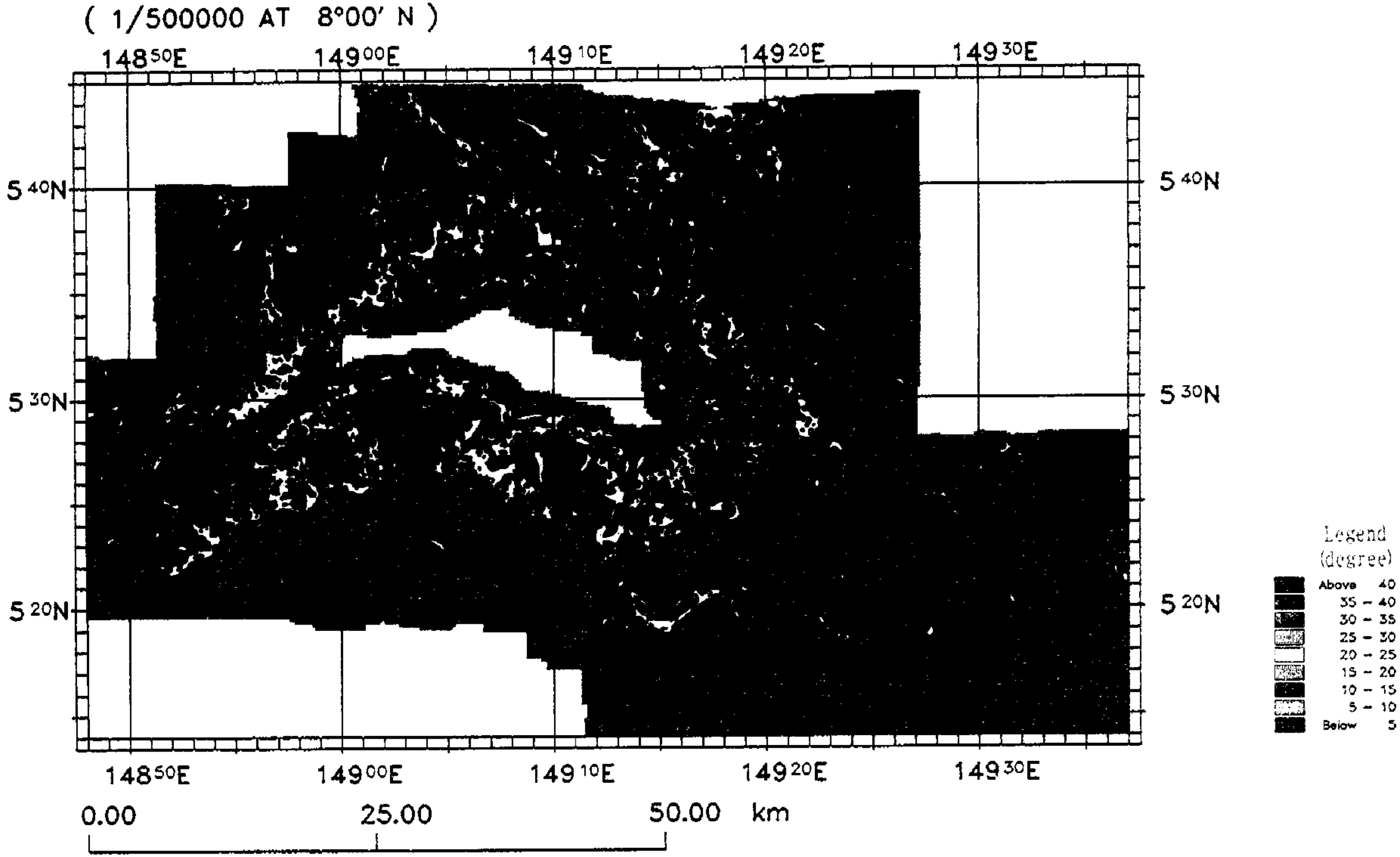
Appendix Fig. 3 (2) Topographic gradient map based on MBES of MC02 area.



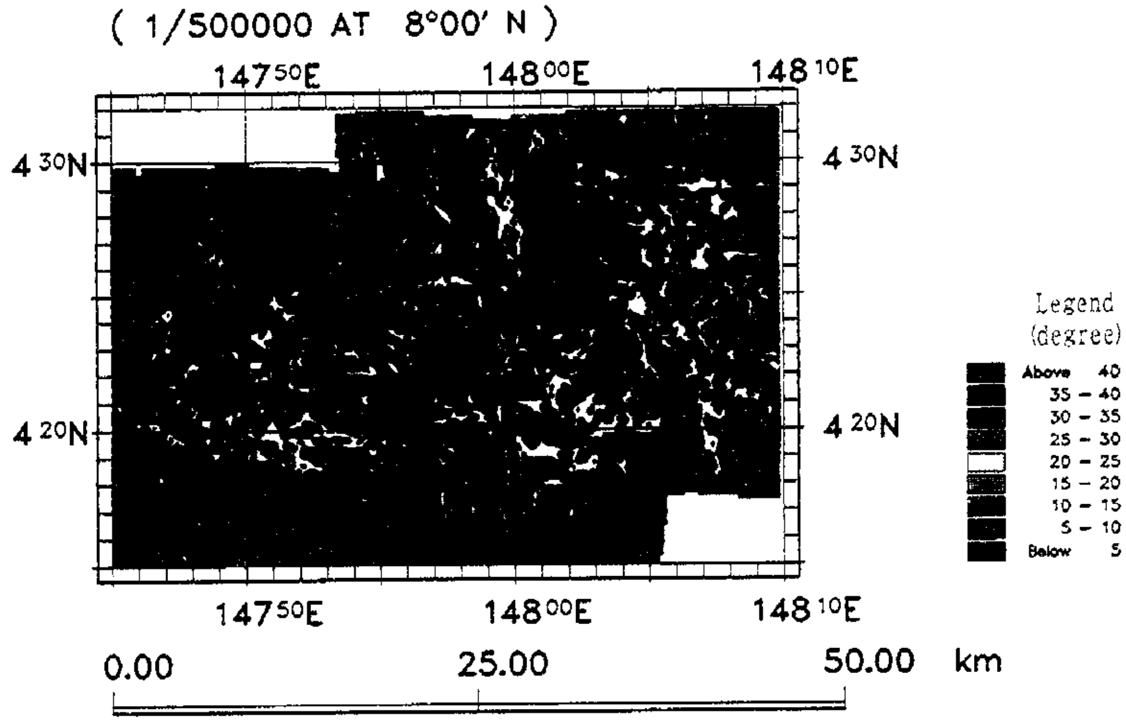
Appendix Fig. 3 (3) Topographic gradient map based on MBES of MC03 area.



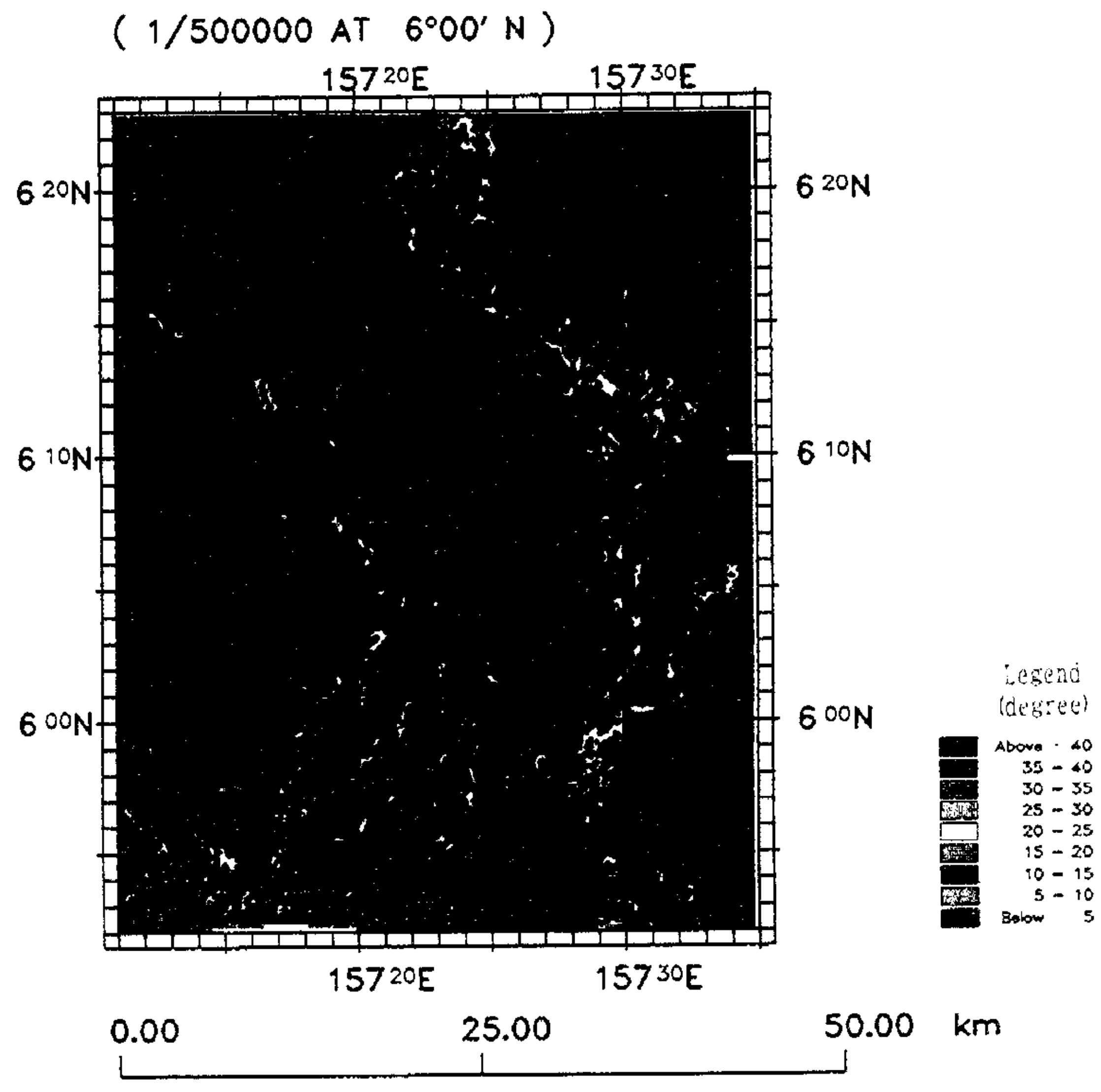
Appendix Fig. 3(4) Topographic gradient map based on MBES of MC04 area.



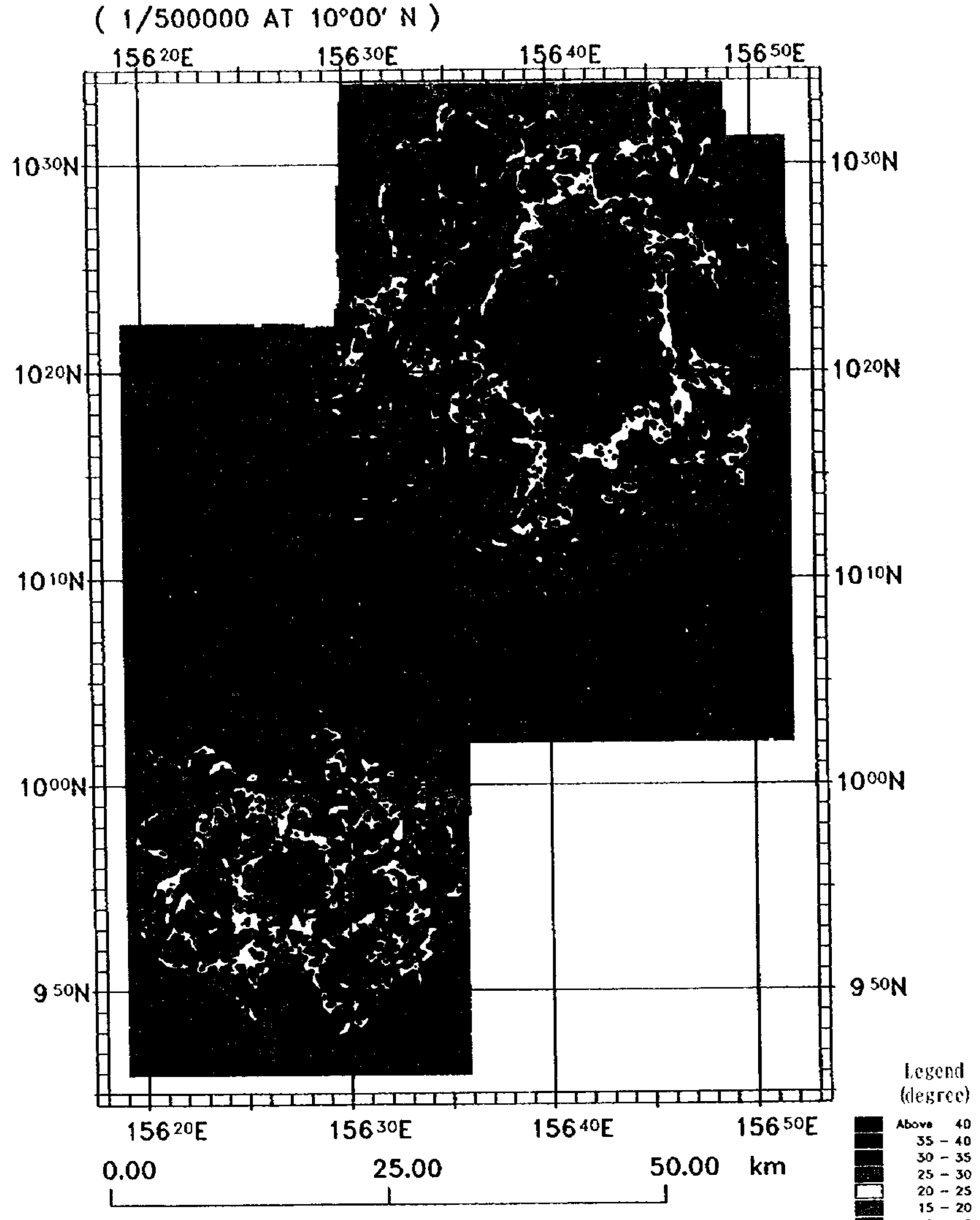
Appendix Fig. 3 (5) Topographic gradient map based on MBES of MC05 area.



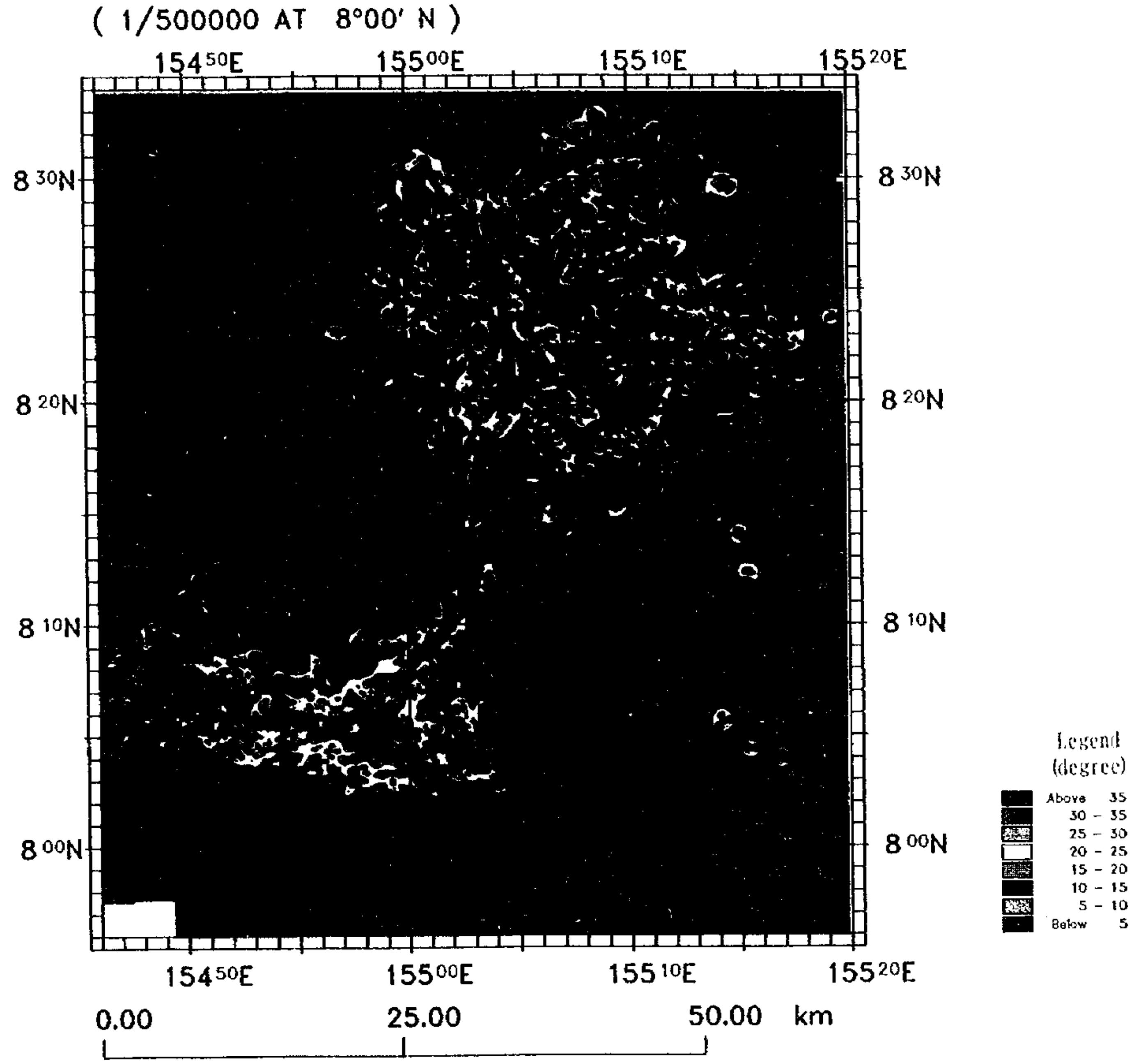
Appendix Fig. 3 (6) Topographic gradient map based on MBES of MC06 area.



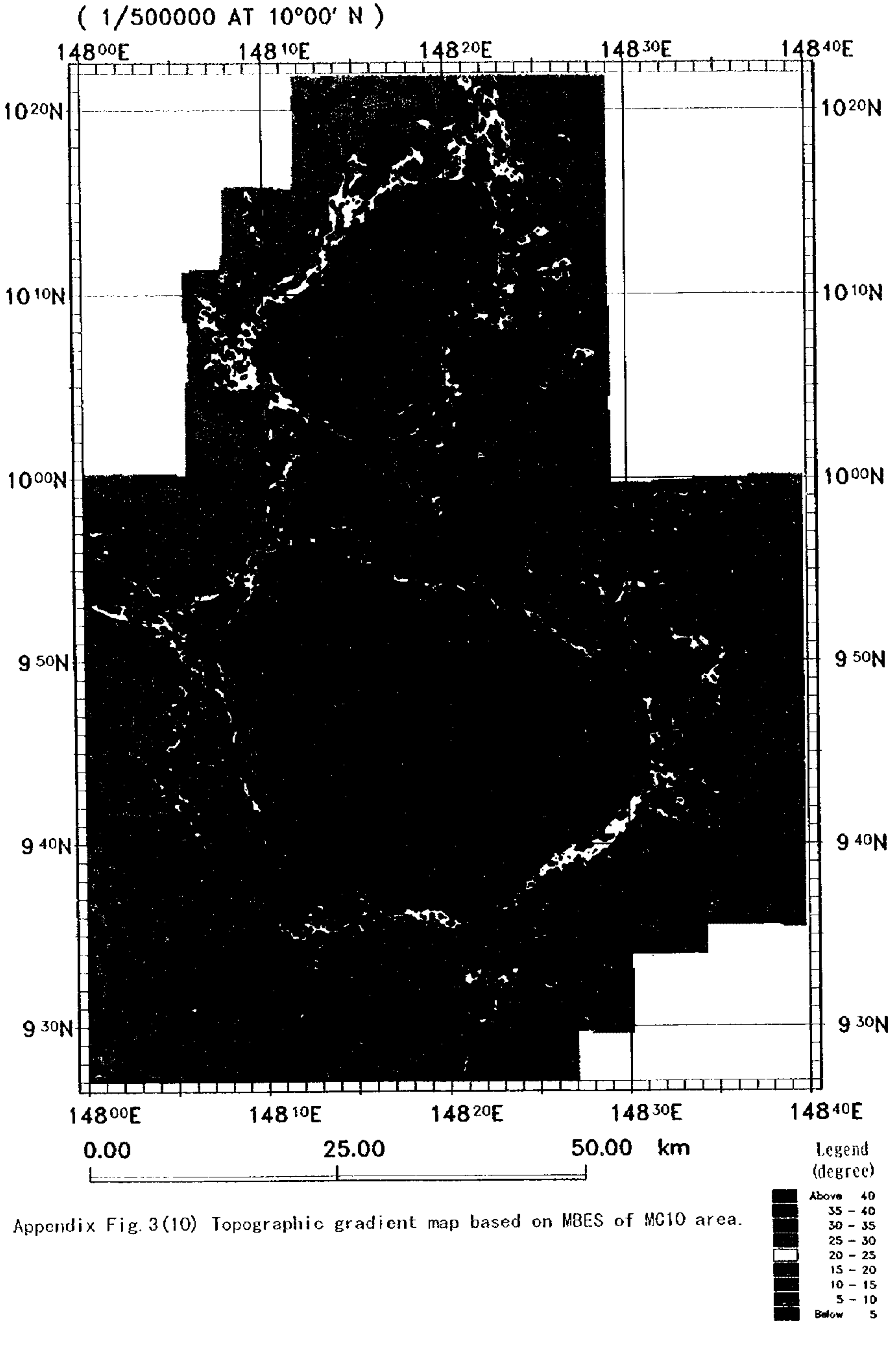
Appendix Fig. 3 (7) Topographic gradient map based on MBES of MC07 area.



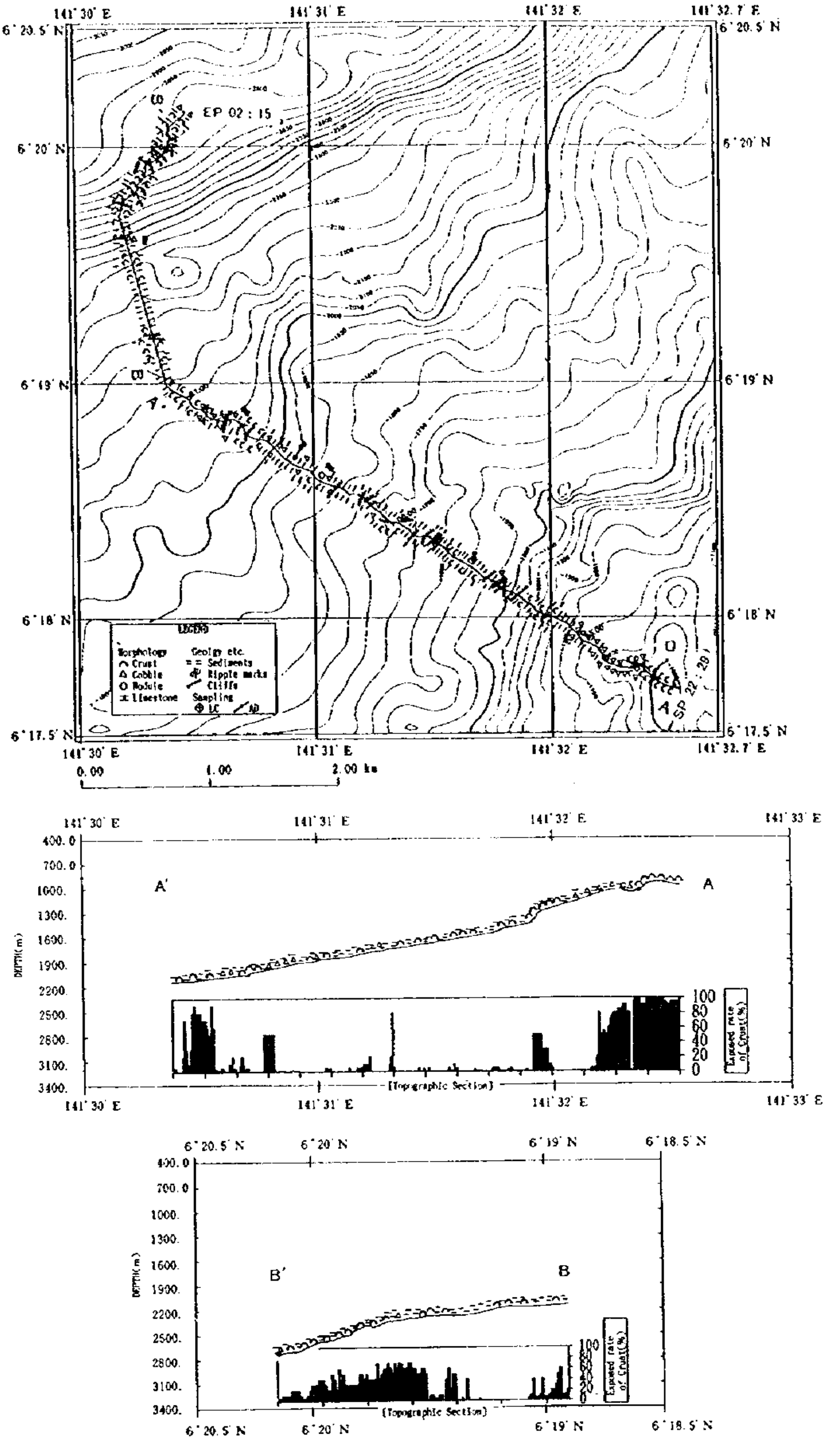
Appendix Fig. 3(8) Topographic gradient map based on MBES of MC08 area.



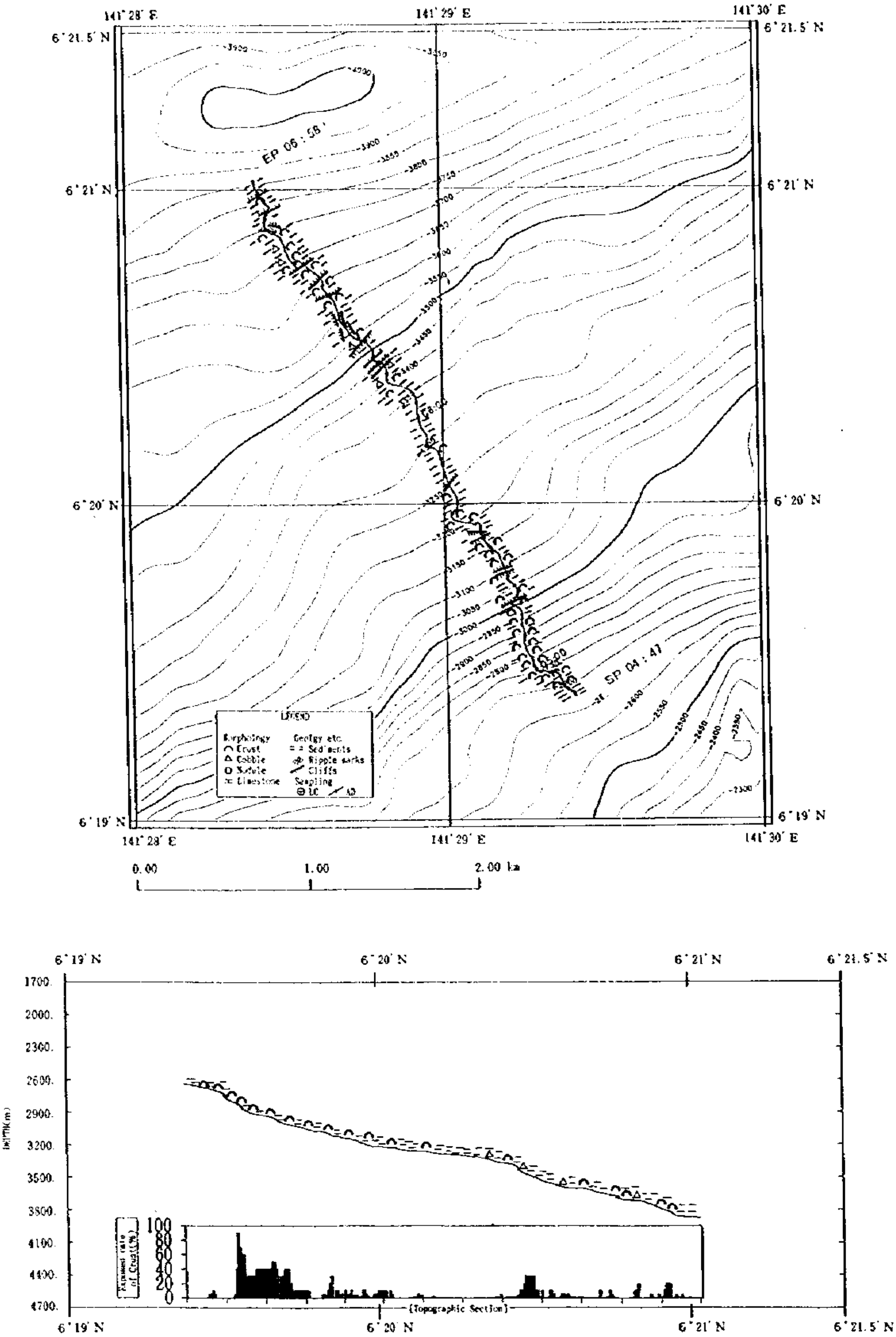
Appendix Fig. 3(9) Topographic gradient map based on MBES of MC09 area.



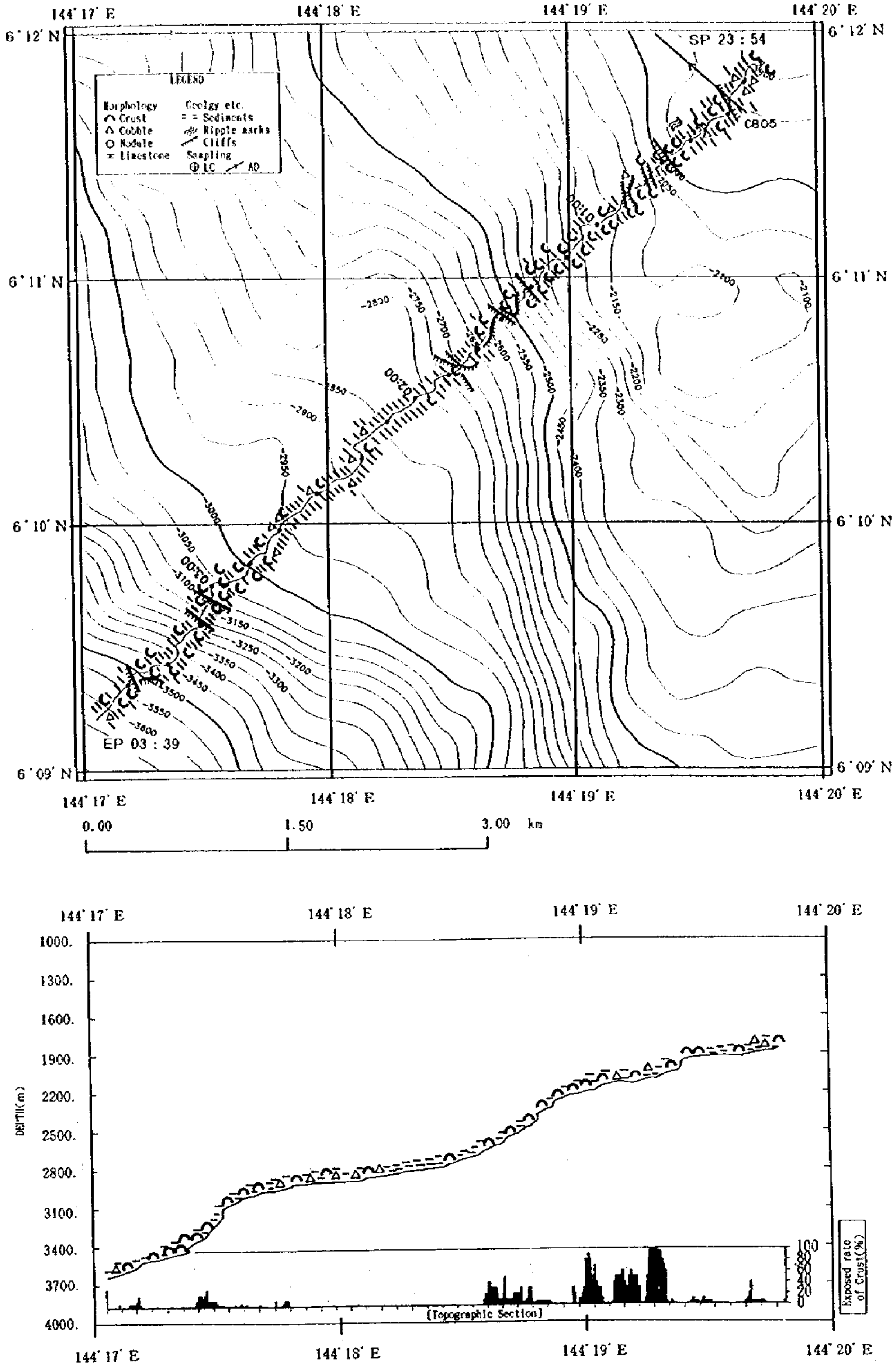
Appendix Fig. 3(10) Topographic gradient map based on MBES of MC10 area.



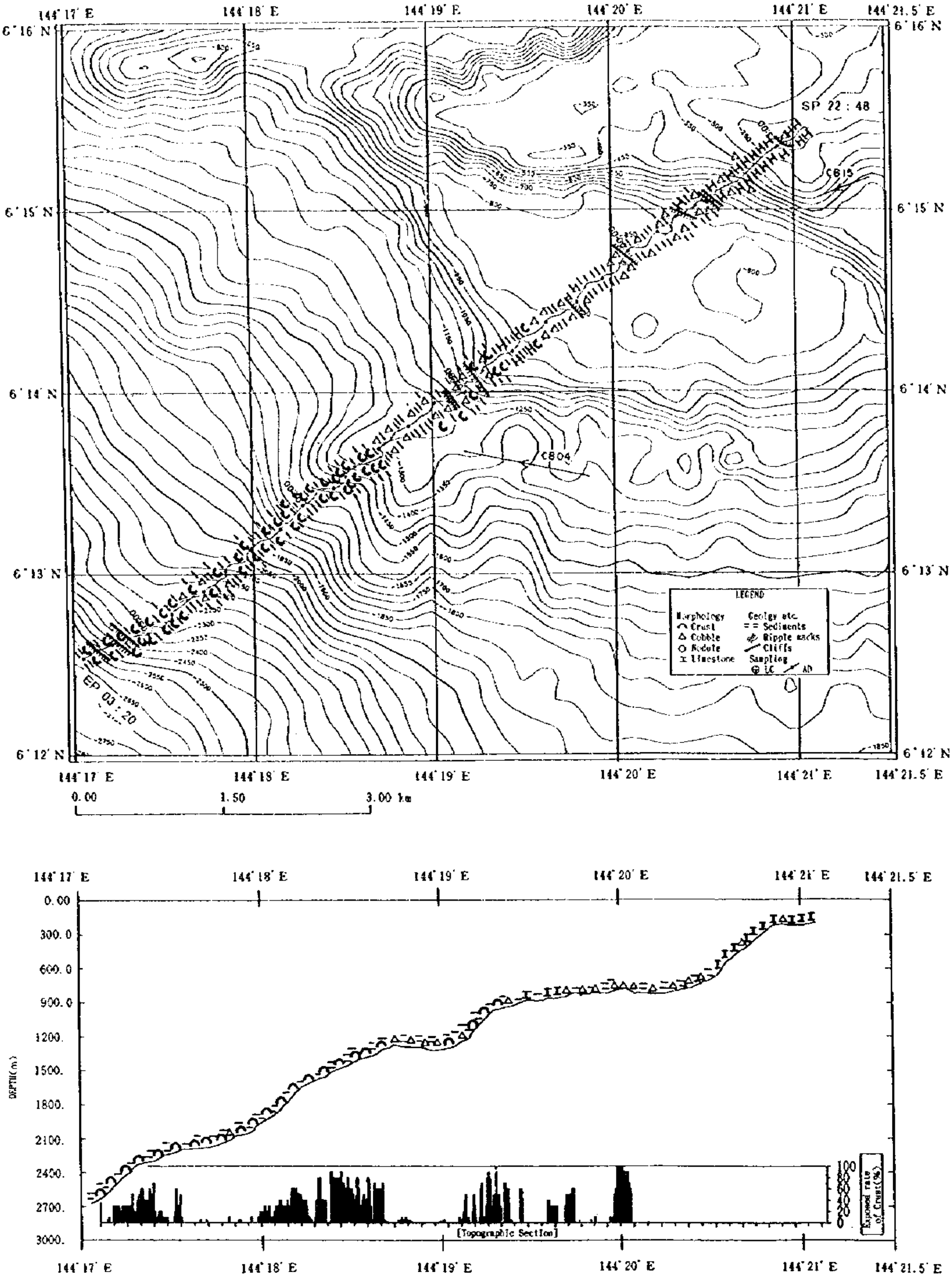
Appendix Fig. 4 (1) Route map of FDC observation and exposed rate diagram of manganese crusts (MC03 area : Line 97SMC03FDC010)



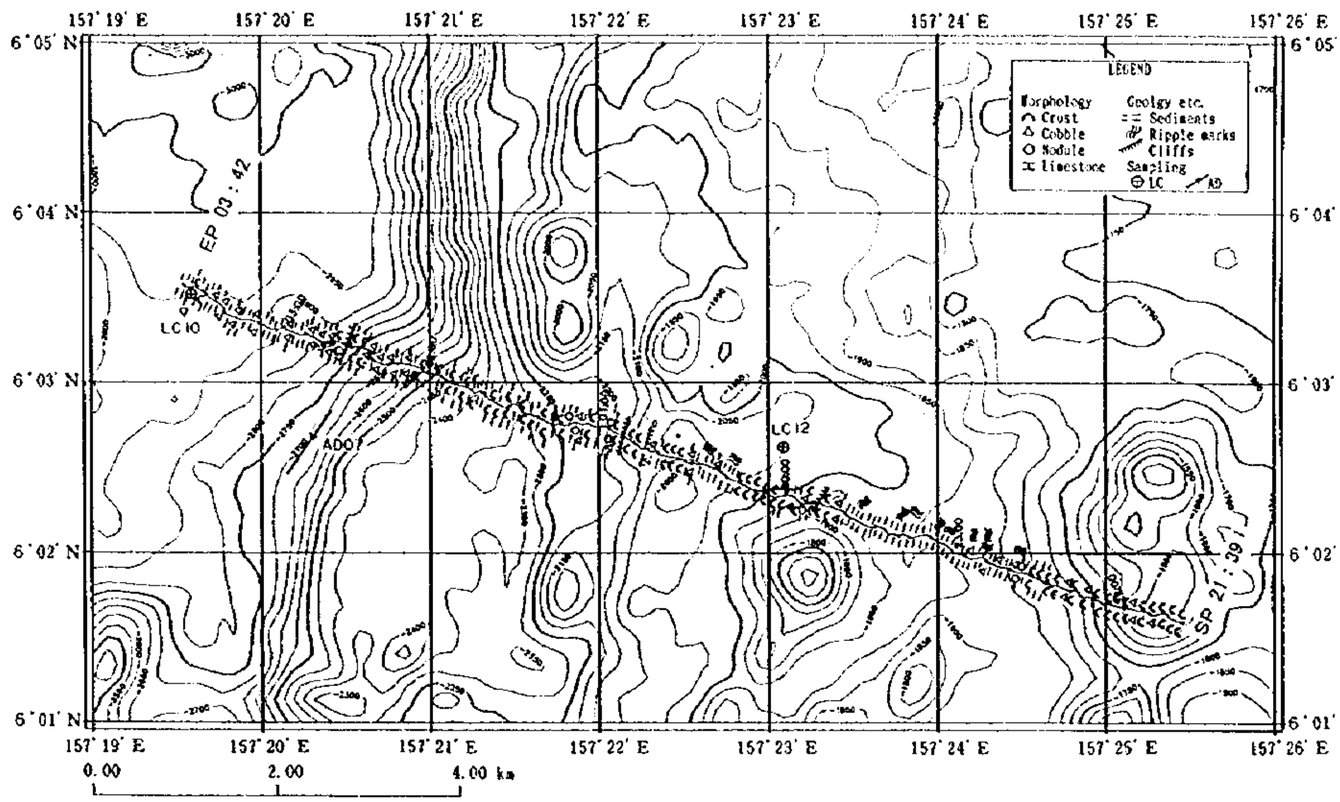
Appendix Fig. 4 (2) Route map of FDC observation and exposed rate diagram of manganese crusts (MC03 area : Line 97SMC03FDC011)

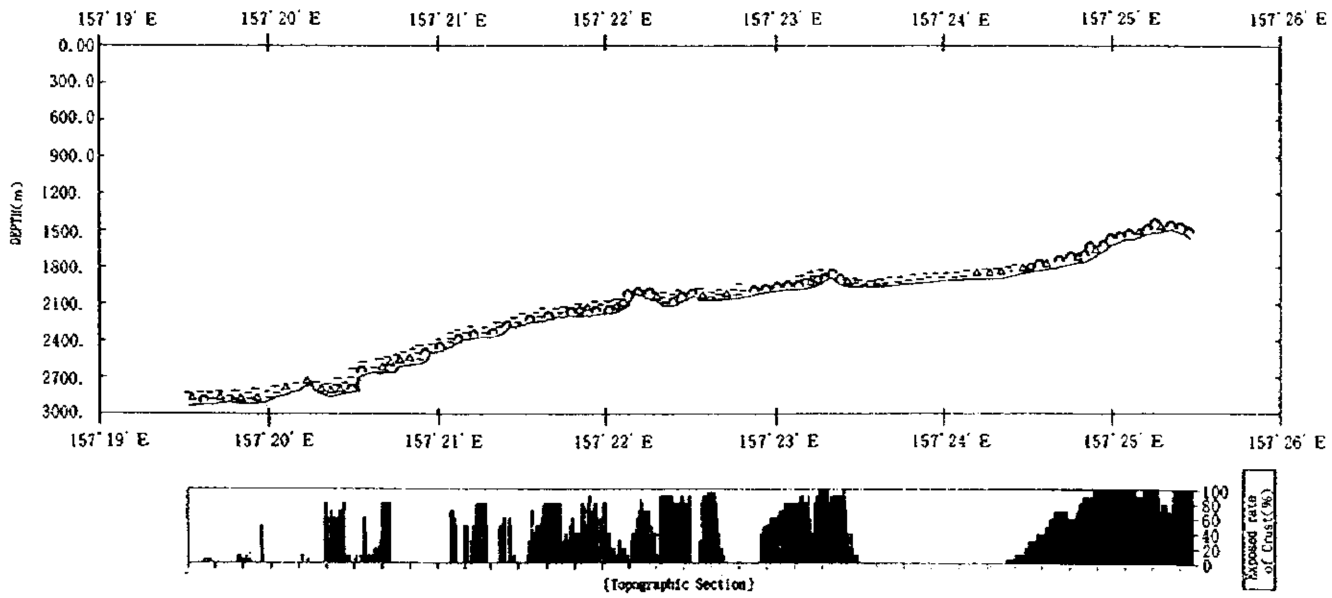


Appendix Fig. 4 (3) Route map of FDC observation and exposed rate diagram of manganese crusts (MC04 area : Line 97SMC04FDC01)

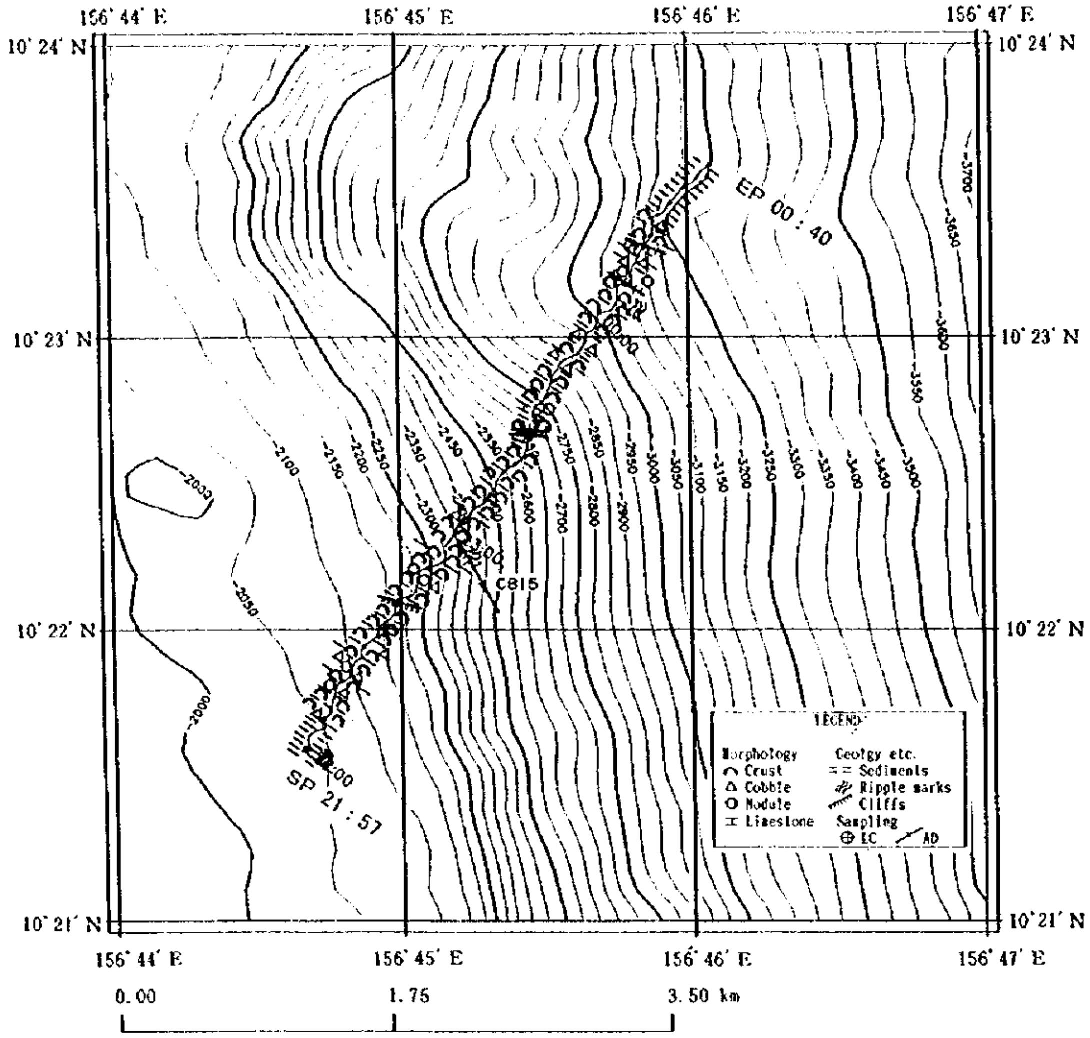


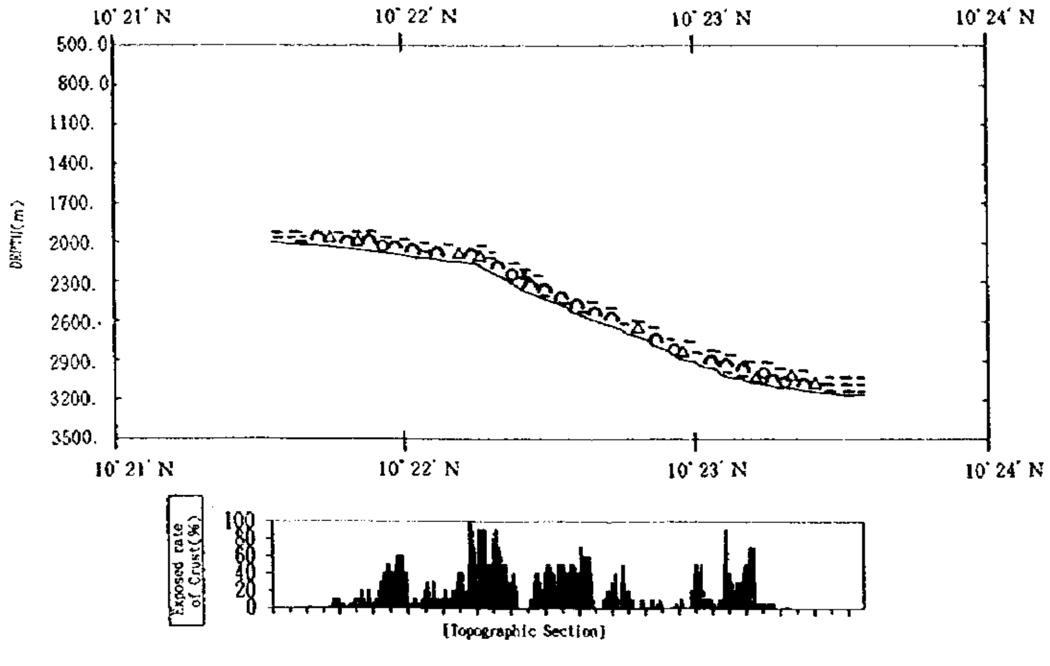
Appendix Fig. 4 (4) Route map of FDC observation and exposed rate diagram of manganese crusts (MC04 area : Line 97SMC04FDC02)



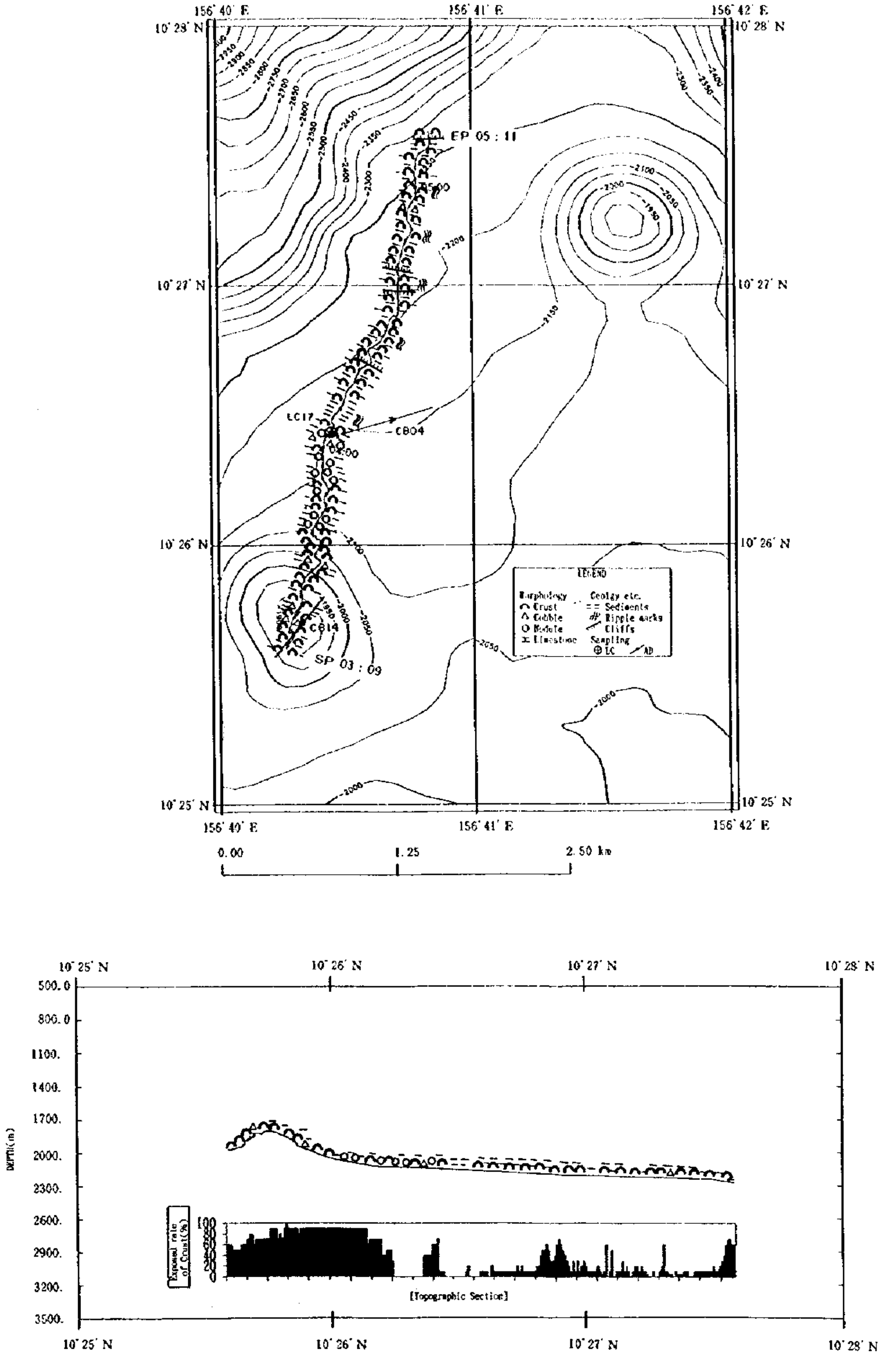


Appendix Fig. 4 (5) Route map of FDC observation and exposed rate diagram of manganese crusts (MC07 area : Line 97SMC07FDC01)

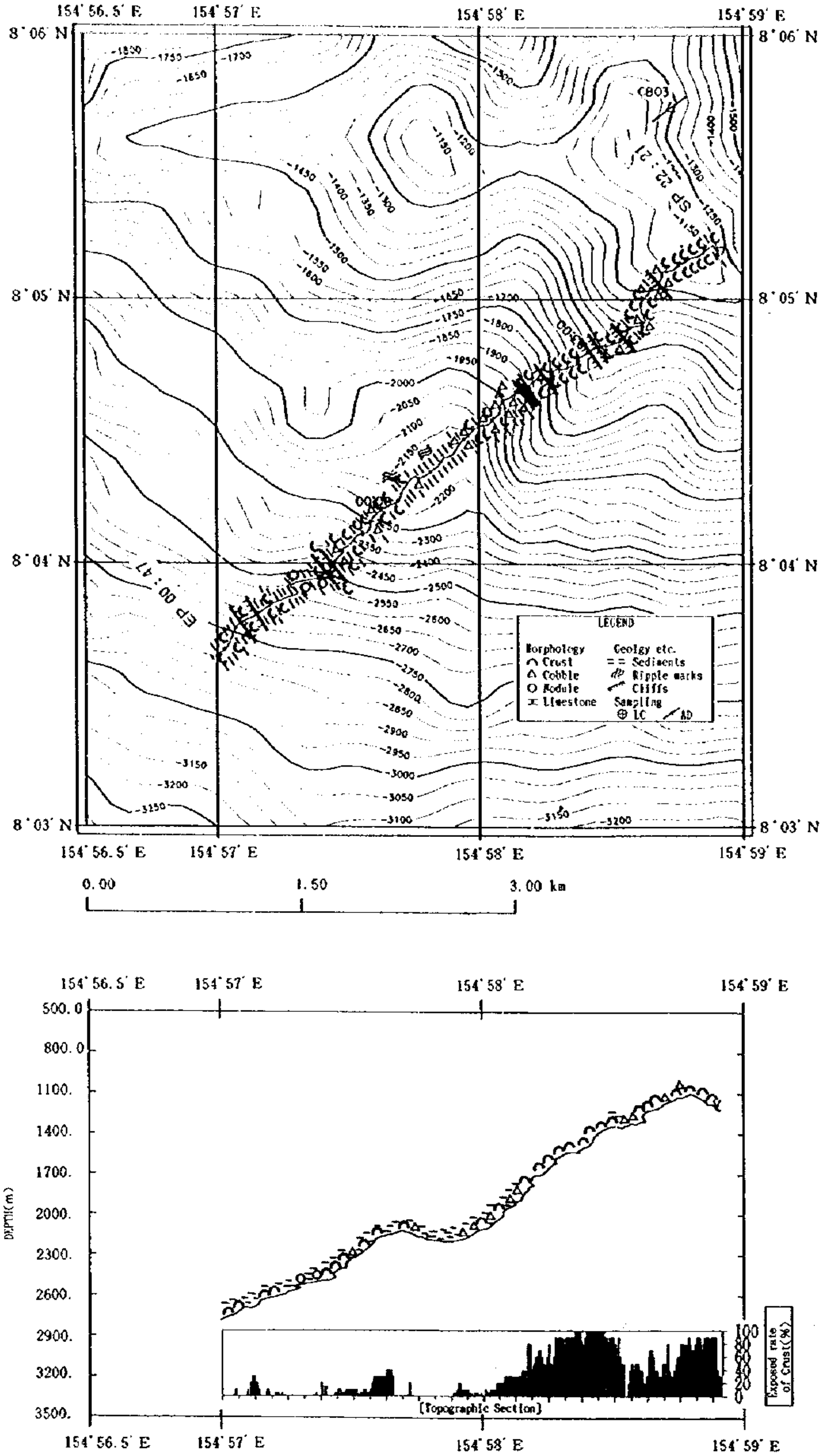




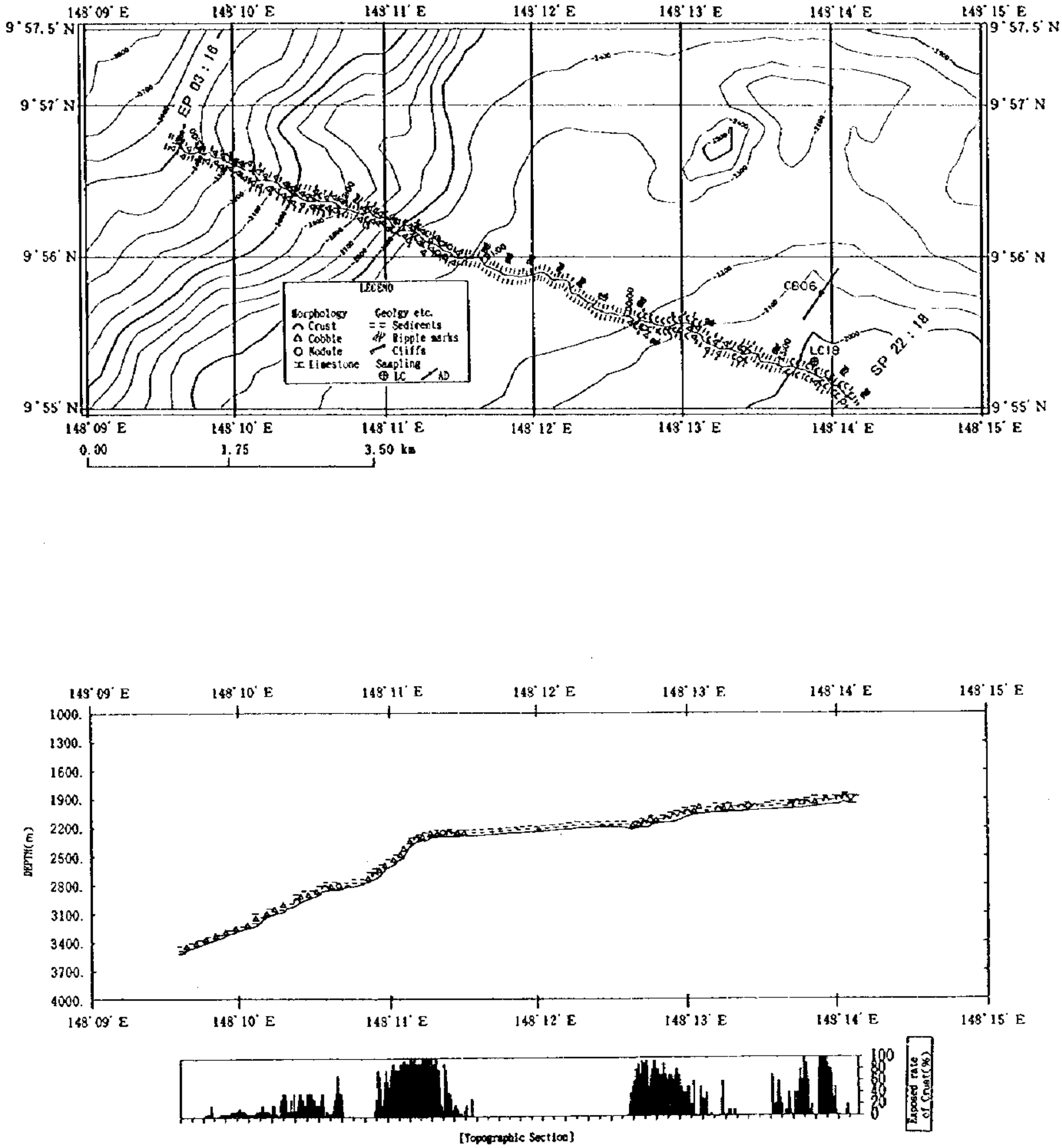
Appendix Fig. 4 (6) Route map of FDC observation and exposed rate diagram of manganese crusts (MC08 area : Line 97SMC08FDC01)



Appendix Fig. 4 (7) Route map of FDC observation and exposed rate diagram of manganese crusts (MC08 area : Line 97SMC08FDC02)



Appendix Fig. 4 (8) Route map of FDC observation and exposed rate diagram of manganese crusts (MC09 area : Line 97SMC09FDC01)



Appendix Fig. 4 (9) Route map of FDC observation and exposed rate diagram of manganese crusts (MC10 area : Line 97SMC10FDC01)