Preliminary Report
of
the Hakuho-Maru Cruise KH98-1

January 16 - March 16, 1998

Tokyo-Cairns-Pohnpei-Tokyo

Legs 1 and 2: Marine Geological and Geophysical Study of Ontong-Java Plateau and Northern Solomon Trench (ODP)

Leg 3: Chemical, Geological and Physical Oceanography of the Caroline Basin and the Mariana Arc System

by
The Scientific Members of the Cruise

Edited by
Asahiko Taira, Chief of the Mission

The Ocean Research Institute, The University of Tokyo
1-15-1 Minamidai, Nakano-ku, Tokyo 164-8639

Contents

Nauru basin seismic investigation with MCS reflection and sonobuoy refraction (R. L. Larson and L. J. Abrams)

A Study of the Crust and Upper-Mantle Structure of OJP using OBSs (Kimihiro Mochizuki, Eiichiro Araki, Shinji Yoneshima, Masanao Shinohara, Seiichi Miura, Yasuhira Aoyagi, Hiromasa Nishisaka, Manabu Mochida, Takashi Yoshizawa, Takeshi Sato, Minoru Nishino)

The circulation of the intermediate and deep water mases in the western tropical Pacific. (Mueller, Carlsen, Yamashiro, Kitagawa, Hasumoto et al.)

Seafloor Magnetotellurics of Western Pacific Upper Mantle - OBEM Study [Leg 3] - (Hiroaki TOH and Tadanori GOTO)

Petrological studies on the geological cross section exposed along the Southern Mariana trench inner wall during KH98-1 (Leg 3) cruise. (Ishii, Haraguchi, Hirata, Hayasaka, Maedima, Sato, Taniguchi, Masuda, Yamanaka and Nishio)

Crustal evolution and back arc tectonics of the southern end of the Mariana Trough (H. Masuda)

Search for and chemical characterization of hydrothermal plumes in the Mariana Trough during the KH-98-1 Cruise(T.Gamo, H. Hasumoto, S. Kitagawa, K. Okamura, E. Nakayama, H. Obata, J. Ishibashi, Y. Nishio, H.Masuda, T. Yamashiro, T. Yamanaka)

Air sampling for measuring stable carbon isotopic composition of non-methane hydrocarbons (NMHC) and methyl chloride (CH3CI) in western Pacfic atmosphere (U. Tsunogai and N. Yoshida, T. Gamo)

Onland collection fo igneous rocks at Pohnpei (Ponape) island , Federated States of Micronesia (Teruaki, Ishii, Yasutaka Hayasaka, Hiroshi Sato, Yukiko Hirata, Takeaki Maejima, Satoru Haraguchi and Hidetsugu Taniguchi)

Preface

Cruise KH98-1 by the R/V Hakuho Maru of the Ocean Research Institute, the University of Tokyo composed of three legs:

Leg 1: Geological and geophysical investigation of the Ontong-Java Plateau (OJP), northern Solomon Trench and Lyra Basin.

Leg 2: Multichannel seismic reflection and sonobuoy refraction survey of the OJP and Nauru Basin stratigraphy.

Leg 3: Geological, geochemical and physical oceanographic studies of the Carolina Basin and the Marina Arc.

Legs 1 and 2 included site survey activities for the Ocean Drilling Program.

Ontong Java Plateau is the largest oceanic plateau in the present world ocean and represents a product of episodic mass and heat transfer process probably by mantle plume during the Cretaceous. The mode of magnetic process and tectonic setting of this plateau formation, however, remains largely unconstrained.

The fate of oceanic plateau at a convergent margin is another fundamental problem related to mass balance and plate kinematics. What is the effect of plateau collision on the continental crust formation and evolution ? Does plateau collision affect the global plate kinematics ? How is the "subductibility" of oceanic plateau lithosphere ? The collision of the OJP against the Solomon arc provides an opportunity to investigate such important questions related to oceanic plateau collision.

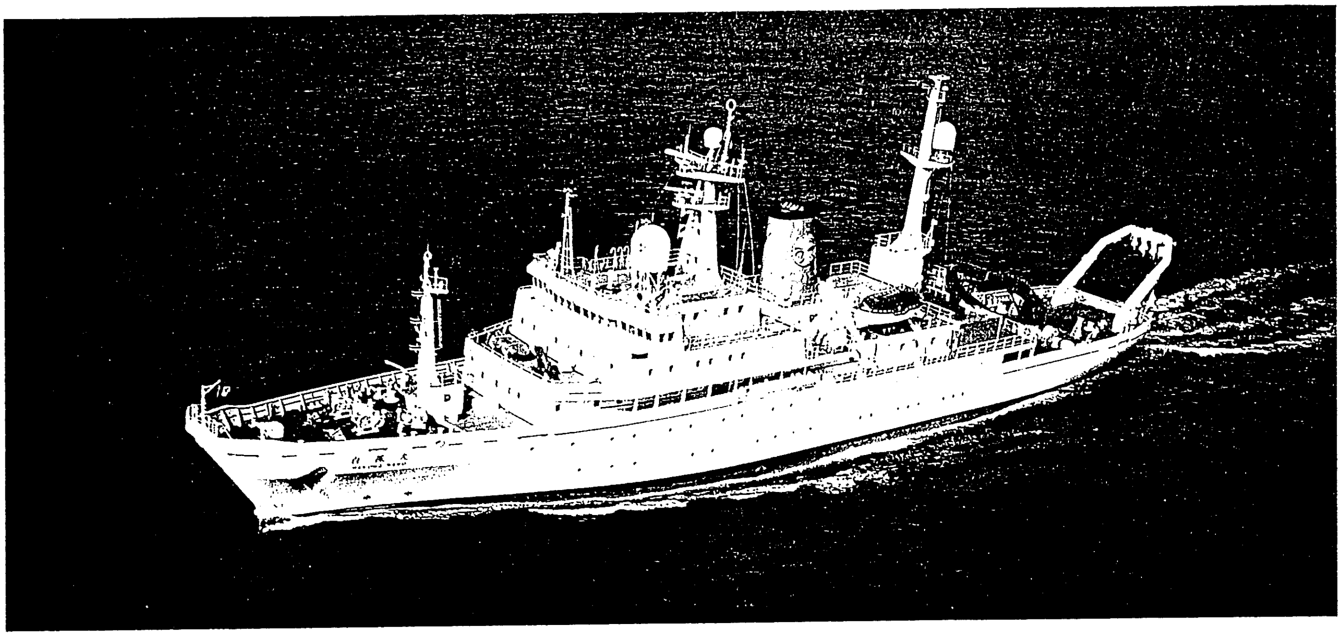
The main objectives of Legs 1 and 2 are to investigate the above two questions (origin of oceanic plateau and its fate at convergent margin) using marine geophysical and geological methods.

During Leg 3, three sets of scientific targets were addressed: deep water circulation of the Western Pacific tropical region, nature of hydrothermal activity in the Mariana Trough (a back arc basin) and petrological evolution of the Mariana arc system. Retrieval of mooring systems previously deployed by R/V Sonne, hydrocast works and rock dredge sampling were conducted for this purpose.

The cruise was quite successful and we have achieved more than 90% of what we had planned. We thank the ship's officers and crew members for their effort to support this cruise. A part of Japanese scientist participation

was financially supported by the grant-in-aid of Monbusho to the chief scientist. 12 foreign scientists participated the cruise. Among them, 4 scientists were supported by JOI for their ODP site survey augmentation activities. I thank for each country's interest and support for the success of this cruise.

Asahiko Taira
Chief scientist of the cruise



HAKUHO MARU

OPERATING CHARACTERISTICS OF R.V. HAKUHO MARU

Keel Laid: May 9, 1988

Launched: October 28, 1988

Completed: May 1, 1989

Gross Tonage: 3,987 tons

Length (o.a.): 100.00 m

Length (b.p.): 90.00 m

Bredth (mld.): 16.20 m

Depth (mld.): 6.35 m

Draft (mld.): 6.00 m

Cruising Speed: 16 knots

Complement: 89 including 35 Scientists

Propulsion System: Diesel for cruising;

Electric for slow speeds & dynamic positioning

Engine: 1,900 ps×720 rpm×4

Moter: 460 kW×12P×2

Propeller: 4-wing skewed CPP×2

Twin shaft & twin rudder

Bow Thruster: 4-wing CPP, 187 rpm×2

Stern Thruster: 4-wing CPP, 251 rpm×1

Main Generator: for propulsion,

1,550 KVA (1,085 kW)×2

for electric power, 893.75 KVA (715 kW)×3

Electric power Supply: AC 450 V3 ϕ 60 Hz×2 [main], AC 100 V 80 KVA 60 Hz×2, AC 115 V6 KVA 400 Hz×2 [precision]

Navigation: Gyro compass, Radar & ARPA, Auto-pilot device, Joystic control system, Auto-nav. system including Loran C, NNSS, GPS, Doppler Log, EM Log, Data logger and track display

Deck Gears:

#1 Heavy duty winch with 15,000 m of 14 mm ϕ steel wire

#2 Armoured cable winch with 12,000 m of 8.15 mm ϕ Ti-wire for CTD

Swell Compensator (1.5 m stroke) for the above 2 winches

3Hydrographic winch with 12,000 m of 6.4 mm ϕ Ti-wire

#4 Heavy duty winch with 7,000 m of 9 mm ϕ steel wire

#5 Rope winch for 6,000 m×14 mm ϕ nylon rope

#6 BT winch with 1,000 m×3 mm ϕ steel wire [removable]

#7 Nonmagnetic rubber-coated cable winch for magnetometer, 700 m×16 mm ϕ

#8 BT winch with 1,500 m×3 mm ϕ steel wire [bow starboard]

A-shaped stern gantry: 7.0 m (W)×8.0 m (H), 11 ton max. load

Side-beam for starboard deck work: 4 m stroke, 11 ton max. load

Deck crane: aft #2 deck with 3 tons max. capacity×1

Constructed by: Mitsubishi Heavy Industries Co., Ltd.

(Shimonoseki Shipyard & Engine Works)

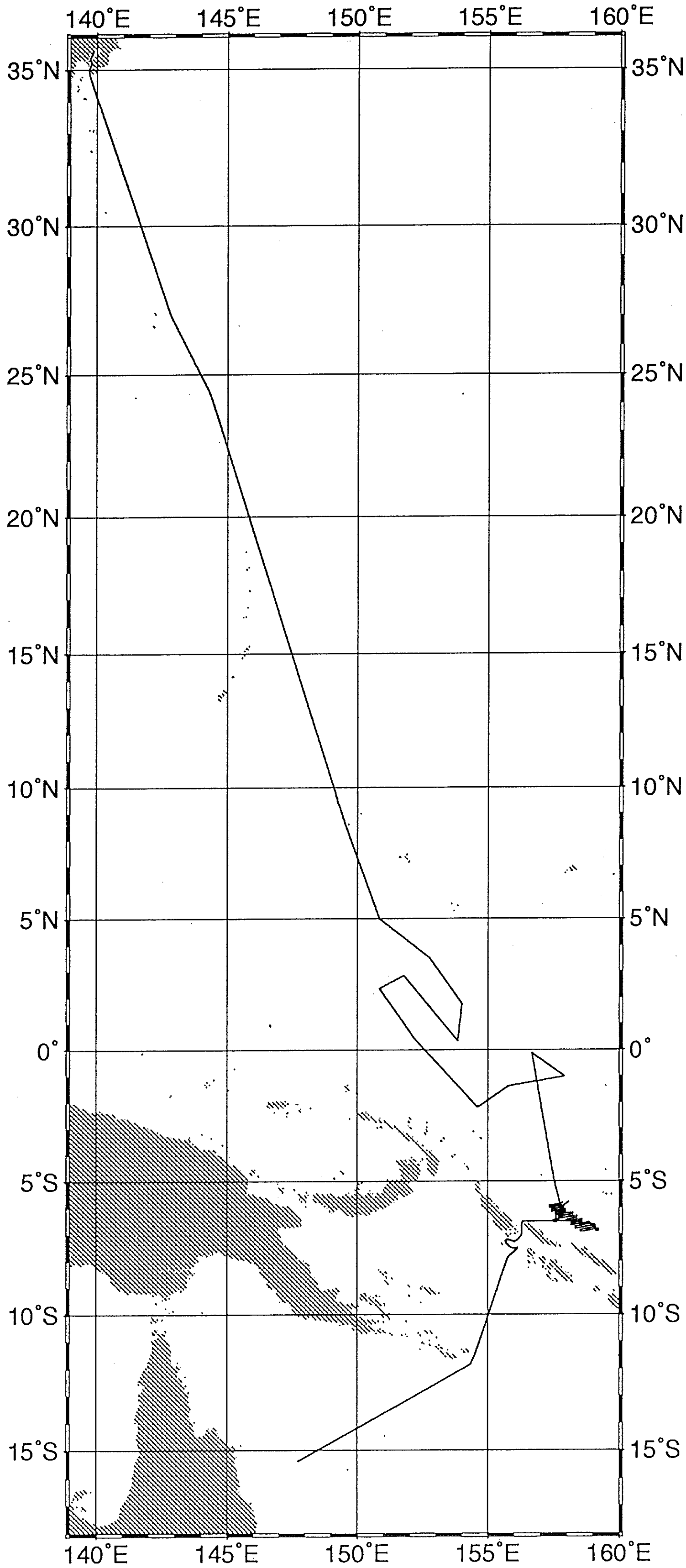
KH98-1 Cruise LEG.1 1998.1.16~2.3 Tokyo-Cairns

Name	Title	Institute	E-mail address
Asahiko Taira (Chief Scientist of the Mission)	Professor	ORI, Univ. of Tokyo	ataira@ori.u-tokyo.ac.jp
Hidekazu Tokuyama	Associate Professor	ORI, Univ. of Tokyo	tokuyama@ori.u-tokyo.ac.jp
Hiroaki Toh	Research Associate	ORI, Univ. of Tokyo	toh@ori.u-tokyo.ac.jp
Kimihiro Mochizuki	Research Associate	ORI, Univ. of Tokyo	kimi@ori.u-tokyo.ac.jp
Masao Nakanishi	Research Associate	ORI, Univ. of Tokyo	nakanisi@ori.u-tokyo.ac.jp
Chiaki Igarashi	Technical Staff	ORI, Univ. of Tokyo	igarashi@ori.u-tokyo.ac.jp
Fujio Yamamoto	Technical Staff	ORI, Univ. of Tokyo	yamamoto@ori.u-tokyo.ac.jp
Eiichiro Araki	Graduate Student	ORI, Univ. of Tokyo	araki@ori.u-tokyo.ac.jp
Shinji Yoneshima	Graduate Student	ORI, Univ. of Tokyo	shinji@ori.u-tokyo.ac.jp
Hiromasa Nishisaka	Graduate Student	Chiba Univ.	nishisaka@earth.s.chiba-u.ac.jp
Manabu Mochida	Graduate Student	Chiba Univ.	mmochida@earth.s.chiba-u.ac.jp
Takashi Yoshizawa	Graduate Student	Chiba Univ.	tyoshiza@earth.s.chiba-u.ac.jp
Yoshiharu Nagaya	Chief Scientist	Hydorgrapic Department, Japan	ynagaya@cue.jhd.go.jp
Wietze Van der Werff	Research Fellow	Geol. Sur. Japan	wietze@gsj.go.jp
Edward L. Winterer	Professor	Scripps Inst. Oceanography	jwinterer@ucsd.edu
Paul Mann	Research Scientist	Univ. of Texas	paulm@utig.ig.utexas.edu

KH98-1 Cruise LEG.2 1998.2.9~2.27 Cairns-Pohnpei

Name	Title	Institute	E-mail address
Asahiko Taira (Chief Scientist of the Mission)	Professor	ORI, Univ. of Tokyo	ataira@ori.u-tokyo.ac.jp
Kimihiro Mochizuki	Research Associate	ORI, Univ. of Tokyo	kimi@ori.u-tokyo.ac.jp
Chiaki Igarashi	Technical Staff	ORI, Univ. of Tokyo	igarashi@ori.u-tokyo.ac.jp
Eiichiro Araki	Graduate Student	ORI, Univ. of Tokyo	araki@ori.u-tokyo.ac.jp
Shinji Yoneshima	Graduate Student	ORI, Univ. of Tokyo	shinji@ori.u-tokyo.ac.jp
Minoru Nishino	Graduate Student	Tohoku Univ.	nishino@aob.geophys.tohoku.ac.jp
Masanao Shinohara	Associate Professor	Chiba Univ.	mshino @earth.s.chiba-u.ac.jp
Seiichi Miura	Graduate Student	Chiba Univ.	miura @earth.s.chiba-u.ac.jp
Yasuhira Aoyagi	Graduate Student	Chiba Univ.	aoyagi @earth.s.chiba-u.ac.jp
Takeshi Sato	Graduate Student	Chiba Univ.	tsato@earth.s.chiba-u.ac.jp
Millard F. Coffin	Research Scientist	Univ. of Texas at Austin	mikec@utig.ig.utexas.edu
Mark Wiederspahn	Senior System Analys	Univ. of Texas at Austin	markw@utig.ig.utexas.edu
Roger L. Larson	Professor	Univ. of Rhode Island	rlar@gsosun1.gso.uri.edu
Lewis J. Abrams	Associate Professor	Univ. of North Carolina	abramsl@uncwil.edu
Loren W. Kroenke	Professor	Univ. of Hawai	kroenke@soest.hawaii.edu
Garrett T. Ito	Research Fellow	Univ. of Hawai	gito@soest.hawaii.edu
Olqv Eldholm	Professor	Univ. of Oslo	olav.eldholm@geologi.uio.no
Tadeusz P. Gladczenko	Graduate Student	Univ. of Oslo	tadeusz@geologi.uio.no

KH-98-1 Leg 1 Track



KH-98-1 Leg 1 Station and Work log (Tokyo-Carins)

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	16	4	33	35 38.590N	139 46.510E	0	PILOT CAME ON BOARD
98	1	16	4	47	35 38.570N	139 46.490E	0	LET GO SHORE LINES
98	1	16	4	47	35 38.580N	139 46.500E	0	COMMENCED HEAVING UP ANCHOR
98	1	16	4	55	35 38.560N	139 46.450E	0	UP & DOWN ANCHOR
98	1	16	4	56	35 38.560N	139 46.460E	0	SLOW AHEAD ENGINES
98	1	16	5	21	35 35.000N	139 47.670E	0	PILOT LEFT HER
98	1	16	5	27	35 34.470N	139 48.390E	0	PASSED TOKYO B.W
98	1	16	5	29	35 34.180N	139 48.720E	0	PASSED NO1 BUOY & s/co on 147°
98	1	16	6	41	35 19.600N	139 42.660E	48	ENTERED URAGA T.R.
98	1	16	7	22	35 12.520N	139 46.450E	41	PASSED URAGA SUIDO TRAFFIC ROUTE
98	1	16	7	25	35 11.880N	139 46.370E	52	RUNG UP ENGINES
98	1	16	7	30	35 10.530N	139 46.040E	151	a/co to 201°
98	1	16	8	21	34 58.400N	139 40.080E	99	a/co to 180°
98	1	16	8	30	34 56.005N	139 40.060E	6	a/co to 161°
98	1	16	10	55	34 21.330N	139 54.360E	3407	SLOW AHEAD ENGINES
98	1	16	11	0	34 20.550N	139 54.670E	3920	PROTON SURVEY START
98	1	16	11	31	34 16.030N	139 56.420E	4006	RUNG UP ENGINES
98	1	16	17	11	32 48.310N	140 32.450E	1643	a/co to 155°
98	1	16	17	29	32 43.550N	140 34.600E	1774	a/co to 160°
98	1	17	16	53	27 00.120N	142 49.380E	3681	a/co to 153°
98	1	17	16	54	26 59.900N	142 49.510E	3695	FULL AHEAD ENGINES
98	1	17	22	0	25 56.850N	143 25.410E	2868	RUNG UP ENGINES
98	1	17	23	41	25 36.390N	143 37.090E	3278	FULL AHEAD ENGINES
98	1	18	0	34	25 29.160N	143 41.140E	1988	RUNG UP ENGINES
98	1	18	5	47	24 20.690N	144 19.760E	4659	SLOW AHEAD ENGINES
98	1	18	6	0	24 19.860N	144 19.670E	4662	PROTON SURVEY FINISHED
98	1	18	6	6	24 19.910N	144 19.610E	4663	LET GO OBM-1
98	1	18	6	35	24 20.360N	144 19.460E	4655	S/M-T/M
98	1	18	6	37	24 20.280N	144 19.470E	4661	PROTON SURVEY START
98	1	18	6	43	24 19.890N	144 19.230E	4665	s/co on 162°
98	1	18	6	50	24 18.650N	144 19.710E	4728	RUNG UP ENGINES
98	1	20	17	17	09 45.180N	149 09.970E	5374	SLOW AHEAD ENGINES
98	1	20	17	25	09 44.320N	149 10.020E	5363	T/M-S/M
98	1	20	17	29	09 44.140N	149 10.000E	5368	EMB PROTON SURVEY FINISHED
98	1	20	17	34	09 44.090N	149 09.940E	5370	EMB LET GO OBM
98	1	20	18	57	09 44.980N	149 10.010E	5378	EMB LET GO OBS
98	1	20	23	8	09 44.450N	149 10.390E	5373	EMB F/W CHECK POSITION
98	1	20	23	9	09 44.450N	149 10.370E	5370	SLOW AHEAD ENGINES
98	1	20	23	13	09 44.190N	149 10.360E	5362	PROTON SURVEY START
98	1	20	23	30	09 40.950N	149 10.730E	5365	RUNG UP ENGINES
98	1	21	0	19	09 29.150N	149 14.640E	5047	HALF AHEAD ENGINES
98	1	21	0	47	09 25.460N	149 14.340E	4960	RUNG UP ENGINES
98	1	21	4	27	08 32.980N	149 32.540E	2610	a/co to 160°
98	1	21	18	30	05 10.590N	150 46.170E	4646	SLOW AHEAD ENGINES
98	1	21	18	35	05 09.600N	150 46.350E	4648	8-SHAPE ROTATION RIGHT TURNIGNG 8-SHAP
98	1	21	18	49	05 09.560N	150 46.560E	4646	8-SHAPE ROTATION LEFT TURNING
98	1	21	19	5	05 09.520N	150 46.980E	4648	8-SHAPE ROTATION FINISHED
98	1	21	19	13	05 07.660N	150 47.210E	4644	s/co on 160°
98	1	21	19	15	05 07.110N	150 47.380E	4645	RUNG UP ENGINES
98	1	21	19	43	05 00.180N	150 49.780E	4643	a/co to 129. PASSED MAG-1
98	1	22	5	7	03 29.960N	152 45.079E	4335	P'D MAG-2 AND A/CO. TO 144
98	1	22	13	33	01 45.320N	153 59.849E	3451	PASSED MAG-3 & a/co to 187°
98	1	22	18	49	00 19.850N	153 51.049E	3607	a/co to 320°
98	1	22	18	54	00 19.950N	153 50.109E	3620	s/co on 320°
98	1	22	18	56	00 20.180N	153 49.909E	3624	P'D MAG-4
98	1	23	6	54	02 50.010N	151 44.970E	4581	P'D MAG-5 AND A/CO. TO 242
98	1	23	10	33	02 21.590N	150 52.950E	5043	a/co to 255.
98	1	23	10	48	02 19.980N	150 50.020E	5049	PASSED MAG-6 S/CO ON 145

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	23	20	2	00 24.800N	152 10.080E	4596	PASSED MAG-7
98	1	23	22	16	00 00.000N	152 33.269E	4424	PASSED THE EQUATOR SOUTHWARD
98	1	24	8	55	01 59.900S	154 24.909E	2894	PASSED MAG-8 & A/CO TO 137
98	1	24	9	58	02 12.030S	154 36.069E	2599	PASSED MAG-9 & A/CO TO 056
98	1	24	15	25	01 25.200S	155 44.509E	2091	SLOW AHEAD ENGINES
98	1	24	15	30	01 24.690S	155 45.219E	2097	8-SHAPE ROTATION RIGHT TURNIGNG
98	1	24	15	44	01 24.290S	155 44.779E	2094	8-SHAPE ROTATION LEFT TURNING
98	1	24	15	59	01 24.110S	155 44.489E	2097	8-SHAPE ROTATION FINISHED
98	1	24	16	19	01 23.140S	155 47.129E	2101	OJC10PROTON SURVEY FINISHED
98	1	24	16	31	01 22.930S	155 47.649E	2096	OJC10LET GO OBS
98	1	24	16	37	01 22.930S	155 47.529E	2096	SLOW AHEAD ENGINES
98	1	24	16	43	01 22.980S	155 47.629E	2095	s/co on 080°
98	1	24	16	50	01 22.770S	155 48.889E	2090	RUNG UP ENGINES
98	1	24	17	44	01 20.580S	156 01.939E	2004	SLOW AHEAD ENGINES
98	1	24	18	6	01 20.080S	156 03.639E	1995	OJC11LET GO OBS
98	1	24	18	12	01 20.100S	156 03.529E	1997	SLOW AHEAD ENGINES
98	1	24	18	18	01 19.930S	156 03.569E	1999	s/co on 080°
98	1	24	18	26	01 19.780S	156 04.859E	1985	RUNG UP ENGINES
98	1	24	19	24	01 17.650S	156 19.119E	1941	SLOW AHEAD ENGINES
98	1	24	19	29	01 17.450S	156 19.569E	1941	STOP ENGINES
98	1	24	19	31	01 17.440S	156 19.539E	1942	OJC12SET OBS
98	1	24	19	35	01 17.440S	156 19.449E	1943	SLOW AHEAD ENGINES
98	1	24	19	38	01 17.340S	156 19.449E	1943	s/co on 080°
98	1	24	19	48	01 17.140S	156 21.139E	1936	RUNG UP ENGINES
98	1	24	20	45	01 14.930S	156 35.169E	1896	SLOW AHEAD ENGINES
98	1	24	20	50	01 14.820S	156 35.659E	1892	STOP ENGINES
98	1	24	20	51	01 14.810S	156 35.619E	1891	OJC14SET OBS
98	1	24	20	55	01 14.800S	156 35.569E	1892	OJC14SLOW AHEAD ENGINES
98	1	24	21	0	01 14.660S	156 35.519E	1890	OJC14s/co on 80°
98	1	24	21	0	01 14.660S	156 35.519E	1890	OJC14s/co on 80°
98	1	24	21	7	01 14.500S	156 36.699E	1910	RUNG UP ENGINES
98	1	24	22	6	01 12.170S	156 51.069E	1848	SLOW AHEAD ENGINES
98	1	24	22	11	01 12.060S	156 51.659E	1847	STOP ENGINES
98	1	24	22	13	01 12.040S	156 51.629E	1847	OBJ3 SET OBS
98	1	24	22	15	01 12.040S	156 51.599E	1847	OBJ3 T/M-S/M
98	1	24	22	35	01 12.070S	156 52.509E	4099	OBMC SET OBMC
98	1	24	22	44	01 12.060S	156 52.299E	1844	OBMC S/M-T/M
98	1	24	22	48	01 12.060S	156 52.229E	1844	OBMC SLOW AHEAD ENGINES
98	1	24	22	52	01 11.930S	156 52.129E	1843	s/co on 080°
98	1	24	23	0	01 11.620S	156 53.539E	1843	RUNG UP ENGINES
98	1	24	23	55	01 09.810S	157 07.179E	1805	SLOW AHEAD ENGINES
98	1	25	0	2	01 09.510S	157 07.499E	1806	STOP ENGINES
98	1	25	0	4	01 09.510S	157 07.479E	1807	SET OJC
98	1	25	0	7	01 09.540S	157 07.419E	1805	SLOW AHEAD ENGINES
98	1	25	0	14	01 09.200S	157 07.179E	1811	s/co on 080°
98	1	25	0	23	01 08.950S	157 08.909E	1809	RUNG UP ENGINES
98	1	25	1	21	01 06.960S	157 22.899E	1845	SLOW AHEAD ENGINES
98	1	25	1	28	01 06.630S	157 23.239E	1844	STOP ENGINES
98	1	25	1	29	01 06.640S	157 23.199E	1845	OBS-5OJC-15
98	1	25	1	33	01 06.640S	157 23.099E	1845	SLOW AHEAD ENGINES
98	1	25	1	38	01 06.450S	157 22.909E	1849	s/co on 080°
98	1	25	1	44	01 06.260S	157 24.059E	1840	RUNG UP ENGINES
98	1	25	2	46	01 04.260S	157 38.849E	1872	SLOW AHEAD ENGINES
98	1	25	2	53	01 03.970S	157 39.309E	1880	STOP ENGINES
98	1	25	2	54	01 03.980S	157 39.289E	1879	OBS-6OJC 16
98	1	25	2	58	01 04.010S	157 39.179E	1877	SLOW AHEAD ENGINES
98	1	25	3	2	01 03.910S	157 39.179E	1878	s/co on 080°
98	1	25	3	11	01 03.640S	157 40.629E	1902	RUNG UP ENGINES
98	1	25	4	9	01 01.380S	157 54.819E	2013	SLOW AHEAD ENGINES
98	1	25	4	19	01 01.200S	157 55.359E	2015	OJC17LET GO OBS

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	25	4	28	01 01.140S	157 54.979E	2014	OJC17PROTON SURVEY START
98	1	25	4	36	01 00.370S	157 54.109E	2015	s/co on 305°
98	1	25	4	41	00 59.770S	157 53.229E	2026	RUNG UP ENGINES
98	1	25	4	56	00 57.220S	157 49.839E	2027	SLOW AHEAD ENGINES
98	1	25	5	8	00 56.450S	157 48.799E	2036	PROTON SURVEY FINISHED
98	1	25	5	22	00 55.050S	157 46.639E	2040	RUNG UP ENGINES
98	1	25	10	6	00 08.700S	156 41.199E	2024	SLOW AHEAD ENGINES
98	1	25	10	11	00 08.250S	156 40.529E	2010	STOP ENGINES
98	1	25	10	12	00 08.260S	156 40.469E	2010	OJC1 SET OBS
98	1	25	10	16	00 08.290S	156 40.289E	2008	OJC1 SLOW AHEAD ENGINES
98	1	25	10	20	00 08.510S	156 40.079E	2008	s/co on 168°
98	1	25	10	28	00 09.990S	156 40.469E	2019	RUNG UP ENGINES
98	1	25	11	22	00 23.620S	156 43.379E	2024	SLOW AHEAD ENGINES
98	1	25	11	27	00 24.210S	156 43.319E	2022	STOP ENGINES
98	1	25	11	28	00 24.210S	156 43.289E	2026	OBS-2OJC-2
98	1	25	11	33	00 24.270S	156 43.189E	2024	SLOW AHEAD ENGINES
98	1	25	11	36	00 24.410S	156 43.039E	2026	s/co on 170°
98	1	25	11	42	00 25.770S	156 43.269E	2020	RUNG UP ENGINES
98	1	25	12	37	00 39.600S	156 46.139E	1964	SLOW AHEAD ENGINES
98	1	25	12	41	00 40.100S	156 46.079E	1962	STOP ENGINES
98	1	25	12	43	00 40.110S	156 46.049E	1963	OBS-3OJC-3
98	1	25	12	47	00 40.150S	156 45.929E	1965	SLOW AHEAD ENGINES
98	1	25	12	51	00 40.290S	156 45.809E	1967	s/co on 167°
98	1	25	13	0	00 42.080S	156 46.079E	1951	RUNG UP ENGINES
98	1	25	13	52	00 55.380S	156 48.939E	1864	SLOW AHEAD ENGINES
98	1	25	13	58	00 56.200S	156 48.909E	1866	STOP ENGINES
98	1	25	14	51	00 56.120S	156 48.669E	1866	OBS-4OJC-4
98	1	25	14	58	00 56.190S	156 48.479E	1867	SLOW AHEAD ENGINES
98	1	25	15	3	00 56.400S	156 48.289E	1866	s/co on 169°
98	1	25	15	13	00 58.400S	156 48.749E	1876	RUNG UP ENGINES
98	1	25	17	6	01 27.370S	156 54.299E	1755	SLOW AHEAD ENGINES
98	1	25	17	17	01 28.210S	156 54.289E	1748	OJC-6LET GO OBS
98	1	25	17	22	01 28.290S	156 54.219E	1749	SLOW AHEAD ENGINES
98	1	25	17	26	01 28.510S	156 54.059E	1750	s/co on 170°
98	1	25	17	40	01 31.200S	156 54.709E	1727	RUNG UP ENGINES
98	1	25	18	27	01 43.380S	156 57.049E	1665	SLOW AHEAD ENGINES
98	1	25	18	36	01 44.130S	156 57.089E	1656	OJC-7LET GO OBS
98	1	25	18	40	01 44.190S	156 57.049E	1657	SLOW AHEAD ENGINES
98	1	25	18	44	01 44.390S	156 56.949E	1659	s/co on 170°
98	1	25	18	55	01 46.080S	156 57.359E	1636	RUNG UP ENGINES
98	1	25	19	46	01 59.360S	156 59.799E	1603	SLOW AHEAD ENGINES
98	1	25	19	51	01 59.950S	156 59.899E	1601	STOP ENGINES
98	1	25	19	55	02 00.020S	156 59.859E	1601	OJC8 SET OBS
98	1	25	19	59	02 00.070S	156 59.809E	1602	SLOW AHEAD ENGINES
98	1	25	20	3	02 00.310S	156 59.739E	1603	s/co on 170°
98	1	25	20	12	02 02.090S	157 00.159E	1604	RUNG UP ENGINES
98	1	25	21	4	02 15.480S	157 02.529E	1619	SLOW AHEAD ENGINES
98	1	25	21	8	02 15.930S	157 02.569E	1631	STOP ENGINES
98	1	25	21	16	02 16.050S	157 02.429E	1630	SLOW AHEAD ENGINES
98	1	25	21	18	02 16.130S	157 02.379E	1627	PROTON SURVEY START
98	1	25	21	20	02 16.180S	157 02.379E	1627	s/co on 170°
98	1	25	21	33	02 18.150S	157 02.749E	1624	RUNG UP ENGINES
98	1	26	2	33	03 35.080S	157 16.759E	1722	SLOW AHEAD ENGINES
98	1	26	2	43	03 36.090S	157 16.979E	1722	PROTON SURVEY FINISHED
98	1	26	3	0	03 37.270S	157 17.179E	1722	OBS OJL-1
98	1	26	3	6	03 37.370S	157 17.219E	1723	SLOW AHEAD ENGINES
98	1	26	3	13	03 37.720S	157 17.359E	1722	PROTON SURVEY START
98	1	26	3	23	03 39.340S	157 17.549E	1720	s/co on 170°
98	1	26	3	23	03 39.420S	157 17.559E	1720	RUNG UP ENGINES
98	1	26	8	10	04 55.710S	157 30.899E	1503	SLOW AHEAD ENGINES

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	26	8	16	04 56.330S	157 30.969E	1469	TO S/M
98	1	26	8	17	04 56.350S	157 30.969E	1469	PROTON SURVEY START
98	1	26	8	39	04 58.500S	157 31.459E	1476	OJL2 SET OBS
98	1	26	8	46	04 58.560S	157 31.539E	1479	TO T/M
98	1	26	8	49	04 58.650S	157 31.549E	1480	PROTON SURVEY START
98	1	26	9	4	05 00.990S	157 32.219E	1547	RUNG UP ENGINES
98	1	26	14	7	06 18.480S	157 51.939E	3072	PROTON SURVEY FINISHED
98	1	26	14	18	06 19.110S	157 52.199E	3077	STOP ENGINES
98	1	26	14	19	06 19.120S	157 52.219E	3076	OBS NC-1
98	1	26	14	26	06 19.170S	157 52.379E	3081	SLOW AHEAD ENGINES
98	1	26	14	30	06 19.300S	157 52.499E	3083	s/co on 200°
98	1	26	14	36	06 20.500S	157 52.099E	3158	RUNG UP ENGINES
98	1	26	15	33	06 34.440S	157 46.889E	3402	SLOW AHEAD ENGINES
98	1	26	15	41	06 35.080S	157 46.829E	3415	NC-2 LET GO OBS
98	1	26	15	46	06 35.140S	157 46.949E	3416	SLOW AHEAD ENGINES
98	1	26	15	50	06 35.070S	157 46.929E	3416	s/co on 323°
98	1	26	16	0	06 33.790S	157 46.059E	3395	RUNG UP ENGINES
98	1	26	16	0	06 33.790S	157 46.059E	3395	RUNG UP ENGINES
98	1	26	16	57	06 22.590S	157 37.479E	3233	SLOW AHEAD ENGINES
98	1	26	17	6	06 22.120S	157 37.119E	3234	NC-3 LET GO OBS
98	1	26	17	16	06 22.190S	157 37.239E	3235	PROTON SURVEY START
98	1	26	17	29	06 21.210S	157 36.089E	3230	RUNG UP ENGINES
98	1	26	17	37	06 22.450S	157 35.429E	3250	P'D SB-1
98	1	26	17	55	06 27.260S	157 36.419E	3315	P'D SB-2
98	1	26	18	15	06 32.800S	157 37.089E	3454	P'D SB-3
98	1	26	18	59	06 28.610S	157 30.739E	3371	P'D SB-4
98	1	26	19	34	06 26.200S	157 40.439E	3314	P'D SB-5 A/CO TO 025
98	1	26	21	45	05 53.370S	157 54.959E	2705	PASSED SB-6 A/CO TO 055
98	1	26	22	24	05 47.510S	158 03.869E	2529	PASSED SB-7 CO TO VAR
98	1	26	22	37	05 46.680S	158 05.039E	2489	PROTON SURVEY FINISHED
98	1	26	22	44	05 46.800S	158 05.099E	2490	TO S/M
98	1	26	23	18	05 47.170S	158 04.359E	2503	LAUNCH OF IZANAGI
98	1	26	23	31	05 47.320S	158 03.889E	2530	DROP IZANAGI
98	1	27	0	36	05 47.170S	157 58.909E	2799	LAUNCH OF STREAMER CABLE
98	1	27	2	3	05 48.050S	157 52.689E	2799	PROTON SURVEY START
98	1	27	2	37	05 49.150S	157 50.139E	2799	SET STREAMER CABLE
98	1	27	2	50	05 49.550S	157 49.059E	2799	AIR-GUN STARTED
98	1	27	6	56	05 55.410S	157 21.809E	2799	P'D IZ-2
98	1	27	7	2	05 55.530S	157 21.199E	2799	a/co to 170°
98	1	27	7	33	05 59.030S	157 20.709E	2799	a/co to 080°
98	1	27	11	28	05 54.620S	157 50.809E	2799	a/co to 170°
98	1	27	12	6	05 58.040S	157 53.199E	2799	a/co to 260°
98	1	27	16	22	06 04.560S	157 25.619E	2799	a/co to 170°
98	1	27	16	37	06 06.050S	157 24.859E	2799	s/co on 170°
98	1	27	16	52	06 08.030S	157 25.429E	2799	a/co to 080°
98	1	27	17	11	06 09.100S	157 27.469E	2799	S/C ON 080
98	1	27	20	45	06 03.470S	157 56.079E	2799	a/co to 170°
98	1	27	21	20	06 06.840S	157 58.129E	2799	a/co to 259°
98	1	27	21	35	06 08.170S	157 57.379E	2799	s/co on 259°
98	1	28	1	5	06 12.700S	157 34.579E	2799	a/co to 169°
98	1	28	1	39	06 16.720S	157 34.819E	2799	a/co to 80°
98	1	28	6	25	06 10.040S	158 13.169E	2799	a/co to 170° AND F/W LINE 6
98	1	28	6	40	06 10.970S	158 14.689E	2799	s/co on 170°
98	1	28	6	58	06 13.130S	158 15.269E	2799	a/co to 259°
98	1	28	7	13	06 14.430S	158 14.529E	2799	s/co on 259° ON LINE 7
98	1	28	11	30	06 20.630S	157 44.479E	2799	a/co to 169°
98	1	28	11	58	06 24.120S	157 44.209E	2799	a/co to 080°
98	1	28	12	14	06 25.160S	157 46.139E	2799	SET LINE 16
98	1	28	14	57	06 20.750S	158 09.149E	2799	AIR-GUN ENDED
98	1	28	15	34	06 19.960S	158 13.029E	2799	LET GO AIRGUN

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	28	16	35	06 18.250S	158 21.699E	2799	a/co to 170° AND F/W LINE 8
98	1	28	16	50	06 19.230S	158 23.299E	2799	s/co on 170°
98	1	28	17	7	06 21.290S	158 23.989E	2799	a/co to 259°
98	1	28	17	28	06 23.010S	158 22.409E	2799	s/co on 259° AND ON LINE 9
98	1	28	20	36	06 27.240S	158 01.199E	2799	a/co to 170°
98	1	28	20	50	06 28.720S	158 00.529E	2799	s/co on 170°
98	1	28	21	7	06 31.050S	158 01.109E	2799	a/co to 79°
98	1	28	21	22	06 32.160S	158 02.999E	2799	s/co on 79° ON LINE 10
98	1	29	0	45	06 25.760S	158 33.799E	2799	a/co to 169°
98	1	29	1	17	06 28.980S	158 35.989E	2799	a/co to 260°
98	1	29	1	33	06 30.360S	158 35.149E	2799	s/co on 260° & ON LINE 11
98	1	29	5	20	06 35.540S	158 09.559E	2799	a/co to 170°
98	1	29	5	35	06 36.980S	158 08.719E	2799	s/co on 170°
98	1	29	5	51	06 39.110S	158 09.459E	2799	a/co to 079°
98	1	29	6	5	06 40.110S	158 11.169E	2799	s/co on 079° AND ON LINE 12
98	1	29	10	45	06 32.440S	158 50.419E	2799	a/co to 169° OFF LINE 10
98	1	29	11	20	06 35.660S	158 52.619E	2799	a/co to 260°
98	1	29	11	39	06 37.080S	158 51.139E	2799	a/co to 260° & ON LINE13
98	1	29	16	0	06 43.360S	158 19.929E	2799	a/co to 170° AND OFF LINE 13
98	1	29	16	15	06 44.860S	158 19.179E	2799	s/co on 170°
98	1	29	16	30	06 46.890S	158 19.829E	2799	a/co to 079°
98	1	29	16	47	06 47.940S	158 21.819E	2799	s/co on 079° AND ON LINE 14
98	1	29	22	15	06 39.700S	159 04.689E	2799	a/co to 169° OFF LINE 14
98	1	29	22	30	06 40.680S	159 06.059E	2799	s/co on 169°
98	1	29	22	47	06 42.880S	159 06.469E	2799	a/co to 259°
98	1	29	23	5	06 44.370S	159 05.099E	2799	s/co on 259° & ON LINE 15
98	1	30	3	30	06 50.970S	158 32.359E	2799	a/co to 170° AND OFF LINE 15
98	1	30	3	44	06 52.290S	158 31.369E	2799	s/co on 170°
98	1	30	4	1	06 54.560S	158 31.889E	2799	a/co to 079°
98	1	30	4	20	06 55.480S	158 33.979E	2799	s/co on 079° AND ON LINE 16
98	1	30	9	6	06 48.270S	159 11.789E	2799	USED COURSE VARIOUSLY OFF LINE 16
98	1	30	10	40	06 52.010S	159 07.339E	2799	s/co on 349° ON LINE 17
98	1	30	11	30	06 45.970S	159 06.259E	2799	END OF SEISMIC SURVEY
98	1	30	11	36	06 45.530S	159 06.199E	2799	AIR-GUN ENDED
98	1	30	11	42	06 45.080S	159 06.129E	2799	PROTON SURVEY FINISHED
98	1	30	12	2	06 43.390S	159 05.819E	2799	RECOVERY OF STREAMER
98	1	30	12	29	06 41.550S	159 05.649E	2799	FINISH STREAMER CABLE
98	1	30	13	17	06 38.920S	159 04.469E	2799	RETRIEVE OF IZANAGI
98	1	30	13	34	06 38.540S	159 04.429E	2799	ALL FINISH
98	1	30	13	37	06 38.410S	159 04.379E	2799	s/co on 300°
98	1	30	13	39	06 38.320S	159 04.269E	2799	ENG' TO T/M
98	1	30	13	40	06 38.280S	159 04.219E	2799	PROTON SURVEY START
98	1	30	13	46	06 37.860S	159 03.579E	2799	a/co to 278°
98	1	30	13	51	06 37.700S	159 02.579E	2799	RUNG UP ENGINES
98	1	30	17	17	06 30.050S	158 10.059E	3127	a/co to 170°
98	1	31	0	21	06 30.040S	156 20.379E	680	a/co to 196°
98	1	31	0	30	06 32.150S	156 19.499E	520	SLOW AHEAD ENGINES
98	1	31	0	39	06 33.200S	156 19.249E	463	PROTON SURVEY FINISHED
98	1	31	0	45	06 34.380S	156 18.929E	434	RUNG UP ENGINES
98	1	31	1	22	06 43.690S	156 16.099E	450	a/co to 164° ENTER BOUGAINVILLE STRAIT
98	1	31	2	7	06 52.370S	156 18.489E	509	a/co to 191° CLEAR OUT BOUGAINVILLE ST
98	1	31	2	48	07 02.420S	156 16.899E	1187	a/co to 221°
98	1	31	4	3	07 17.440S	156 03.969E	1321	SLOW AHEAD ENGINES
98	1	31	4	10	07 17.990S	156 03.549E	1346	SBO-1 LET GO OBS
98	1	31	4	14	07 18.020S	156 03.589E	1347	SLOW AHEAD ENGINES
98	1	31	4	18	07 18.100S	156 03.519E	1345	s/co on 182°
98	1	31	4	29	07 17.700S	156 01.889E	1262	RUNG UP ENGINES
98	1	31	5	38	07 16.800S	155 47.709E	1226	SLOW AHEAD ENGINES
98	1	31	5	45	07 17.370S	155 47.769E	1219	SB-5 LET GO OBS
98	1	31	5	49	07 17.410S	155 47.879E	1219	SLOW AHEAD ENGINES

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth	Works
98	1	31	6	7	07 16.630S	155 45.779E	1179	RUNG UP ENGINES
98	1	31	7	30	07 12.650S	155 35.279E	1120	SLOW AHEAD ENGINES
98	1	31	7	34	07 12.690S	155 35.889E	1123	STOP ENGINES STOP ENGINES
98	1	31	7	35	07 12.680S	155 35.929E	1120	SB-1 SET OBS
98	1	31	7	38	07 12.680S	155 36.019E	1117	SLOW AHEAD ENGINES
98	1	31	7	47	07 13.400S	155 37.299E	1091	RUNG UP ENGINES
98	1	31	9	0	07 27.850S	155 52.339E	903	USED COURSE VARIOUSLY
98	1	31	9	23	07 32.140S	155 51.969E	1121	SLOW AHEAD ENGINES
98	1	31	9	36	07 31.300S	155 52.619E	1000	STOP ENGINES
98	1	31	9	37	07 31.320S	155 52.619E	999	SB-4 SET OBS
98	1	31	9	41	07 31.380S	155 52.639E	998	SLOW AHEAD ENGINES
98	1	31	9	45	07 31.490S	155 52.839E	980	s/co on 090°
98	1	31	9	53	07 31.030S	155 54.729E	830	RUNG UP ENGINES
98	1	31	10	41	07 30.320S	156 08.269E	811	SLOW AHEAD ENGINES
98	1	31	10	51	07 30.330S	156 09.749E	672	STOP ENGINES
98	1	31	10	52	07 30.330S	156 09.769E	675	LET GO OBS(SB-2)
98	1	31	10	56	07 30.330S	156 09.829E	677	SLOW AHEAD ENGINES
98	1	31	11	8	07 31.770S	156 08.389E	856	RUNG UP ENGINES
98	1	31	12	0	07 41.500S	155 58.759E	2208	PUT CLOCK'S AHEAD 1 HOUR FOR S.M.T.
98	1	31	13	4	07 52.000S	155 45.069E	4822	SLOW AHEAD ENGINES
98	1	31	13	10	07 52.310S	155 44.469E	4719	STOP ENGINES
98	1	31	13	11	07 52.320S	155 44.479E	4724	OBS SB-3
98	1	31	13	15	07 52.410S	155 44.529E	4683	SLOW AHEAD ENGINES
98	1	31	13	19	07 52.540S	155 44.439E	4611	s/co on 199°
98	1	31	13	23	07 52.930S	155 44.399E	4452	PROTON SURVEY START
98	1	31	13	29	07 54.270S	155 44.199E	4148	RUNG UP ENGINES
98	2	1	3	43	11 29.900S	154 30.089E	1440	a/co to 205°
98	2	1	5	15	11 50.910S	154 20.039E	2068	a/co to 241°
98	2	2	8	47	15 23.250S	147 44.460E	1154	SLOW AHEAD ENGINES
98	2	2	8	54	15 23.720S	147 43.660E	1149	PROTON SURVEY FINISHED
98	2	2	9	3	15 24.420S	147 42.390E	1152	FULL AHEAD ENGINES
98	2	2	11	14	15 39.760S	147 13.200E	1364	a/co to 224°

Items of Routine Observations

C. Igarashi

The following observations were carried out throughout the cruise as a routine. Some of the results will be reported in the other articles.

3.1 Meteorological and Oceanographical Data

The following data were measured and recorded every minute all through the cruise.

Date and Time	GMT	Air temperature	°C
Ship position		Dew point	°C
(Lat and Lon)	deg	Water temperature	°C
System heading	deg	System speed	kt
Gyro heading	deg	Rain strength	mm/h
Log speed	kt	Air pressure	mb
Water depth		Wind speed	m/s
(Seabeam or PDR)	m	Short wave radiation	kw/m^2
Relative humidity	%	All wave radiation	kw/m^2
Salinity		All radiation temperature	°C
Wind direction	deg	Conductivity	mmho
Infrared radiation temperature	°C		
Water temperature for conductivity sensor	°C		

3.2 3.5kHz Subbottom Profiler Survey (SBP)

The survey system is composed of an acoustic transducer and tranceiver system installed in the bow sonar dome, and a signal processor and recorder in the laboratory No.3. This system has twelve transducers (3*4 TR109), and the laboratory equipments consist of a correlation echo sounder processor (CESP III) , a tranceiver (PTR-105B), and a graphic recorder (LSR-1807) manufactured by Raytheon Co.Ltd. It is possible to feed the ship cruising data through the onboard LAN system.

The subbottom profiling was made at 1000m range, scanning interval of 1.33 sec/scan, with the paper speed 200 lines/inch, and transducer output power of -6 db.

Seafloor Magnetotellurics of Western Pacific Upper Mantle
- OBEM Study -

Hiroaki TOH* and Yoshiharu NAGAYA**

**Ocean Research Institute, University of Tokyo, JAPAN*
***Hydrographic Department, Maritime Safety Agency, JAPAN*

1. Objectives

It is possible to sample a series of different electrical conductivity structures of the western Pacific upper mantle by the seafloor magnetotelluric (MT) observation planned in this expedition since the MT sites distribute in a region of different evolution and age of wide variety. The goal of the OBEM study, therefore, consists in detection of the upper mantle heterogeneity of the western Pacific.

Specifically, the objectives of the MT study are two folds: (1) To image the plume upwelling, if any, beneath the Ontong-Java Plateau (OJP) by a comparative MT study between the East Mariana Basin (EMB) and OJP. It is unlikely that the plume is still upwelling at present since OJP is thought to have erupted 120 Ma ago. Hence, the target here is to seek any traces of the plume such as depression of the 410 km discontinuity (Nolasco et al., 1998) or to confirm that both the lithosphere and the asthenosphere far beneath OJP are normal compared with those of other places (e.g., EMB) in the western Pacific. (2) To derive the lithospheric thicknesses beneath the old but of different age seafloor. In other words, to add three estimates on the diagram shown as Fig. 1. The thickness of the electrical lithosphere is known to have a strong linear dependence on square root of age [Ma] even at very old seafloors, which implies that evolution of the electrical lithosphere, like that of marine heat flows, can be approximated by a cooling half space model. However, the linear dependence has not yet been established since MT observations on very old seafloors are scarce. Hence, this issue is also important and added as our second objective.

Another objective consists in state-of-the-art electromagnetic (EM) instrumentation at sea as well. One of the three EM instruments deployed at EMB is named SFEMS (SeaFloor ElectroMagnetic Station) which has been newly developped at Ocean Research Institute, University of Tokyo in collaboration with the Ocean Hemisphere Project (OHP). An older version of SFEMS was first build in 1996 (Toh and Hamano, 1997) which was characterized by its long life time (up to 2 yrs), an absolute scalar magnetometer (Overhauser Proton Precession Magnetometer) and its acoustic link to the surface. Further innovation has been made to the present version of SFEMS used in this cruise, which will be described in the following section.

2. Instruments

Figures 2 through 4 show the EM instruments employed in this expedition. SFEMS in Fig. 2 consists of three parts, namely, the long-life pop-up-type platform made of a titanium frame, EM sensors such as the Overhauser-type absolute magnetometer and an Acoustic Telemetry Modem (ATM) that enables the acoustic link between the seafloor and the sea surface. Major innovation made to the new SFEMS is the increased number of observable components. SFEMS is now capable of collecting 3 components of the geomagnetic field, 2 components of the geoelectric field and 2 components of tilts in addition to the absolute value of the geomagnetic total force for more than 1 yr (384 days) by 1 minute interval. It was achieved by integrating an existing MT variograph using fluxgate sensors and silver-silver chloride electrodes into the old SFEMS at the cost of a slight increase (10 kg) in its weight. As a result, present SFEMS weighs about 385 kg and 285 kg in air with and without lead weights, respectively. Its weight in water is 57 kg and -40 kg with and without the balast, respectively. SFEMS becomes larger in size as well since two orthogonal electric dipoles as long as 5.09 m were added to measure the horizontal electric field. Resolution of the EM field and tilts amounts to 0.1 nT, 60 nV/m and 29 μradians, respectively. Acoustic communication to SFEMS is possible at a rate of 40 baud while SFEMS can answer back by 1200 baud at maximum. SFEMS is equipped with an interface board (I/F) that connects ATM and the EM sensors. Specifically, ATM is connected to I/F by a serial port at a rate of 9600 baud. I/F controls the EM sensors either via serial connection to the Overhauser magnetometer at a rate of 38400 baud, or current loop to the MT variograph at a rate of 9600 baud.

The Ocean Bottom ElectroMagnetometers (OBEMs) in Figs. 3 and 4 are the conventional MT variographs which are basically the same as that integrated into the new SFEMS except for different measuring methods of the geoelectric field. OBEM2 shown in Fig. 3 is the oldest type in our existing EM fleet characterized by its rather large dipole length (5.4 m) and height. OBEM1 in Fig. 4 is the newest but its main difference from the former version of OBEM is slight reduction of its size. Resolution of the electric field alone varies with change in the dipole lengths while that of the magnetic field remains the same. E-resolution of OBEM1 and OBEM2 are 55 and 57 nV/m, respectively.

The recording methods of the electric field utilized in this expedition are two folds: (1) Differential amplification with (SFEMS) and without (OBEM1) an additional reference electrode. (2) Isolation amplification without any reference electrode (OBEM2). The latter is more power-consuming than the former though it has a better protection against current leaks. Introduction of a reference electrode guarantees much stable geoelectric measurements with less noise in principle. However, it should at least be confirmed once by practical application. It is not preferable to do an MT array study with different measuring methods but this is because we're still in search for a better way to measure the minute variations of the natural geoelectric field.

Table 1 summarizes the self potentials of the silver-silver chloride electrodes attached to each instrument just before launch.

3. Sea Experiment in Leg 1

Figure 5 shows the MT site location. The EM instruments were deployed during Leg 1 of this cruise along the way from Japan to OJP. All the instruments were equipped with a pair of flashing light and VHF transmitter (43.528 MHz) for the sake of prompt discovery of each instrument after successful arrival at the sea surface.

OBEM1 was deployed at the southern tip of the Ogasawara Plateau on 06:06 UT 18/JAN/'98. This site will be revisited in Leg 3 to recover the instrument.

SFEMS was installed at the sourthern border of the East Mariana Basin on 18:57 UT 20/JAN/'98. Precise positioning of SFEMS was tried by several acoustic rangings listed in Table 2 together with that of OBS-EMB deployed at 1 nautical mile south of SFEMS. As for the location of the ship at the time of the acoustic ranging, refer to the map included in a report on OBS study by Mochizuki et al. of this volume. Unfortunately, however, the acoustic communication with SFEMS was unable to be accomplished due to shortage of ship time. It was postponed until its recovery in Leg 3.

OBEM2 was deployed at the top of OJP on 22:35 UT 24/JAN'98. This site locates at 1 nautical mile east of the centre of the large OBS cross array, each profile of which is as long as 240 km. OBEM2 is planned to be recovered in Leg 2.

Finally, Table 3 summarizes the deployments completed in Leg 1 of this cruise. If several geomagnetic disturbances are successfully recorded, it is quite probable to probe into the deep Earth in spite of the rather short expected maximum duration of the data.

REFERENCES

Nolasco, R., P. Tarits, J. H. Filloux and A. D. Chave, Magnetotelluric imaging of the Society Islands hot spot. (submitted to *J. Geophys. Res.*)

Parsons, B. and J. G. Sclater, An Analysis of the variation of ocean floor bathymetry and heat flow with age, *J. Geophys. Res.*, **82**, 803-827, 1977.

Toh, H. and Y. Hamano, The first realtime measurement of seafloor geomagnetic total force - Ocean Hemisphere Project, *J. Japan Soc. Mar. Surv. Tech.*, **9**, 1-13, 1997.

Figure and Table Captions

Table 1 Self potentials of each electrode just before launch and respective IDs.

Table 2 Summary of the acoustic ranging at site SFEMS.

Table 3 Summary table of the deployment. 'Acoustics' column shows the release codes of the installed instruments. NY denotes Nichiyu Giken code.

Fig. 1 Age-thickness curve showing a strong linear dependence of the depths to the asthenospheric conductours in the north Pacific on square root of seafloor age [Ma]. Vertical line corresponds to square root of 70 Ma at which flattening of age-depth curve begins to occur (Parsons and Sclater, 1977). Horizontal line is also Parson and Sclater's asymptotic thickness of the oceanic lithosphere.

Fig. 2 Concept of older version of SFEMS.

Fig. 3 Top and plan views of the oldest OBEM.

Fig. 4 Top and plan views of the newest OBEM.

Fig.5 Site map of the MT observation conducted in this cruise. 4000 m countours of the bathymetry are also shown.

Table 1

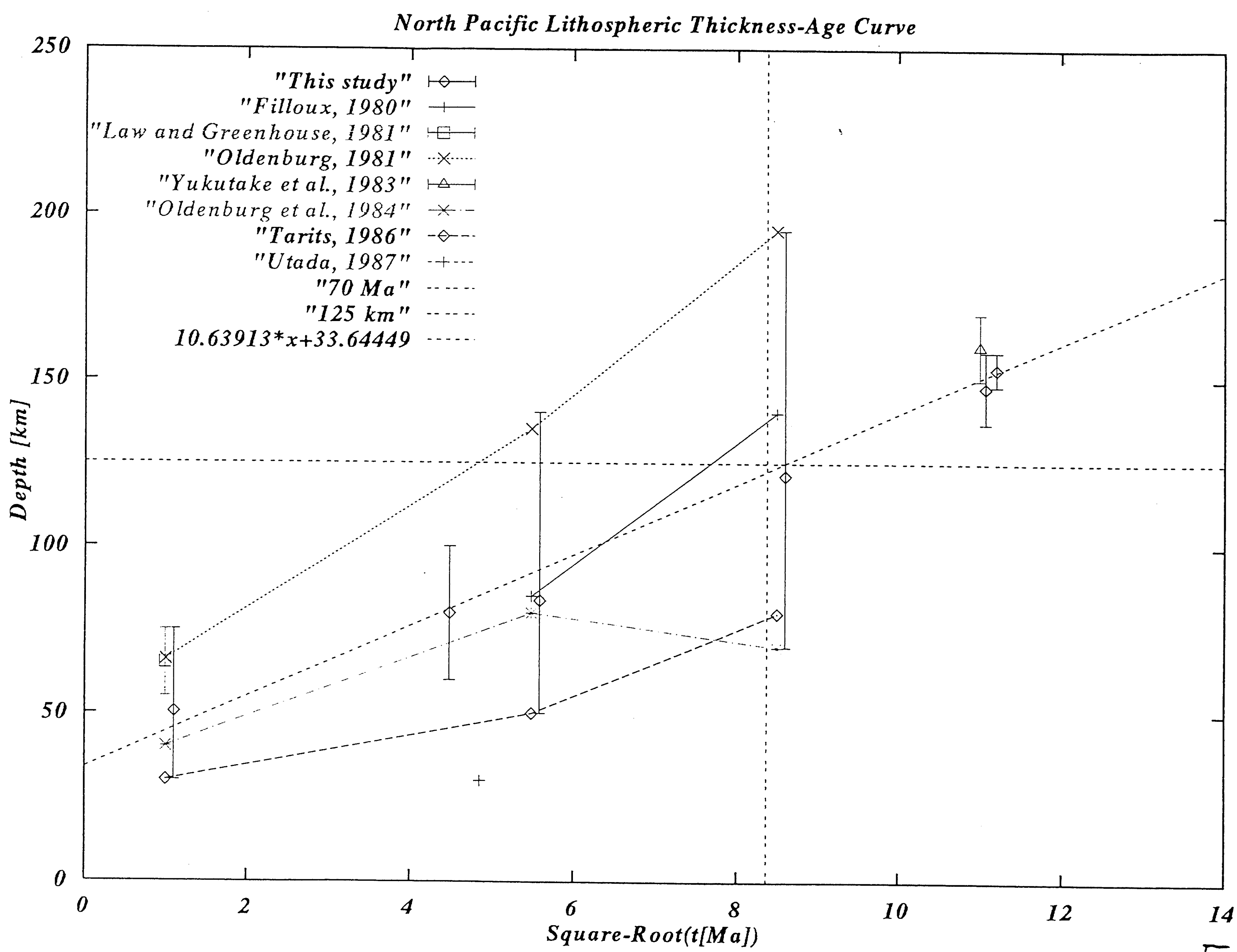
Site Name	Self Potential (N+, S-)	Self Potential (E+, W-)	EID[N]	EID[S]	EID[E]	EID[W]	EID[G]
OBEM1	63 μV	-98 μV	2	20	3	14	-
SFEMS	93 μV	572 μV	K6	S18	S19	S21	S16
OBEM2	449 μV	1453 μV	K1	K21	K4	S22	-

Table 2

Latitude (N)	9 44.87	9 44.43	9 44.42	9 44.40	9 44.40	9 44.40	9 42.97	9 44.60	9 44.60	9 44.60	9 44.59	9 44.59
Longitude (E)	149 10.0	149 10.0	149 10.0	149 09.9	149 09.9	149 09.9	149 09.9	149 11.0	149 11.0	149 11.0	149 10.9	149 10.9
Depth (m)	5374	5368	-	-	-	-	5349	-	-	-	-	-
Slant Range (m)	5507	5564	5651	5573	5479	5616	6506	5912	5874	5928	5817	5799

Table 3

Apparatus	Site	Position	Depth	Rate	Acoustics	Descending Speed	Ascending Speed	Duration	Start Time
OBEM-HD	OBEM1	24 19.91'N 144 19.61'E	4663 m	30 sec	NY-3A	0.7 m/s (1h51m to the bottom)	0.55 m/s (2h22m to the surface)	55 days	19/JAN/'98 00:00 UT
SFEMS	SFEMS	9 44.98'N 149 10.01'E	5378 m	30 sec	NY-3G	0.8 m/s (1h52m to the bottom)	0.7 m/s (2h08m to the surface)	43 days	22/JAN/'98 00:00 UT
TT4	OBEM2	1 12.07'S 156 52.51'E	1843 m	30 sec	Benthos-F	0.6 m/s (52m to the bottom)	0.5 m/s (1h02m to the surface)	29 days	26/JAN/'98 00:00 UT



North Pacific Lithospheric Thickness-Age Curve
"This study"
"Filloux, 1980"
"Law and Greenhouse, 1981"
"Oldenburg, 1981"
"Yukutake et al., 1983"
"Oldenburg et al., 1984"
"Tarits, 1986"
"Utada, 1987"
"70 Ma"
"125 km"
10.63913*x+33.64449
Depth [km]
250
200
150
100
50
0
0
2
4
6
8
10
12
14
Square-Root(t[Ma])

Fig. 1

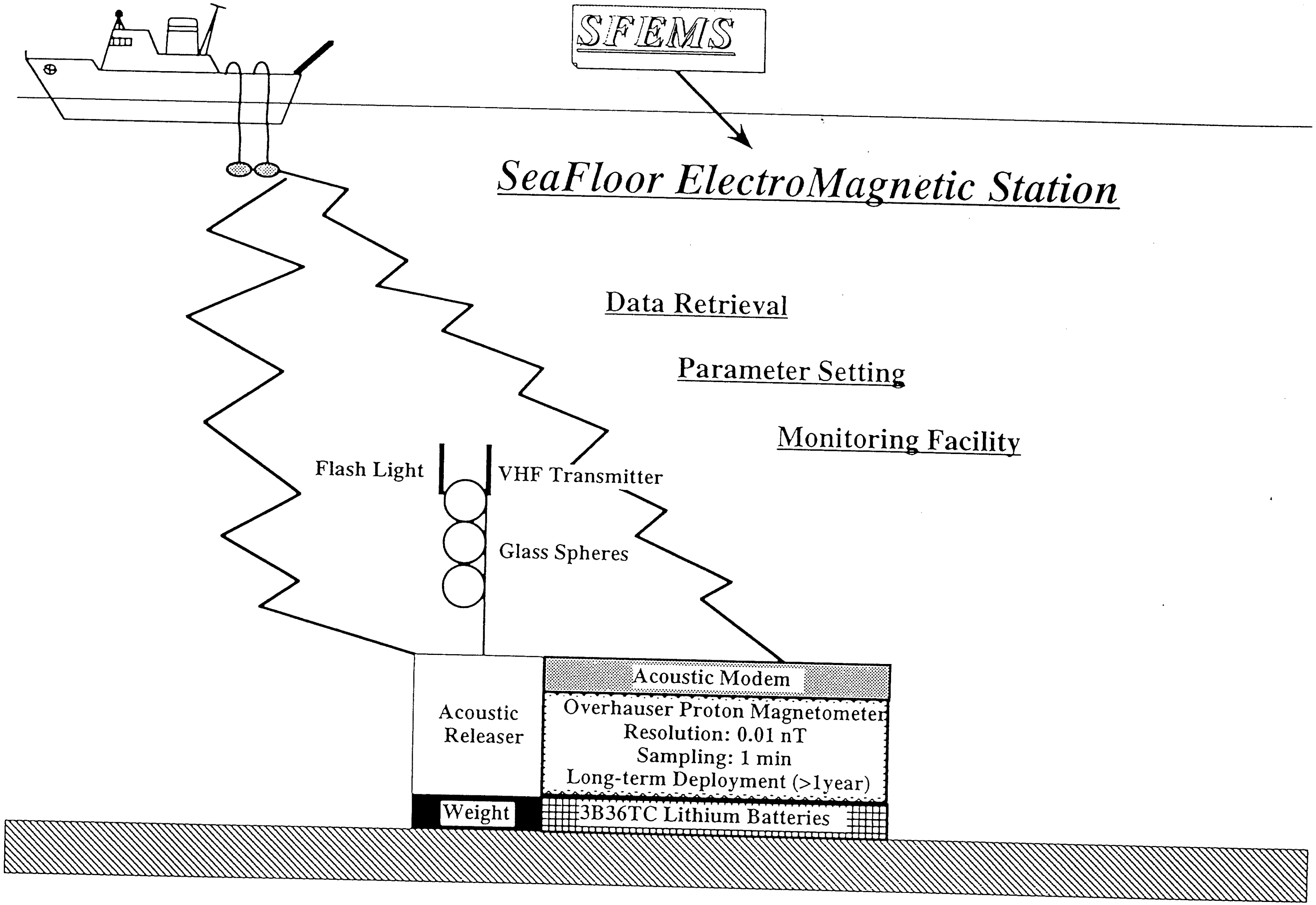
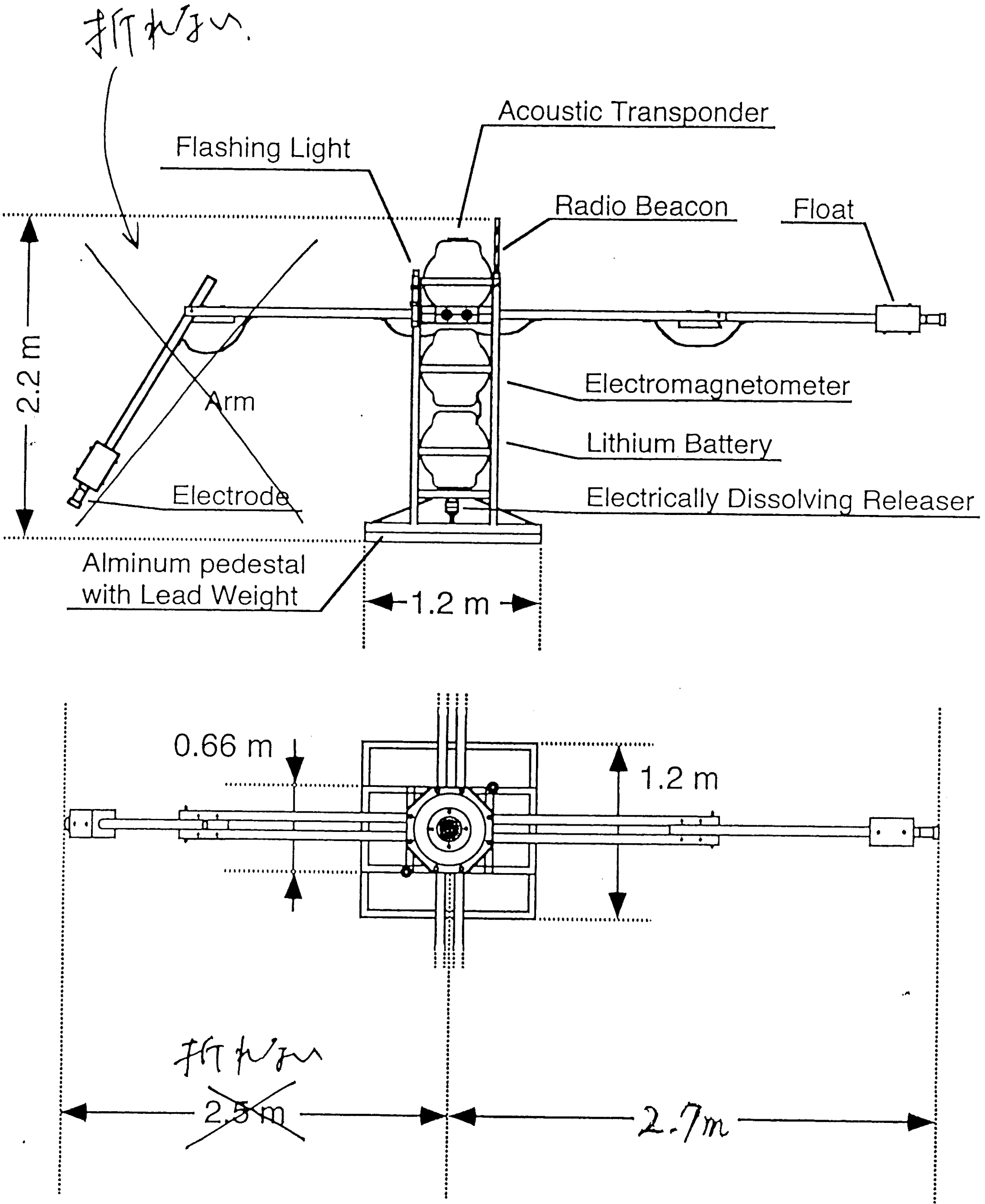


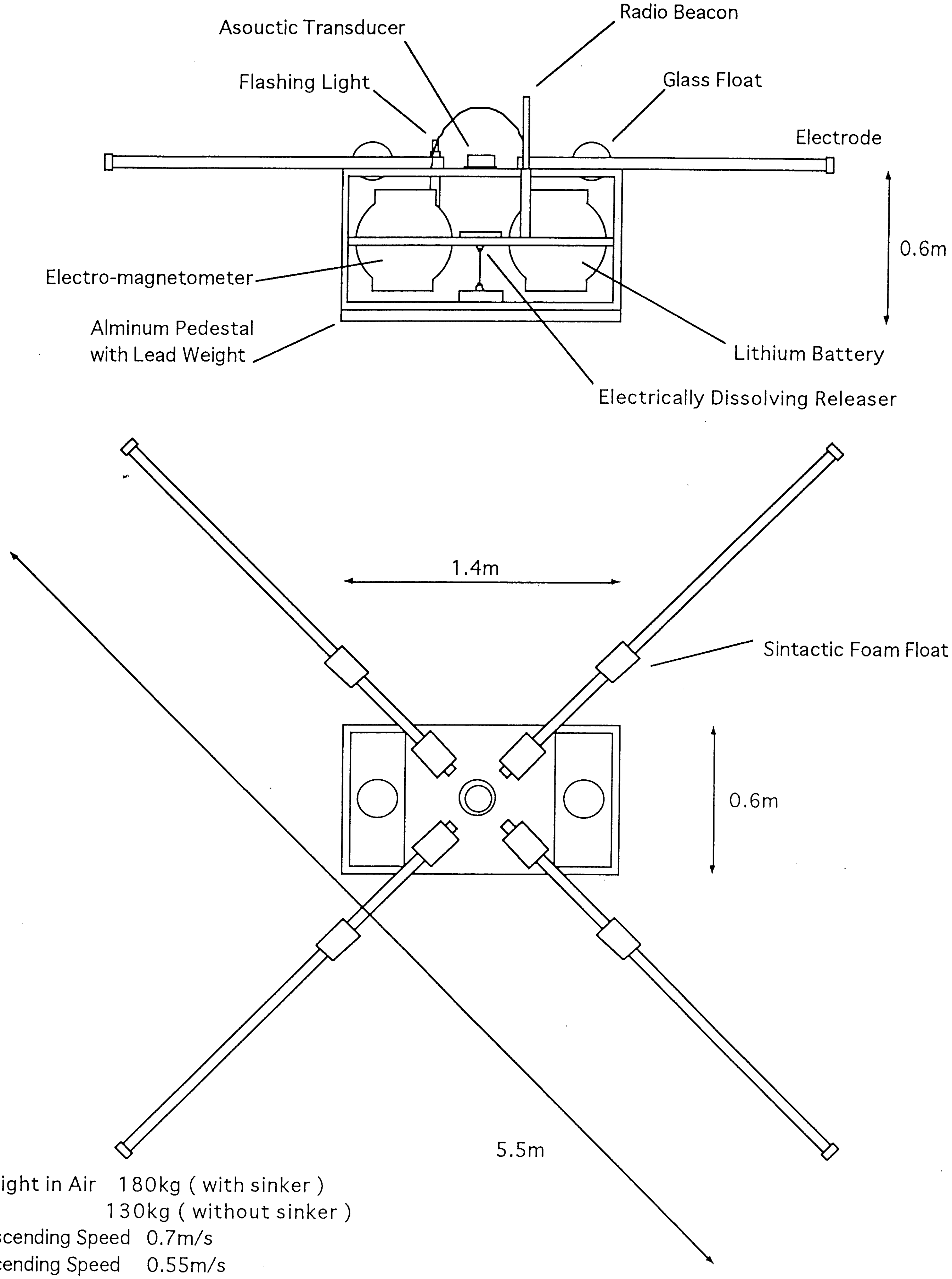
Fig. 2. Concept of SFEMS.



OBEM Type TT

Net Weight	150 kg (in Air)
	20 kg (in Water)
Net Buoyancy	20 kg

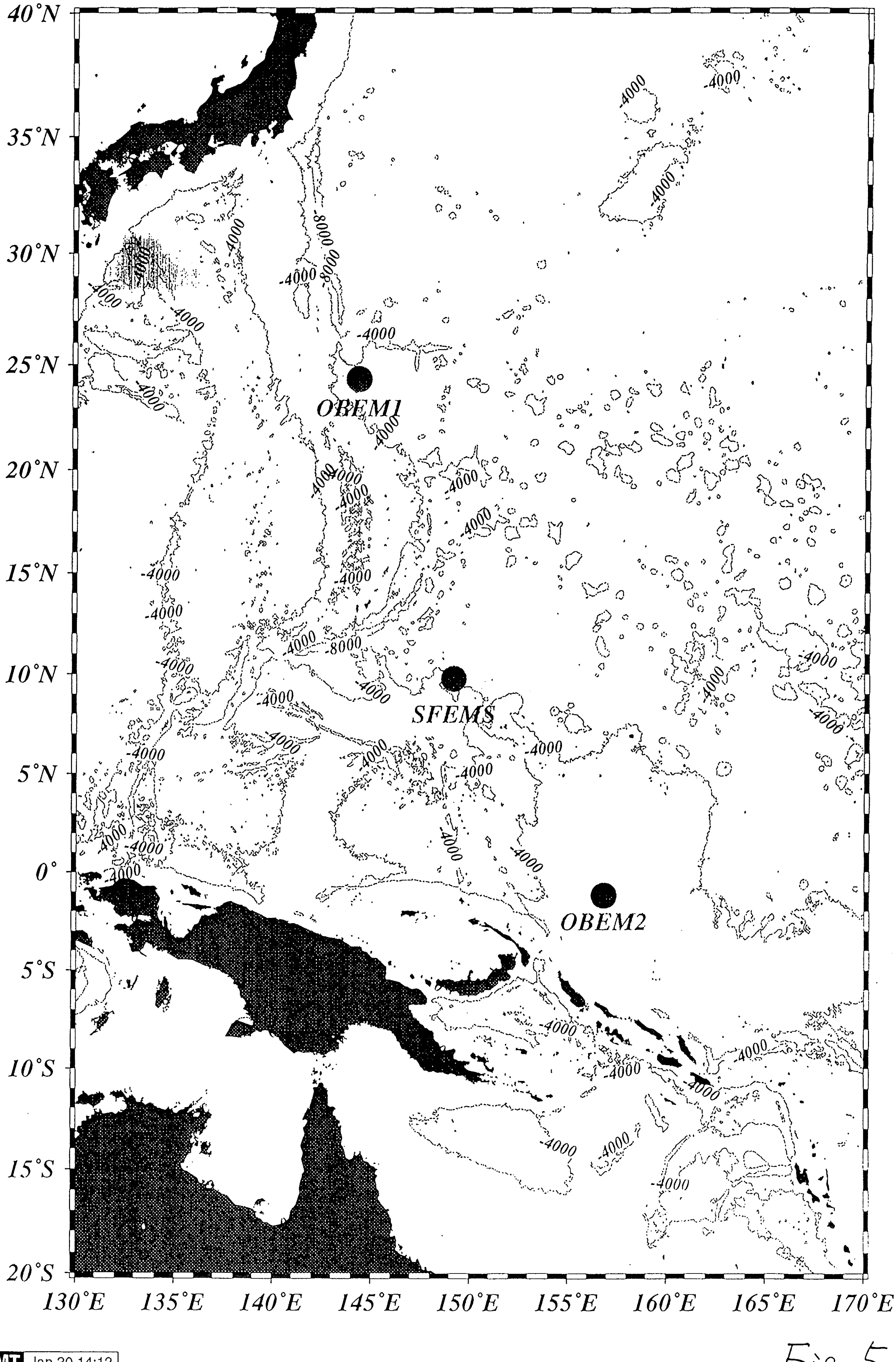
Fig. 3



Weight in Air 180kg (with sinker)
130kg (without sinker)
Descending Speed 0.7m/s
Ascending Speed 0.55m/s

Fig. 4

OBEM-HD



GMT Jan 30 14:12

Fig. 5

Geomagnetic Survey in the Lyra Basin, west of Ontong Java Plateau: Testing a tectonic hypothesis

M. Nakanishi[1] and E. L. Winterer[2]

1: Ocean Research Institute, the University of Tokyo

2: Scripps Institution of Oceanography, UCSD

Introduction

Ontong Java Plateau (OJP) is the largest of the half dozen major oceanic plateaus in the Pacific Ocean basin and is roughly the same size as the Kerguelen Plateau in the Indian Ocean. OJP rises about 2 km above the surrounding deep ocean floor and has an area within the 4.5-km contour of about 1.8×10^6 km^2. Assuming a depth to the M discontinuity of about 30 km (Gladczenko, 1994), the total volume of crustal material beneath OJP is about 50×10^6 km^3.

The origin of this huge volume of crustal material has been a major enduring problem of marine geology over the past 25 years [Kroenke, 1972; Hussong et al., 1979; Nur and Ben-Avraham, 1982; Crough, 1983; Olson and Nam, 1986; Mahoney, 1987; Richard et al., 1989; Duncan and Richards, 1991; Larson, 1991; Mahoney and Spencer, 1991; Tarduno et al., 1991; Coffin and Eldholm, 1993; Mahoney et al., 1993a; Saunders et al., 1993; Gladczenko, 1994; Coffin and Gahagan, 1995; Winterer and Nakanishi, 1995a, 1995b; Neal et al., 1997; Gladczenko et al., 1997]. Hypotheses for the origin fall into three classes:

1) OJP is, from its seismic velocity structure and thickness, possibly a continental fragment [Nur and Ben-Avraham, 1982];
2) OJP is the product of an oceanic mid-plate plume [Coffin and Eldholm, 1993; Neal et al., 1997];
3) OJP is the product of a plume close to [Mahoney, 1987; Mahoney et al., 1993a; Tejada et al., 1996] or on [Kroenke, 1974; Hussong et al., 1979; Winterer and Nakanishi, 1995a, 1998] an active oceanic spreading center.

All authors who have speculated on the orientation of a seafloor-spreading fabric of the OJP lithosphere have depicted it as trending ENE, except for Winterer and Nakanishi [1995a], who show it as NE.

A new satellite-gravity map of OJP [Sandwell and Smith, 1997] reveals a strong pattern of gravity ridges and troughs trending orthogonally NW and NE, traceable from Lyra Basin west of OJP into Nauru and Stewart Basins east of OJP. The NW-trending features, typically about 100 km wide, with 20-30 mgal of relief, align along arcs concentric to a distant pole in the far NE Pacific. Because thick pelagic sediments drape rather evenly over basaltic basement, except where incised by submarine canyons, OJP bathymetry reflects a ridge-and-trough structure on the top of basement, congruent with the gravity features. The summit region of OJP is a broad north-plunging arch about 500 km wide with about 500 m of relief, side to side, and with an axis of symmetry offset along left-stepping NW-trending breaks. The arch falls away abruptly onto steeper concave flanking slopes that gradually diminish in gradient towards the adjacent basins. Trends of both gravity and bathymetry over the OJP are at an angle to the Early Cretaceous-Late Jurassic Phoenix magnetic lineations of Nauru Basin. Magnetic anomalies M1-M10 are identified by Winterer and Nakanishi (1998) on OJP, indicating SE-aging crust on the SE side, and a half-rate of spreading of about 4 cm/yr.

The rough bilateral symmetry of the plateau and the nearly identical radiometric and limiting paleontological ages of about 122 Ma for basaltic basement at DSDP Site 289 on the E limb of the summit arch and ODP Site 807 on the W limb suggested to Winterer and Nakanishi [1998] that along the summit of the plateau there was a NE-trending spreading center, abandoned about 119 Ma, and offset by NW-trending fracture zones.

As documented by Mahoney and Spencer [1991], Mahoney et al. [1993a], and Mahoney et al. [1993b], the geochemistry of the lavas suggests eruption from a plume head close to or on a spreading center. Winterer and Nakanishi [1998] suggested that OJP was created by a plume that was centered beneath the spreading axis of a NE-trending active ocean ridge. Voluminous plume activity, which may have begun about 130 Ma, continued until ridge abandonment. Mid-plate lavas continued to erupt into Albian time on older crust in the adjacent East Mariana and Nauru basins.

Purpose

Winterer and Nakanishi [1998] suggested that a simple test of the hypothesis that OJP is an abandoned Early Cretaceous spreading ridge would be to make magnetic surveys in Lyra Basin and in the unnamed basin southeast of the plateau. The hypothesis in its simplest form predicts NE-trending M-series anomalies aging away from the crest of OJP.

During KH 98-1 leg1, we made a 70-hour, 1050-n.m. magnetic survey oriented in three parallel lines oriented along parts of three troughs between putative fracture zones. No time was available for any lines in Stewart Basin, on the SE side of OJP.

Method

We used a proton precession magnetometer for the geomagnetic survey, which was developed by the Ocean Research Institute, the University of Tokyo. The geomagnetic survey system is composed of a magnetometer unit, and a data-processing unit. The data-processing system comprises a microcomputer, a color display, and printer. We took the navigation data through the Hakuho-maru network from a MAGNABOX Series 5000. The magnetometer unit consists of a console and a sensor with a length of 300 m.

We also measured the three components of the geomagnetic field using a shipboard three-component magnetometer (STCM). The STCM system consists of a microcomputer unit, a controller, and a sensor. Two figure-eight ship maneuvers were carried out to gather data to subtract the effects on the magnetometer data of induced magnetization from the ship.

Results

Figure 1 shows magnetic anomaly profiles in Lyra Basin. Magnetic anomalies were calculated using the reference field of IGRF1995 (IAGA, Division Working Group, 1995).

We did not find evidence in Lyra Basin for NW-aging anomalies that might be the counterparts of the SE-aging anomalies identified previously in a few places on the SE slopes of OJP. Rather, we discovered a set of anomalies that we tentatively identify as M0-M5 on each of our three parallel lines, but aging SE, contrary to our expectation. Much more work remains to be done in comparing of these anomalies to the block model, and in processing the three-component data, which should yield information on direction of magnetization.

One attractive hypothesis is that the Lyra anomalies are within a microplate NW of OJP, and that for a time (M0-M5) the two spreading ridges, namely the Lyra-Pacific along the crest -of OJP, and the Lyra-Izanagi, near the NW side of Lyra Basin, both operated at the same time.

References

Coffin, M.F., and O. Eldholm, Large igneous provinces: crustal structure, dimensions, and external consequences, *Reviews of Geophysics, 32*, 1-36, 1993.

Coffin, M.F., and L.M. Gahagan, Ontong Java and Kerguelen Plateaux: Cretaceous Iceland?, *J. Geol. Soc. London, 152*, 1047-1052, 1995.

Crough, S.T., Hotspot swells, *Ann. Rev. Earth Planet. Sci., 11*, 165-193, 1983.

Duncan, R.A., and M.A. Richards, Hotspots, mantle plumes, flood basalts, and true polar wander, *Reviews of Geophysics, 29*, 31-50, 1991.

Gladczenko, T.P., *Crustal structure and composition of selected transient large igneous provinces*, Cand. Scient., Applied Geophysics thesis, Univ. of Oslo, 1994.

Gladczenko, T.P., M.F. Coffin and O. Eldholm, Crustal structure of the Ontong Java Plateau: Modeling of new gravity and existing seismic data, *J. Geophys. Res., 102*, 22711-22729, 1997.

IAGA Division V Working Group 8, International Geomagnetic Field, 1995 Revision, *J. Geomag. Geoelectr.*, 47, 1257-1261, 1995.

Hussong, D.M., L.K. Wipperman, and L.W. Kroenke, The crustal structure of the Ontong Java and Manihiki plateaus, *J. Geophys. Res., 84*, 6003-6010, 1979.

Kroenke, L., Geology of the Ontong Java Plateau, *Hawaii Inst. Geophys. Rept., 72-75*, 1-119, 1972.

Kroenke, L.W., Origin of continents through development and coalescence of oceanic flood basalt plateaus., *Eos, Trans. Am. Geophys. Un., 55 (4)*, 443, 1974.

Larson, R.L., Latest pulse of Earth: evidence for a mid-Cretaceous superplume, *Geology, 19,* 547-550, 1991.

Mahoney, J.J., An isotopic survey of Pacific oceanic plateaus: Implications for their nature and origin, in *Seamounts, Islands, and Atolls*, edited by B. Keating, P. Fryer, R. Batiza, and G.W. Boehlert, pp. 207-220, Amer. Geophys. Un., Washington, D.C., 1987.

Mahoney, J.J., and K.J. Spencer, Isotopic evidence for the origin of the Manihiki and Ontong Java Plateaus, *Earth Planet. Sci. Lett., 104,* 196-210, 1991.

Mahoney, J.J., M. Storey, R.A. Duncan, K.J. Spencer, and M. Pringle, Geochemistry and age of the Ontong Java Plateau, in *The Mesozoic Pacific: Geology, Tectonics, and Volcanism*, Edited by M.S. Pringle, W.W. Sager, W.V. Sliter, and S. Stein, pp. 233-261, Amer. Geophys. Un., Washington, D.C., 1993a.

Mahoney, J.J., M. Storey, R.A. Duncan, K.J. Spencer, and M. Pringle, Geochemistry and geochronology of Leg 130 basement lavas: nature and origin of the Ontong Java Plateau, in *Proc. ODP, Sci. Results*, edited by W.H. Berger, L.W. Kroenke, L.A. Mayer, and et al., pp. 3-22, Ocean Drilling Project, College Station, TX, 1993b.

Neal, C.R., J.J. Mahoney, L.W. Kroenke, R.A. Duncan, amd M.G. Petterson, The Ontong Java Plateau, in: *Large Igneous Provinces*, edited by J.J. Mahoney and M.F. Coffin, Amer. Geophys. Un. Mon. 100, Washington, D.C., 183-216, 1997.

Nur, A., and Z. Ben-Avraham, Oceanic plateaus, the fragmentation of continents, and mountain building, *J. Geophys. Res., 87*, 3644-3661, 1982.

Olson, P., and I.S. Nam, Formation of seafloor swells by mantle plumes, *J. Geophys. Res., 91*, 7181-7191, 1986.

Richards, M.A., R.A. Duncan, and V.E. Courtillot, Flood basalts and hot spot tracks: plume heads and tails, *Science, 246,* 103-107, 1989.

Sandwell, D.T., and W.H.F. Smith, Marine gravity anomalies from Geosat and ERS satellite altimetry, *J. Geophys. Res., 102*, 10039-10054, 1997.

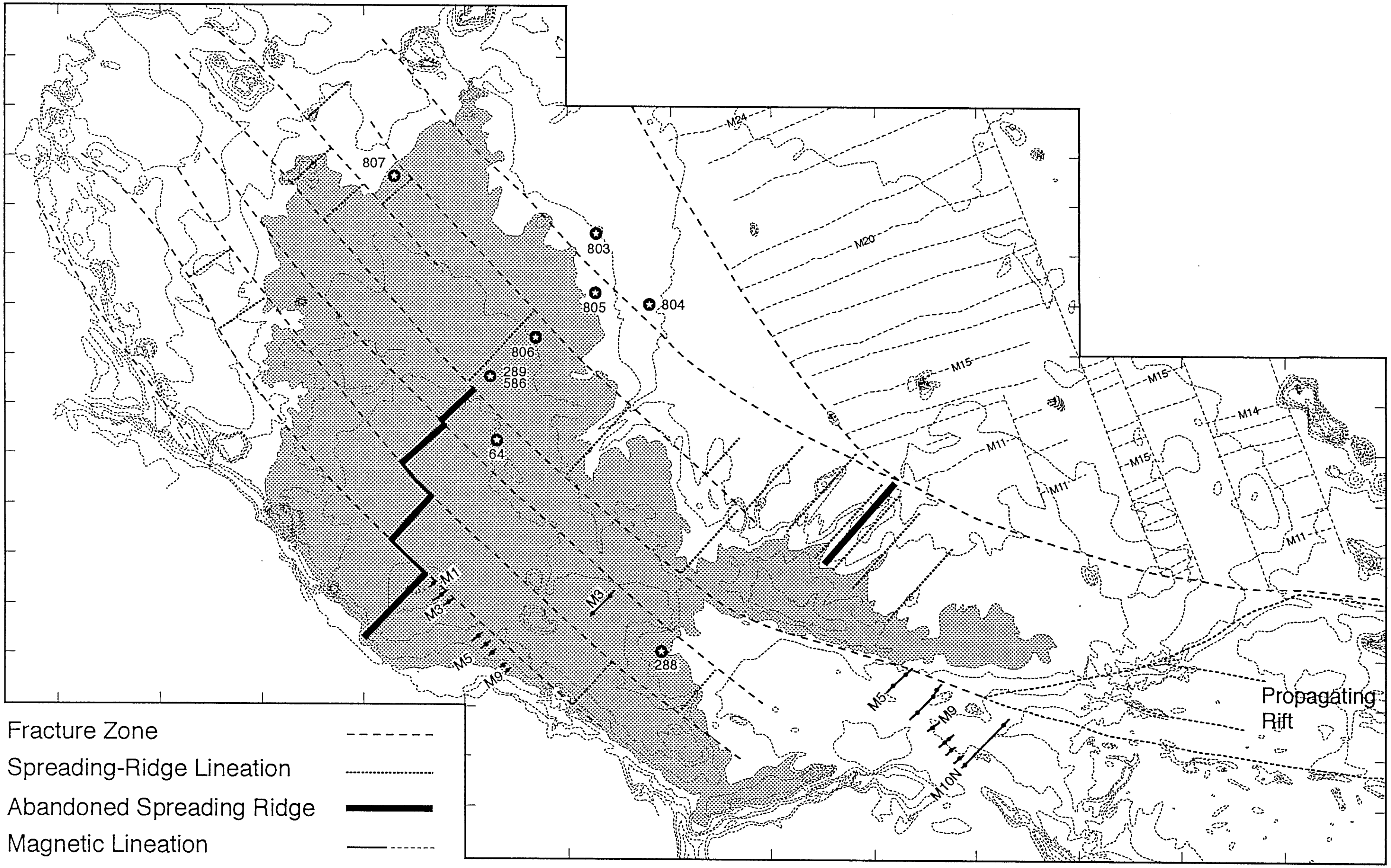
Tarduno, J.A., W.V. Sliter, L. Kroenke, M. Leckie, H. Mayer, J.J. Mahoney, R. Musgrave, M. Storey, and E.L. Winterer, Rapid formation of Ontong Java Plateau by Aptian mantle plume volcanism, *Science, 254,* 399-403, 1991.

Tejada, M.L.G., J.J. Mahoney, R.A. Duncan, and M. Hawkins, Age and geochemistry of basement rocks and alkalic lavas of Malaita and Santa Isabel, Solomon Islands, southern margin of Ontong Java Plateau, *J. Petrol.,* 37, 361-394, 1996.

Winterer, E.L., and M. Nakanishi, Evidence for a plume-augmented abandoned spreading center on Ontong Java Plateau, *Eos, Trans. Am. Geophys. Un., 76, 45 (Supplement))*, 617, 1995a.

Winterer, E.L., and M. Nakanishi, A fresh look at Ontong Java Plateau, in *Int. Union Geod. Geophys*, 21st Gen. Assemb., pp.461, Boulder, CO, 1995b.

Winterer, E.L. and M. Nakanishi, Evidence for a plume-augmented, abandoned, Early Cretaceous spreading center on Ontong Java Plateau, *J. Geophys. Res.*, submitted, 1998.



Fgiure 1. Tectonic map of OjP, shown, NW-trending fracture zones and NE-trending sea-floor spreading rudges. The shaded region has been influenced by plume magmatism. From Winterer and Nakanishi, 1998.

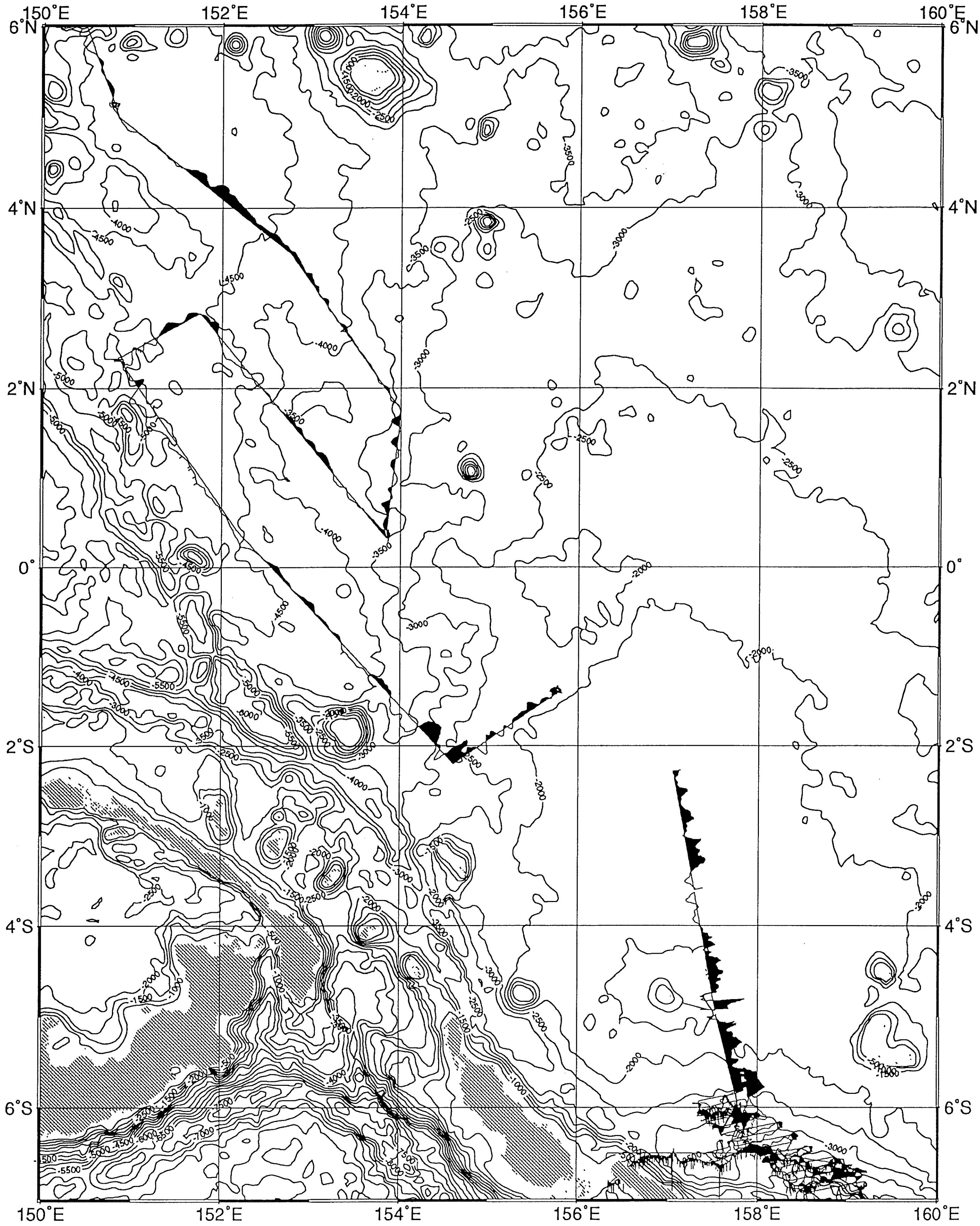


Figure 2. Along-track magnetic anomaly profiles around OJP. Positive anomalies shown in black.