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PART I
I. OUTLINE OF THE GH81-4 CRUISE

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Introduction

The Geological Survey of Japan (GSJ) has carried out, since F.Y.1979, the special research program, "Geological Study of Deep-sea Mineral Resources", funded by the Agency of Industrial Science and Technology, MITI. We may call this program the second five-year program on the study of manganese nodules in the Central Pacific, referring the previous (first) five-year program, "Basic Study on Exploration of Deep-sea Mineral Resources", carried out from F.Y.1974 to F.Y.1978. Standing on the results of the first five-year program, we designed the second five-year program aiming to clarify geological factors which controlls the regional and local variation of various properties of manganese nodules, as introduced by NAKAO *et al.* (1984). For the first year of that, we selected the survey area which includes Mid-Pacific Mountains, Central Pacific Basin, Manihiki Plateau and Penrhyn Basin, along the Wake-Tahiti Transect in order to clarify the regional aspect of the theme. MIZUNO and NAKAO (1982) reported the results of on-board and some on-shore works, for the first year activity, GH80-1 cruise.

This cruise report deals with the activity in F.Y. 1981 (GH81-4 cruise), the third year of this five-year program or the second year focussing the local aspects. We selected two detailed survey areas, along the eastern track of the Wake-Tahiti Transect and in the midst of Central Pacific Basin, where small hills are scattered in a deep-sea basin. Regional view of the survey area is shown in Fig. I-1.

Outline of GH81-4 cruise

Participants of the present cruise were ten scientists from GSJ, NRIPR and MMAJ, nine graduate and undergraduate students as technical assistants from six universities (Table I-1).

The R/V Hakurei-maru commanded by Captain H. OKUMURA sailed from Funabashi Port, Tokyo Bay on August 14th, 1981, made various surveys and observations in the survey area of the Central Pacific, called at Pago Pago Port, American (Eastern) Samoa for 7 days, and returned to Funabashi on October 12th of the same year.

The roughly summarized program and the detailed program of sixty days of the cruise are shown in Tables I-2 and I-3 respectively. We had a trouble on the No. 2 winch controller at the last station of the earlier half of this cruise, just before the calling at Pago Pago. During the 7 day call, it was repaired with assistance of an electric

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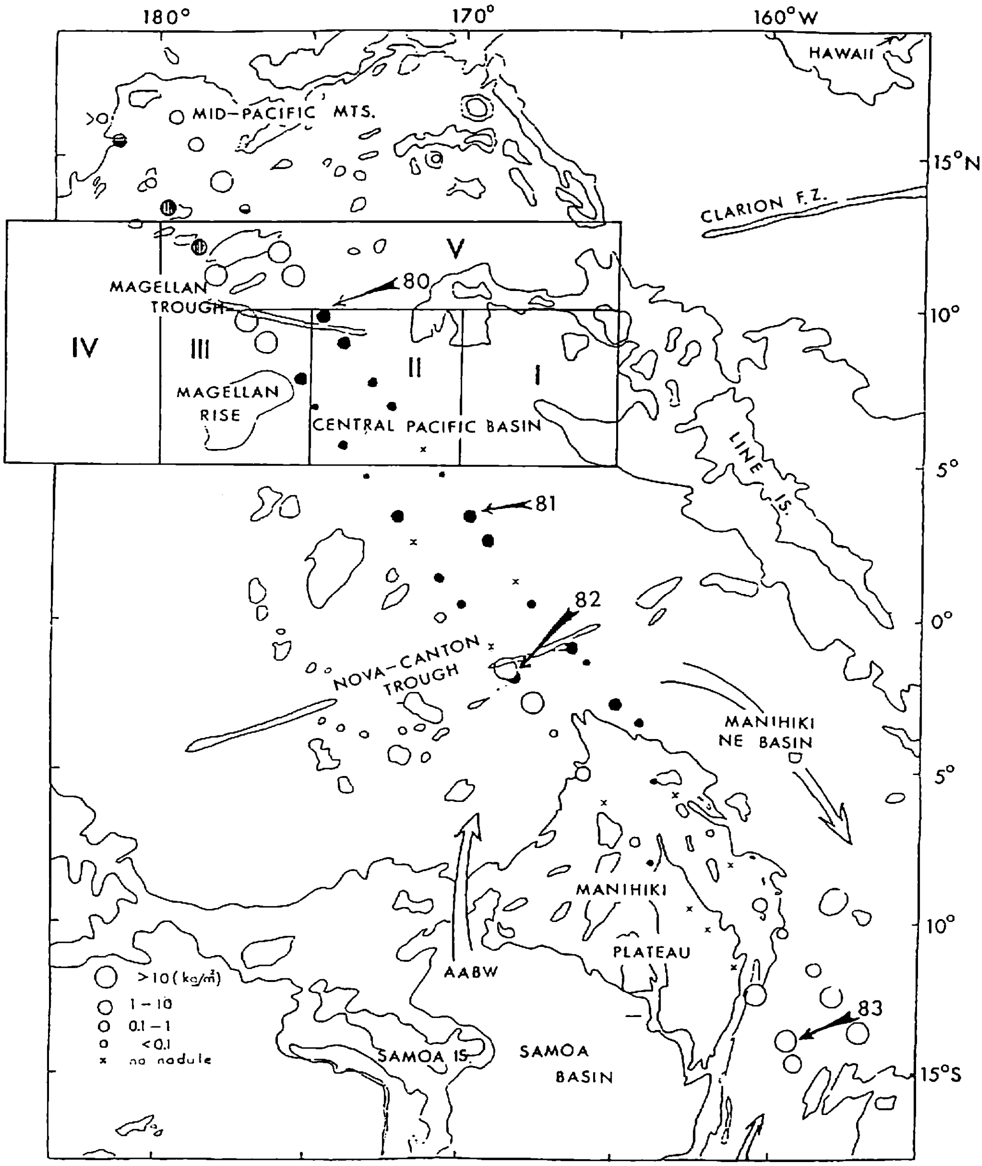

Fig. I-1 Regional view of the survey area.
I: GH74-5 area, II: GH76-1 area, III: GH77-1 area, IV: GH78-1 area and V: GH79-1 area. Two-disit figures (80–83) with an arrow show the detailed survey areas in each fiscal year in 1980's. Circles show surface feature and abundance of the nodules at the sites in GH80-1 area. Solid circle: rough surface nodule, open circle: smooth surface nodule, vertically striped circle: intermediate surface nodule, one circle with solid bottom and striped top: a nodule with rough surface bottom and intermediate surface top.

Table I-1 On-board scientific staffs.

Name	Organization	Speciality and/or responsibility
Seizo Nakao	G.S.J.	Chief scientist; geology
Takemi Ishihara	G.S.J.	Co-chief scientist; NNSS positioning, gravimetric and magnetic survey
Akira Usui	G.S.J.	Scientist; geochemistry and mineralogy
Akira Nishimura	G.S.J.	Scientist; sedimentology
Manabu Tanahashi	G.S.J.	Scientist; magnetic and acoustic survey
Toshitsugu Yamazaki	G.S.J.	Scientist; NNSS positioning, gravimetric and magnetic survey, heat-flow measurement
Eiji Saito	G.S.J.	Scientist; topography
Keiji Handa	N.R.I.P.R.	Senior scientist; exploitation techniques of nodules and engineering property of sediments
Tetsuo Yamazaki	N.R.I.P.R.	Scientist; exploitation techniques of nodules and engineering property of sediments
Ken Nakayama*	M.M.A.J.	Scientist; survey techniques
Masahide Furukawa	Ryukyu Univ.	Undergraduate student; technical assistant
Koji Ueno	Ryukyu Univ.	Ibid.
Masaya Kato	Ryukyu Univ.	Ibid
Kazuma Waimatsu	Tokyo Fisheries Univ.	Ibid.
Natsuki Tsuge	Tokyo Fisheries Univ.	Ibid.
Shinji Takahashi	Kobe Univ.	Ibid.
Yoshihiro Naito	Chiba Univ.	Ibid.
Hajime Hishida	Tokyo Univ.	Ibid.
Hiroshi Nonome	Kumamoto Univ.	Ibid.
Sitivi Kam*	Govt. Western Samoa	Survey techniques of manganese nodules

* Funabashi to Pago Pago

Table I-2 Rough summary of cruise program.

Aug. 14	Lv.	Funabashi (14:00)
		Geophysical survey from off Boso Peninsula to the survey area.
Aug. 24	Ar.	the survey area.
		Geological and geophysical survey.
Sept. 5	Lv.	the survey area.
		Geophysical survey to Pago Pago.
Sept. 10	Ar.	Pago Pago (09:00).
Sept. 16	Lv.	Pago Pago (16:00).
		Geophysical survey to the survey area.
Sept. 22	Ar.	the survey area.
		Geological and geophysical survey.
Sept. 29	Lv.	the survey area.
		Geophysical survey from the survey area to Funabashi.
Oct. 12	Ar.	Funabashi (10:00)

engineer dispatched from Japan. We had a short cruise for the final adjastment of it during the port call as shown in Table I-3.

Survey methods and onshore laboratory works

The survey methods used in the survey area are shown in Table I-4. The length of the survey lines for some geophysical works (bathymetric, magnetic and gravimetric surveys) includes those along the courses between Japan and the survey area, and between the survey area and Pago Pago including preliminary topographic survey in the southern margin of Nova-Canton Trough for the next cruise.

Arrangement of the bottom sampling was to be differed from those in the previous cruises in order to study the local variation of the nodule distribution. Outlined

Table I-3 Daily program of cruise.

Date		Weather	Cruising time	Cruising distance	Remarks
Aug.	14	Rainy	10.00	133.2 n.m.	Lv. Funabashi (14:00)
	15	Cloudy	23.30	314.2	Geophysical survey* (2) to the survey area.
	16	Fine	23.30	316.8	Geophysical survey (2) to the survey area.
	17	Fine	23.30	306.4	Geophysical survey (2) to the survey area.
	18	Fine	23.30	324.1	Geophysical survey (2) to the survey area.
	19	Cloudy	23.30	336.1	Geophysical survey (2) to the survey area.
	20	Fine	23.30	328.1	Geophysical survey (2) to the survey area.
	21	Fine	23.30	333.7	Geophysical survey (2) to the survey area.
	22	Fine	23.30	313.7	Geophysical survey (2) to the survey area.
	23	Cloudy	24.00	328.7	Geophysical survey (2) to the survey area.
	23	Fine	24.00	331.3	Geophysical survey (2) to the survey area.
	24	Fine	24.00	188.0	Geophysical survey (1).
	25	Fine	24.00	131.4	Geophysical survey (1).
	26	Cloudy	24.00	139.3	Geophysical survey (1) and sampling** (Sts. 2576-2579, 2581 and 2582).
	27	Fine	24.00	137.4	Geophysical survey (1) and sampling (Sts. 2586-2588 and 2592-2594).
	28	Fine	24.00	144.1	Geophysical survey (1) and sampling (Sts. 2580, 2583-2585, 2589 and 2590).
	29	Fine	24.00	126.9	Geophysical survey (1) and sampling (Sts. 2591, 2595, 2598, 2599, 2602 and 2603).
	30	Fine	24.00	134.8	Geophysical survey (1) and sampling (Sts. 2600, 2601, and 2604-2608).
	31	Fine	24.00	139.7	Geophysical survey (1) and sampling (Sts. 2596 and 2597).
Sept.	1	Cloudy	24.00	289.7	Geophysical survey (1).
	2	Fine	24.00	329.7	Geophysical survey (1).
	3	Fine	24.00	152.5	Geophysical survey (1) and sampling (Sts. 2609-2618).
	4	Fine	24.00	96.1	Geophysical survey (1) and sampling (Sts. 2619-2628).
	5	Fine	24.00	160.8	Geophysical survey (1) and sampling (Sts. 2629-2638).
	6	Cloudy	24.00	323.3	Geophysical survey (2) to Pago Pago.
	7	Fine	24.00	340.1	Geophysical survey (2) to Pago Pago.
	8	Fine	24.00	343.7	Geophysical survey (2) to Pago Pago.
	9	Cloudy	24.00	254.5	Geophysical survey (2) to Pago Pago.
	10	Cloudy	09.00	21.5	Ar. Pago Pago (09:00).
	11	Cloudy	-	-	-
	12	Fine	-	-	-
	13	Rainy	06.30	33.0	Lv. Pago Pago (17:30). (Repair and test of No.2 winch controller)
	14	Cloudy	19.00	72.6	Ar. Pago Pago (19:00).
	15	Fine	-	-	-
	16	Fine	08.00	100.3	Lv. Pago Pago (16:00). Geophysical survey (2) to the survey area.
	17	Fine	24.00	327.9	Geophysical survey (2) to the survey area.
	18	Fine	24.00	340.9	Geophysical survey (2) to the survey area.
	19	Fine	24.00	317.0	Geophysical survey (2) to the survey area.
	20	Fine	24.00	320.8	Geophysical survey (2) to the survey area.
	21	Fine	24.00	350.8	Geophysical survey (2) to the survey area. Ar. the syrvey area.
	22	Fine	24.00	157.4	Geophysical survey (1) and sampling (Sts. 2640-2651).
	23	Fine	24.00	149.0	Geophysical survey (1) and sampling (Sts. 2652-2663).
	24	Fine	24.00	161.0	Geophysical survey (1) and sampling (Sts. 2664-2669 and 2679).
	25	Fine	24.00	119.5	Geophysical survey (1) and sampling (Sts. 2677-2688).
	26	Fine	24.00	102.3	Geophysical survey (1) and sampling (Sts. 2689-2700).
	27	Fine	24.00	109.5	Geophysical survey (1) and sampling (Sts. 2701-2712).
	28	Cloudy	24.00	139.0	Geophysical survey (1) and sampling (Sts. 2670-2675 and 2713).
	29	Fine	24.30	331.8	Lv. the survey area. Geophysical survey (2) to Funabashi.
	30	Cloudy	24.30	329.1	Geophysical survey (2) to Funabashi.
Oct.	1	Fine	24.30	344.6	Geophysical survey (2) to Funabashi.
	3	Fine	24.30	353.6	Geophysical survey (2) to Funabashi.

Table I-3 (continued)

4	Fine	24.30	350.1	Geophysical survey (2) to Funabashi.
5	Fine	24.30	343.9	Geophysical survey (2) to Funabashi.
6	Cloudy	24.30	345.9	Geophysical survey (2) to Funabashi.
7	Fine	24.30	352.8	Geophysical survey (2) to Funabashi.
8	Fine	24.00	318.5	Geophysical survey (2) to Funabashi.
9	Fine	24.00	335.2	Geophysical survey (2) to Funabashi.
10	Cloudy	24.00	256.2	Geophysical survey (2) to Funabashi.
11	Fine	17.00	206.2	Geophysical survey (2) to Funabashi.
12	Cloudy	01.00	6.5	Ar. Fanabashi (09:00).

* Geophysical survey (1) comprises continuous seismic reflection profiling, and magnetic and gravity measurements. Geophysical survey (2) means the survey with magnetic measurement and gravity measurement.

** Sampling includes bottom photographying by a one-shot camera installed with a box corer or a freefall grab sampler, and heat-flow measurement.

Table I-4 Survey methods in the GH81-4 area. The right-hand column shows a survey line length and an observation number of respective works.

Cruising and positioning by NNSS	
Geophysical methods	
Bathymetric survey by 12kHz PDR	24,981 km (13,488 n.m.)
Subbottom profiling by 3.5kHz SBP	24,981 km (13,488 n.m.)
Continuous seismic reflection profiling by air-gun	2,692 km (1,454 n.m.)
Seismic refraction survey by sono-buoy (4 sites)	67 km (36 n.m.)
Magnetic survey by proton magnetometer	22,500 km (12,149 n.m.)
Gravimetric survey by on-board gravimeter	24,981 km (13,488 n.m.)
Heatflow measurement	H54-66
Geological methods	
Bottom sampling by box corer	B57-68
Bottom sampling by piston corer	P218-230
Bottom sampling by freefall grab with camera	FG310-423
Bottom sampling by dredge	D496

topography and nodule distribution are disclosed in the beginning by about 5 n.m. grid survey. Then the Detailed Survey Areas I and II were selected based on the grid survey, as shown in Fig. I-2. During the detailed survey, several sets of freefall grab sampler and one wire-lined sampler (piston corer or box corer) were used along a straight line, in general, as a serial sampling which were done twice a day. Direction of the serial sampling were decided as to make comprehensive understanding the relation among the genesis of manganese nodules, sedimentation and submarine topography. The minimum distance between each sampling points was about 0.11 n.m., in the detailed survey areas. Results of on-site observation is shown in Table I-5.

Ship's position was determined by NNSS throughout the survey area. The real time positions obtained were recalculated on the basis of estimated water current to make the accuracy as high as possible.

The samples were analyzed also in the onshore laboratory after the cruise by the GSJ and other staffs including non-on-board members. These participants in onshore laboratory works were as follows; chemical analysis of manganese nodules by S. TERASHIMA (GSJ): and chemical analysis of bottom sediment by K. YAMAMOTO and R. SUGISAKI (Nagoya Univ.) and N. MITA (GSJ).

Outline of the survey area

Figure I-3 shows the whole tracks of geophysical works in the survey area which

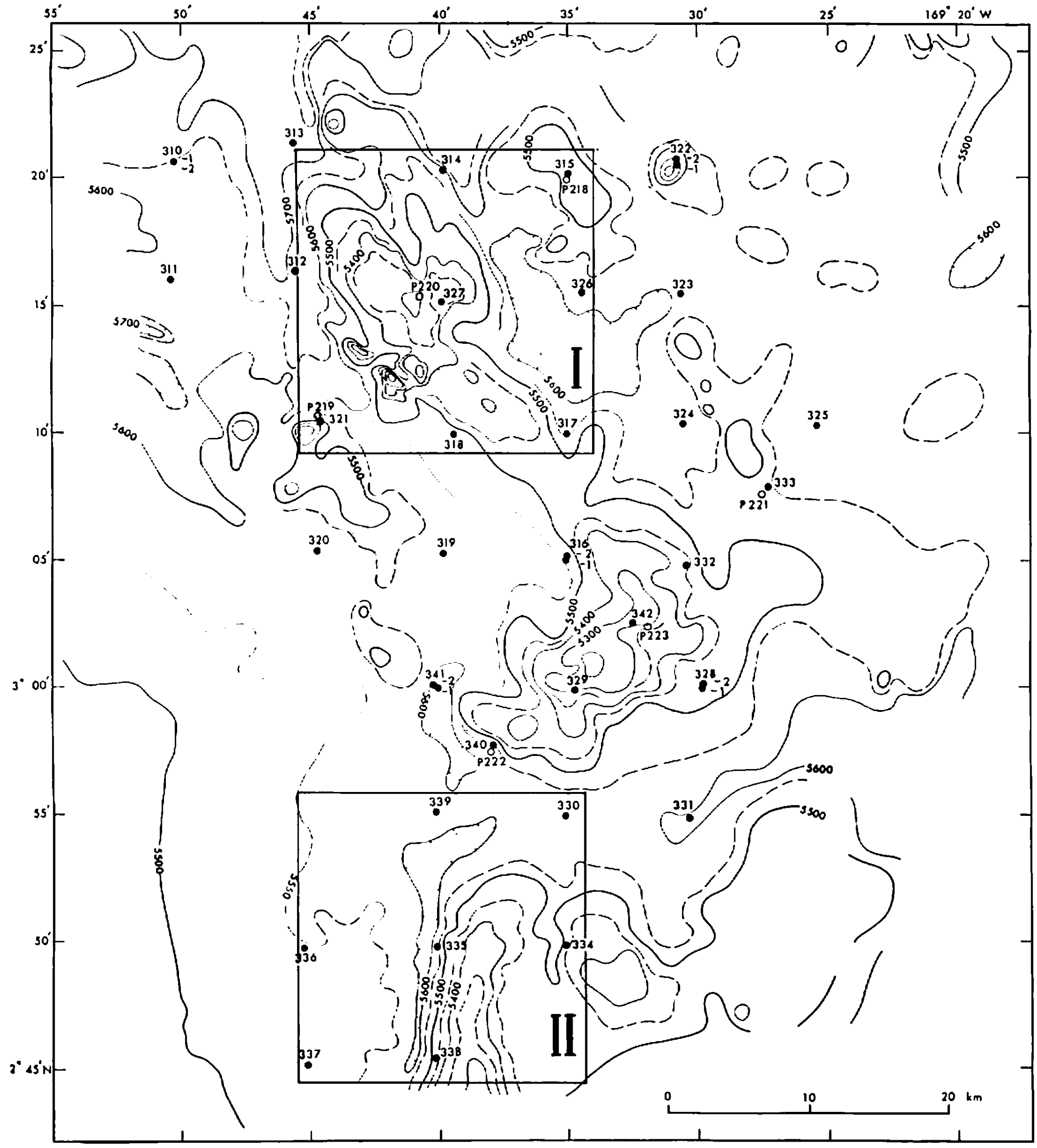

Fig. I-2 GH81-4 survey area with topography, sampling points during the grid survey. I: Detailed Survey Area I, II: Detailed Survey Area II. Three-digit figures after P show sampling number by piston corer, and those without P show that by freefall grab.

Table 1-5 Results of on-site observations during GH81-4 Cruise (August-October, 1981).

Sta. no.	Observ. no.	Local date	Recalculated position Lat. (N)	Long (W)	Corrected depth (m)	Bottom sediment	Manganese nodules Morphology etc.	Abund.	Cover.	Topography
2576	FG310-1	August 26	3°20.57'	169°50.27'	5,649	siliceous ooze	—	0kg/m²	0%	Inter-hill basin
	〃 -2	〃	3 20.55	169 50.30	5,648	〃	—	0	0	〃
2577	FG313	〃	3 21.32	169 45.64	5,727	siliceous clay	Sr	0.1	0	〃
2578	FG314	〃	3 20.23	169 39.87	5,602	〃	Sr	0.1	0	〃
2579	P218(H54)	〃	3 19.86	169 35.06	5,473	siliceous ooze	Vs, Vs+r	—	—	Top of a very small hill
	FG315	〃	3 20.08	169 34.98	5,474	〃	Sr	0.1	0	〃
2580	FG322-1	28	3 20.46	169 30.82	5,572	〃	IDs·r, ISs·r Ds·r	12.8	1	ditto
	〃 -2	〃	3 20.63	169 30.83	5,334	no sample	IDs·r	0.4	(15)	〃
2581	FG311	26	3 15.95	169 50.40	5,624	siliceous ooze	Dr	0.2	0	Inter-hill basin
2582	FG312	〃	3 16.28	169 45.54	5,666	〃	Sr	0.8	0	〃
2583	P220(H56)	28	3 15.30	169 40.79	5,371	〃	Sr	—	—	Top of a hill
	FG327	〃	3 15.11	169 39.93	5,364	〃	Sr	4.5	0	〃
2584	FG326	〃	3 15.46	169 34.47	5,593	〃	—	0	0	Inter-hill basin
2585	FG323	〃	3 15.39	169 30.69	5,599	〃	—	0	0	〃
2586	P219(H55)	27	3 10.57	169 44.69	5,578	siliceous clay	—	—	—	Steep slope of a very small hill
	FG321	〃	3 10.44	169 44.58	5,545	sampler unre-covered		—	—	〃
2857	FG318	〃	3 09.87	169 39.45	5,521	siliceous ooze	—	0	0	Inter-hill basin
2588	FG317	〃	3 09.92	169 35.06	5,537	〃	Sr	0.1	0	〃
2589	FG324	28	3 10.33	169 30.58	5,575	〃	—	0	0	〃
2590	FG325	〃	3 10.27	169 25.46	5,568	〃	—	0	0	Inter-hill basin
2591	P221(H57)	29	3 07.54	169 27.57	5,538	siliceous clay	—	—	—	〃
	FG333	〃	3 07.86	169 27.31	5,527	siliceous ooze	—	0	0	〃
2592	FG320	27	3 05.33	169 44.70	5,573	〃	—	0	0	〃
2593	FG319	〃	3 05.20	169 39.86	5,577	no sample	—	0	0	〃
2594	FG316-1	〃	3 04.93	169 35.07	5,564	siliceous ooze	Sr, Dr	0.1	0	〃
	〃 -2	〃	3 05.11	169 35.04	5,526	〃	IDr, IDPr	2.1	0	〃
2595	FG332	29	3 04.76	169 30.44	5,464	〃	—	0	0	Moderate slope of a hill
2596	P223(H59)	31	3 02.32	169 31.94	5,309	siliceous clay	—	—	—	〃
	FG342	〃	3 02.50	169 32.47	5,287	siliceous ooze	Sr	0.4	0	〃
2597	FG341-1	〃	2 59.94	169 40.03	5,617	〃	Sr	0.3	0	Bottom of a small trough
	〃 -2	〃	3 00.02	169 40.23	5,609	no sample	Sr	0.1	0	〃
2598	FG329	29	2 59.84	169 34.73	5,345	〃	Sr	0.8	0	Moderate slope of a hill
2599	FG328-1	〃	2 59.91	169 29.82	5,484	siliceous ooze	—	0	0	〃
	〃 -2	〃	3 00.06	169 29.82	5,485	〃	—	0	0	〃
2600	P222(H58)	30	2 57.39	169 38.05	5,584	siliceous clay	—	—	—	Foot of a hill
	FG340	〃	2 57.65	169 37.93	5,537	siliceous ooze	—	0	0	〃
2601	FG339	〃	2 55.07	169 40.16	5,589	〃	—	0	0	Inter-hill basin
2602	FG330	29	2 54.93	169 35.12	5,573	〃	—	0	0	〃
2603	FG331	〃	2 54.85	169 30.35	5,593	〃	—	0	0	Inter-hill basin
2604	FG336	30	2 49.72	169 45.22	5,544	〃	—	0	0	〃

Table I-5 (continued)

Sta. no.	Observ. no.	Local date	Recalculated position Lat. (N)	Long (W)	Corrected depth (m)	Bottom sediment	Manganese nodules Morphology etc.	Abund.	Cover.	Topography
2605	FG335	August 30	2 49.78	169 40.13	5,603	no sample	DPs·r, Ts·r Fs·r, Ds·r, Fr	12.6	0	Foot of a hill
2606	FG334	"	2 49.83	169 35.09	5,469	siliceous ooze	Sr	0.3	0	Gentle slop of hill
2607	FG337	"	2 45.16	169 45.09	5,537	"	—	0	0	Inter-hill basin
2608	FG338	"	2 45.38	169 40.15	5,410	"	Sr	4.9	0	Steep slope of a hill
2609	FG343	Sept. 03	3 15.39	169 39.69	5,319	"	Sr	1.3	0	Moderate slope of a hill
2610	FG344	"	3 15.89	169 39.29	5,378	"	Sr	0.1	0	
2611	FG345	"	3 16.38	169 38.90	5,437	"	Sr	0.1	0	↓
2612	FG346	"	3 16.78	169 38.58	5,464	"	—	0	0	NE
2613	B57	"	3 17.50	169 38.16	5,605	"	Vr (Mn coated pumice)	0.1	—	Inter-hill basin
2614	FG347	"	3 18.20	169 37.61	5,592	"	Vr (Mn coated pumice)	0.1	0	
2615	FG348	"	3 18.74	169 37.16	5,557	"	—	0	0	
2616	FG349	"	3 19.29	169 36.74	5,576	"	—	0	0	
2617	FG350	"	3 19.85	169 36.33	5,536	"	Dr (fragments)	0.1	0	↓
2618	B58	"	3 20.61	169 36.16	5,483	siliceous clay	Sr	0.1	—	NE
2619	FG351	04	3 15.43	169 40.76	5,356	"	Sr, Dr	2.8	1	Top of a hill
2620	FG352	"	3 15.78	169 41.07	5,370	"	Sr, Dr	9.6	0	Gentle slope along a ridge
2621	FG353	"	3 16.12	169 41.40	5,422	"	ISPs, IDPs IDs, Is	15.6	30	
2622	B59	"	3 16.39	169 41.26	5,486	"	IDPs, DPs	15.7	30	
2623	FG354	"	3 16.67	169 41.86	5,376	no sample	—	0	(40)	
2624	FG355	"	3 16.96	169 42.41	5,340	siliceous clay	Sr, Dr	5.2	0	
2625	FG356	"	3 17.35	169 43.03	5,392	"	Sr, Dr	11.4	2	
2626	FG357	"	3 17.69	169 43.61	5,456	"	Sr	5.9	—	
2627	FG358	"	3 18.07	169 44.26	5,468	"	Sr	5.8	1	↓
2628	B60	"	3 18.23	169 44.94	5,588	"	Sr	8.8	2	NW
2629	FG359	05	3 10.00	169 45.05	5,248	no sample	—	0	(50)	Top of a very small hill
2630	FG360	"	3 10.65	169 44.12	5,555	siliceous clay	Sr	0.3	0	Inter-hill basin
2631	FG361	"	3 11.32	169 43,19	5,632	siliceous ooze	Sr	0.2	1	↓
2632	FG362	"	3 11.66	169 42.76	5,628	"	IDs, IDPs	9.9	10	NE
2633	FG363	"	3 11.99	169 42.31	5,466	"	IDs, IDPs	15.1	25	Steep slope of a hill
2634	B61	"	3 12.13	169 41.96	5,461	siliceous clay	IDs, IDPs, Fs	14.6	40	Top of a small and steep hill
2635	FG364	"	3 13.28	169 41.62	5,446	siliceous ooze	IDs, IDPs, Is	10.2	15	Steep slope of a hill
2636	FG365	"	3 13.83	169 41.54	5,350	"	Sr	3.0	0	↓
2637	FG366	"	3 14.32	169 41.36	5,356	"	Sr	0.6	0	NE
2638	FG367	"	3 14.93	169 41.27	5,326	"	Sr	1.3	0	Top of a hill
2639	B62	"	—	—	—	abandoned for winch trouble	—	—	—	—
2640	FG368	22	3 16.41	169 40.59	5,374	siliceous clay	Ds, DPs, IDs	14.8	15	Moderate slope along a ridge
2641	FG369	"	3 17.10	169 40.73	5,482	siliceous ooze	Sr	1.7	0	
2642	FG370	"	3 17.81	169 40.89	5,486	"	Sr	0.2	0	↓

Table I-5 (continued)

Sta. no.	Observ. no.	Local date	Recalculated position Lat. (N)	Long (W)	Corrected depth (m)	Bottom sediment	Manganese nodules Morphology etc.	Abund.	Cover.	Topography
2643	FG371	Sept. 22	3 18.64	169 41.04	5,488	"	—	0	0	↓
2644	FG372	"	3 19.56	169 41.22	5,529	"	Sr	0.1	0	NNW
2645	B63	"	3 17.49	169 41.71	5,628	siliceous clay	IDs, IDPs	12.0	—	Foot of a hill
2646	FG373	"	3 15.97	169 44.38	5,686	"	IDr, IDPr, Fr	4.9	2	Gentle slope of a hill.
2647	FG374	"	3 15.82	169 43.55	5,391	no sample	IDr(fragments)	0.1	—	↓
2648	FG375	"	3 15.74	169 42.55	5,363	siliceous clay	Sr, Dr	10.2	5	
2649	FG376	"	3 15.83	169 41.82	5,333	"	Sr, Dr	10.4	15	
2650	FG377	"	3 15.81	169 41.30	5,331	"	IDs·r, Ss·r, Ts·r	8.1	10	E
2651	P224(H60)	"	3 16.64	169 41.07	5,500	"	Ss	—	—	Foot of a hill
2652	FG378	23	3 12.22	169 43.47	5,495	"	IDs, IDPs	9.5	30	Steep slope of a rolled hilly area
2653	FG379	"	3 12.67	169 42.91	5,061	"	IDs	4.0	2	↓
2654	FG380	"	3 13.13	169 42.36	5,318	"	IDs, IDPs	15.1	10	NE
2655	FG381	"	3 13.54	169 41.89	5,341	"	Ss·r, Ds·r Fs·r, IDs·r	18.0	10	Gentle slope of a hill ↓
2656	FG382	"	3 14.05	169 41.30	5,339	"	Sr	0.5	0	NE
2657	B64	"	3 14.59	169 41.61	5,368	"	Sr	1.1	—	NW
2658	FG383	"	3 11.40	169 40.93	5,488	"	Vs (Mn coated rock)	0.1	0	Steep slope of a rolled hilly area
2659	FG384	"	3 12.09	169 40.95	5,256	no sample	IPs, Ts	8.9	20	↓
2660	FG385	"	3 12.68	169 40.97	5,192	siliceous clay	IDs, ISs, Vs (Mn coated rock)	13.0	10	
2661	FG386	"	3 13.25	169 40.99	5,361	"	Ss·r, Ds·r	10.5	—	N
2662	FG387	"	3 13.86	169 41.02	5,336	"	Sr	0.8	—	Moderate slope of a hill
2663	P255(H61)	"	3 13.32	169 41.65	5,427	"	Ds·r	—	—	Steep slope of a hill
2664	FG388	24	3 11.19	169 38.60	5,404	"	Vs (Mn coated rock)	0.1	0	Gentle slope along a a ridge
2665	FG389	"	3 11.78	169 39.10	5,404	"	—	0	0	↓
2666	FG390	"	3 12.39	169 39.59	5,410	"	Dr	0.1	0	
2667	FG391	"	3 12.97	169 40.07	5,371	"	Sr	0.3	0	
2668	FG392	"	3 13.59	169 40.62	5,341	"	Sr	0.9	0	
2669	B65	"	3 14.14	169 40.86	5,368	"	Sr	0.4	—	NW
2670	FG424	28	3 14.37	169 39.65	5,506	"	Sr	3.3	0	Foot of a hill
2671	FG425	"	3 14.37	169 38.88	5,544	"	Dr	0.1	—	
2672	FG426	"	3 14.13	169 38.12	5,557	"	Fr	0.1	0	Inter-hill basin
2673	FG427	"	3 13.89	169 37.43	5,591	"	V (Mn coated rock)	0	—	↓
2674	FG428	"	3 13.70	169 36.75	5,605	"		0	0	
2675	P230(H66)	"	3 13.38	169 35.66	5,600	siliceous clay	—	—	—	ESE
2676	P226(H62)	24	2 53.08	169 34.86	5,547	"	—	—	—	Inter-hill basin
	FG393-1	"	2 53.07	169 34.37	5,556	"	—	0	0	"
	" -2	"	2 53.15	169 34.55	5,551	"	—	0	0	"
2677	FG394	25	2 45.57	169 39.03	5,329	no sample	Sr	0.4	0	Gentle slope along a
2678	FG395	"	2 46.09	169 39.01	5,335	siliceous clay	Sr	0.1	—	ridge
2679	FG396	"	2 46.71	169 38.93	5,333	"	Sr	0.1	0	↓

Table I-5 (continued)

Sta. no.	Observ. no.	Local date		Recalculated position Lat. (N)	Long (W)	Corrected depth (m)	Bottom sediment	Manganese nodules Morphology etc.	Abund.	Cover.	Topography
2680	FG397	Sept.	25	2 47.39	169 38.93	5,339	siliceous clay	Sr	0.1	0	↓
2681	B66		"	2 48.21	169 38.93	5,360	"	Sr	0.1	0	N
2682	FG398		"	2 49.86	169 40.95	5,576	"	—	0	0	Trough
2683	FG399		"	2 49.93	169 40.71	5,609	"	—	0	0	↓
2684	FG400		"	2 49.96	169 40.43	5,645	"	Sr	0.1	0	↓
2685	FG401		"	2 49.99	169 40.32	5,629	no sample	—	(0)	—	↓
2686	FG402		"	2 50.02	169 40.20	5,611	siliceous clay	Dr, SEr, IDr, Fr	8.6	0	↓
2687	FG403		"	2 50.04	169 40.09	5,590	"	IDr, Dr	15.1	1	ENE
2688	P227(H63)		"	2 49.81	169 38.42	5,355	"	—	—	—	Gentle slope along a ridge
2689	FG404		26	2 47.61	169 41.12	5,576	"	—	0	0	Trough
2690	FG405		"	2 47.62	169 40.69	5,659	"	Sr	0.1	0	↓
2691	FG406		"	2 47.63	169 40.62	5,641	"	—	0	—	↓
2692	FG407		"	2 47.64	169 40.33	5,545	"	IDr, Fr	7.6	5	E
2693	FG408		"	2 47.65	169 40.03	5,470	"	Sr	5.7	—	Steep slope of a hill
2694	FG409		"	2 47.66	169 39.73	5,621	"	—	0	0	〃
2695	B67		"	2 47.29	169 40.28	5,620	"	IDr, Fr	3.3	—	〃
2696	FG410		"	2 48.65	169 38.78	5,358	"	Sr	0.1	0	Gentle slope along
2697	FG411		"	2 49.36	169 38.75	5,353	"	—	0	—	a ridge
2698	FG412		"	2 50.72	169 38.71	5,396	"	Dr	0.1	0	↓
2699	FG413		"	2 51.44	169 38.68	5,425	"	Dr	0.1	0	N
2700	P228(H64)		"	2 49.29	169 41.20	5.568	"	—	—	—	Trough
2701	FG414		27	2 50.14	169 37.86	5,589	"		0	0	Moderate slope of a hill
2702	FG415		"	2 50.25	169 37.41	5,418	"	Fr (Mn coated whale ear bone)	0	—	↓
2703	FG416		"	2 50.39	169 36.85	5,467	"	—	0	0	↓
2704	FG417		"	2 50.50	169 36.32	5,510	"	—	0	0	↓
2705	B68		"	2 50.91	169 35.69	5,514	"	Sr	0.1	0	NE
2706	FG418		"	2 45.58	169 41.09	5,596	"	Sr	0.1	0	Trough
2707	FG419		"	2 45.99	169 40.78	5,612	"	—	0	—	↓
2708	FG420		"	2 46.17	169 40.65	5,580	"	—	0	0	↓
2709	FG421		"	2 46.33	169 40.53	5,550	"	—	0	0	NE
2710	FG422		"	2 46.51	169 40.40	5,528	"	Dr, IDr	0.2	0	Steep slope of a hill
2711	FG423		"	2 46.73	169 40.25	5,512	"	IDr, IDPr	9.6	7	↓
2712	P229(H65)		"	2 46.16	169 40.25	5,646	siliceous clay	IDr, IDPr	—	—	NE
2713	D496		28	3 14.99'	169 40.09	5,365	no sample	Sr, Dr, IDs, Crust	—	—	Around the top of a hill
				3 15.75	169 42.55	5,304					

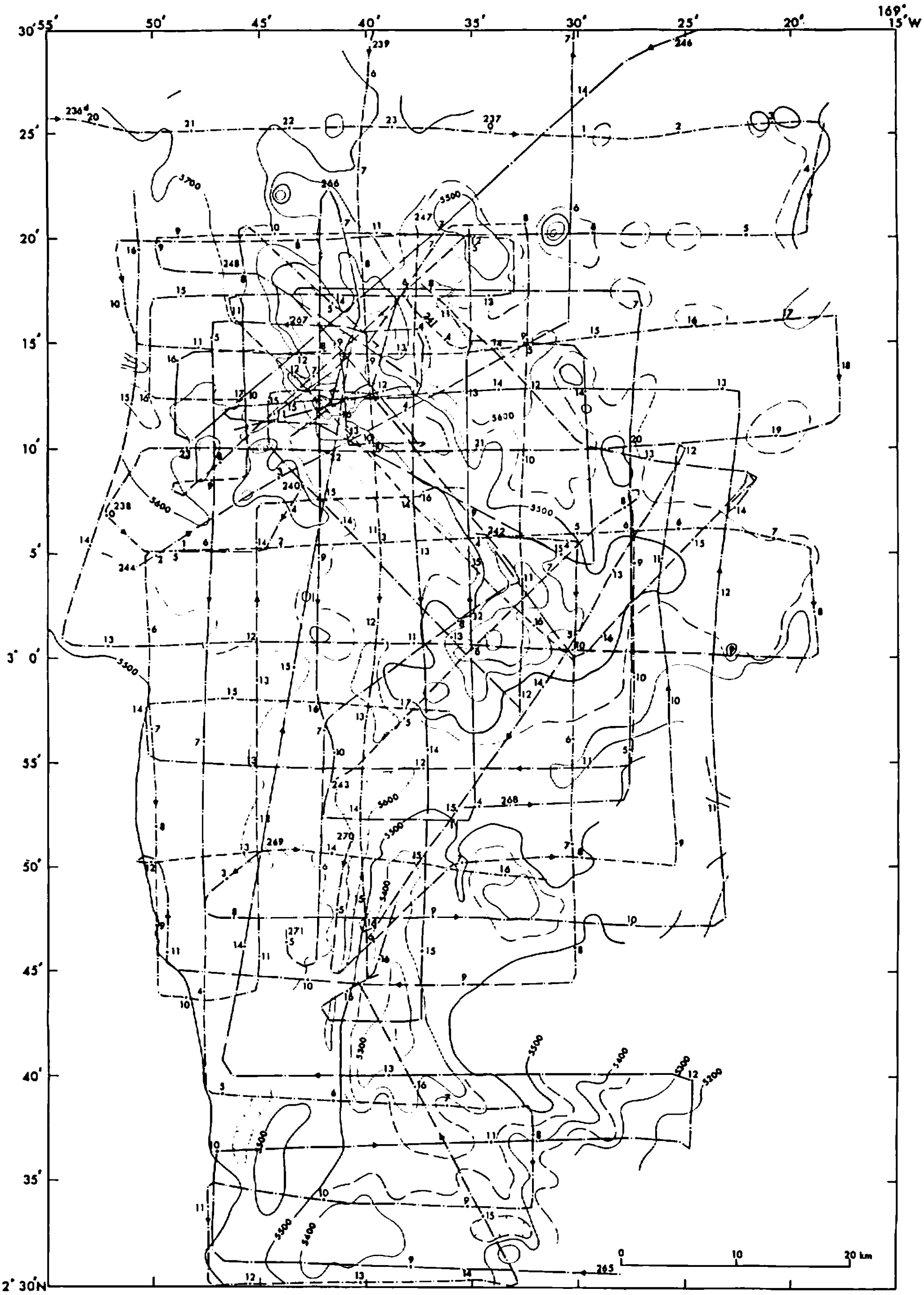

Fig. I-3 Tracks of geophysical works in the survey area.

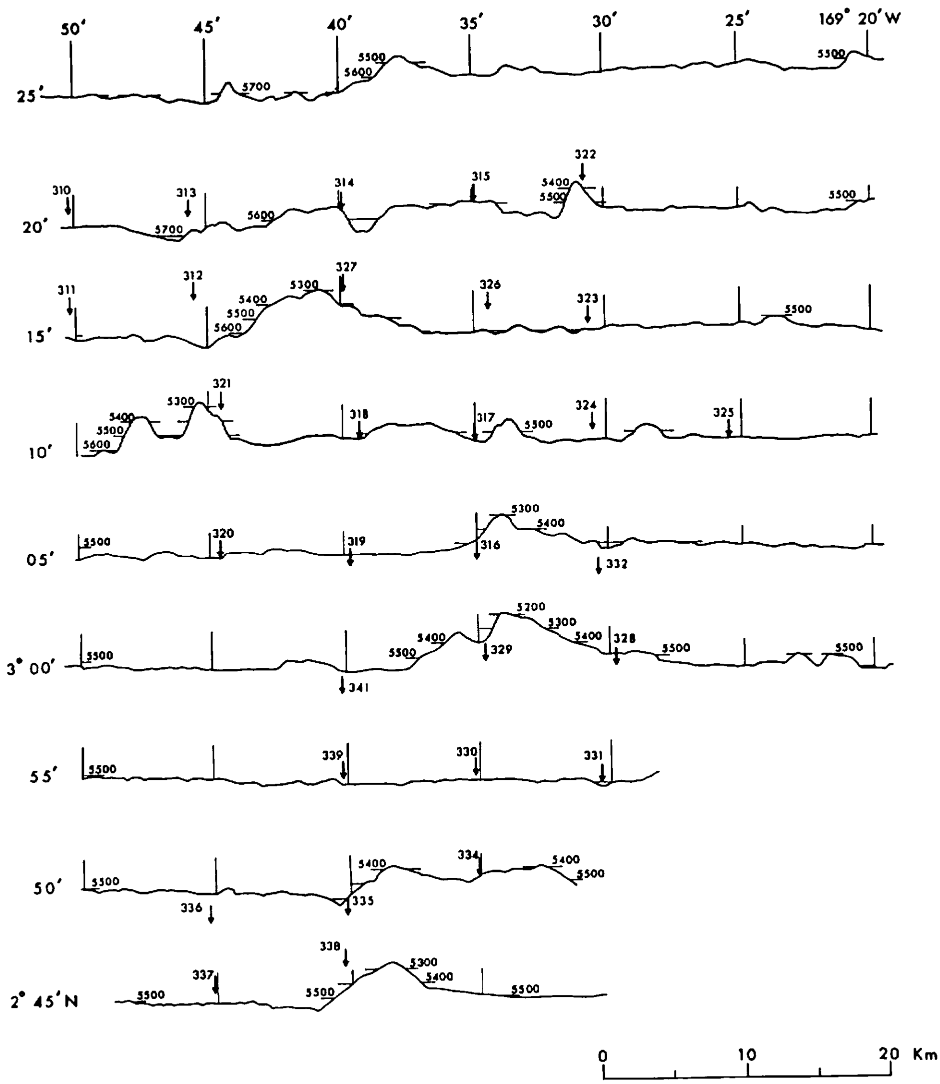

Fig. I-4 East-west topographic sections in the area. Three digit figures show sampling points nearby the track.

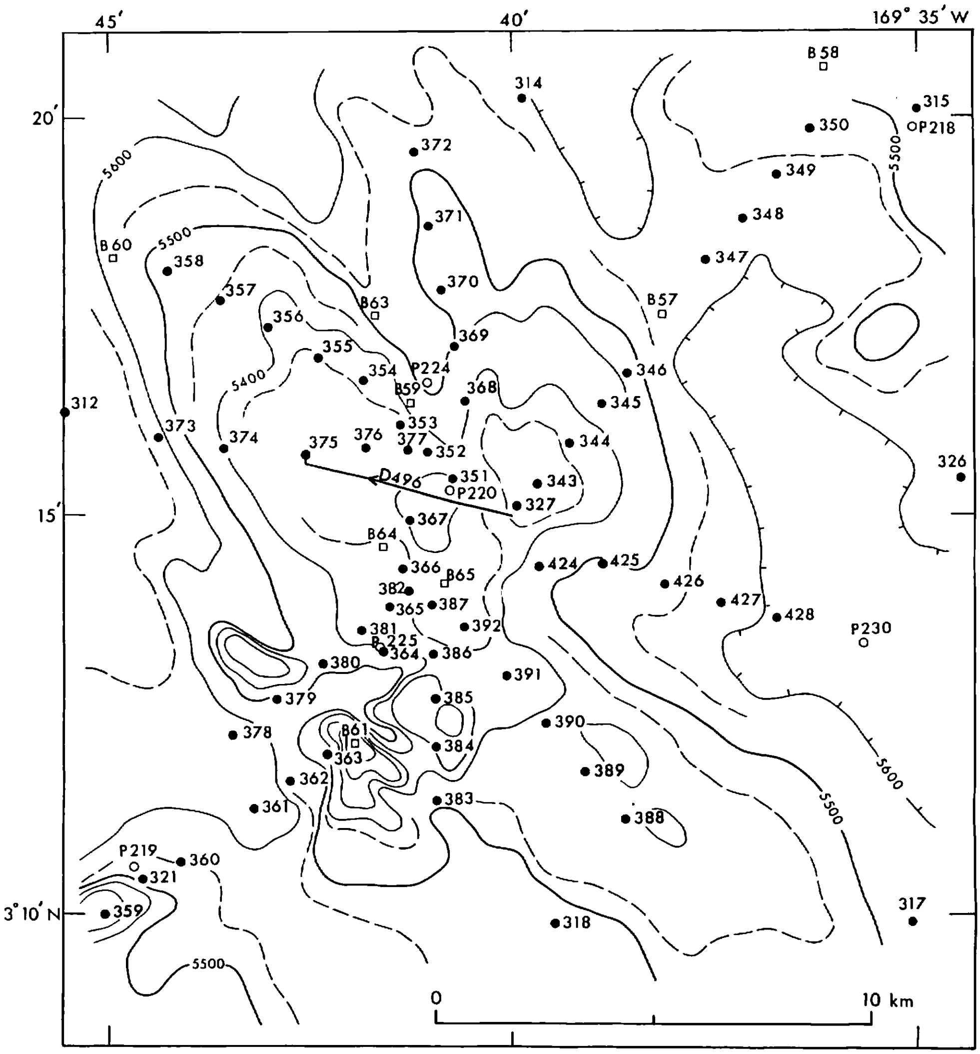

Fig. I-5 Detailed Survey Area I: topography and sampling points during the detailed survey.

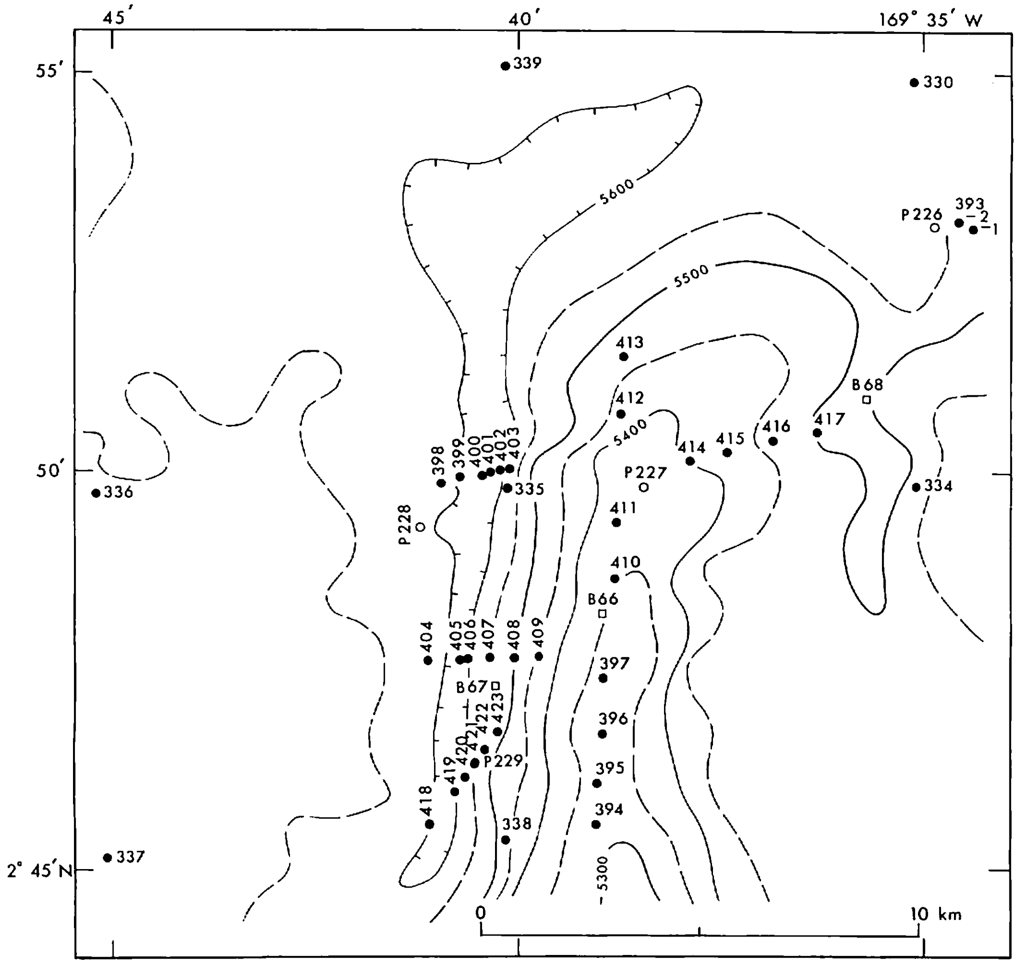

Fig. I-6 Detailed Survey Area II: topography and sampling points during the detailed survey.

bounded by the parallels 3°30′N and 2°30′N, and the meridians 169°55′W and 169° 15′W. As shown in Fig. I-2, there are three major hills in the area. They are usually masked between the contours of 2,750 fath. (5,033 m) and 3,000 fath. (5,490 m), because the tops of them are slightly deeper than 5,000 m and relative height of the each is less than 500 m. Several topographic sections in the area are shown in Fig. I-4. We selected the northern hill as the Detailed Survey Area I, and the southern one as the Detailed Survey Area II. Their topography and sampling stations or points are shown in Figs. I-5 and I-6, respectively.

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