NIRS-RSD-25

RADIOACTIVITY SURVEY DATA in Japan

NUMBER 25
NOV. 1969

National Institute of Radiological Sciences
Chiba, Japan

Radioactivity Survey Data in Japan

Number 25

Nov. 1969

Contents

DATA OF ROUTINE SURVEY

DATA OF THE TENTH NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA

National Institute of Radiological Sciences

DATA OF ROUTINE SURVEY

External Dose Data

External Exposure due to Natural Radiation

(National Institute of Radiological Sciences)

A field survey of exposure rates due to natural radiation has been conducted throughout the Kyushu district of Japan during May, 1968 and October, 1969.

The situation of the Kyushu district in Japan is shown in Figure 1. Distribution of observed locations in the district is indicated in Figure 2. In each location, from one to four sites containing at least 5 stations were chosen for observation and measurements were made there. A total of 119 sites were measured.

Observations were made using a spherical ionization chamber and a scintillation surveymeter. The spherical plastic ionization chamber of which inner diameter and wall thickness are respectively 200 mm and 3 mm (acrylate) has adequate sensitivity for field survey. The chamber was used as a standard of measurement, but it is difficult to observe all locations only by the apparatus, so that a surveymeter which contained a detector consisting of a NaI (Tl) $1''\phi \times 1''$ scintillator was used for regular measurements. In 11 sites, both the chamber and the surveymeter were used for measurment of given stations and their readings are compared for drawing a relationship between them.

Practically the direct readings of the surveymeter were reduced into the readings of the plastic chamber corresponding to it from the relationship of linear proportion. Systematic error at calibration (^{60}Co) and reading error (random) of the plastic chamber were respectively within ±6% (maximum overall error) and within ±3.5% (standard error for 6 μR/hr). Reading error of the surveymeter is about ±3% (standard error for 6 μR/hr).

Measurements in open bare field were made at one meter above the ground and outdoor gamma-ray exposure rates (μR/hr) were due to cosmic rays as well as terrestrial radiation, so that it may be considered that the contribution of fallout due to artificial origin was very slight.

Gamma-ray exposure rates due to natural radiation in each location are shown in Table 1 and population exposure due to natural radiation in each prefecture of the Kyushu district is shown in Table 2 and Figure 3.

Figure 1. The Situation of Kyushu District in Japan

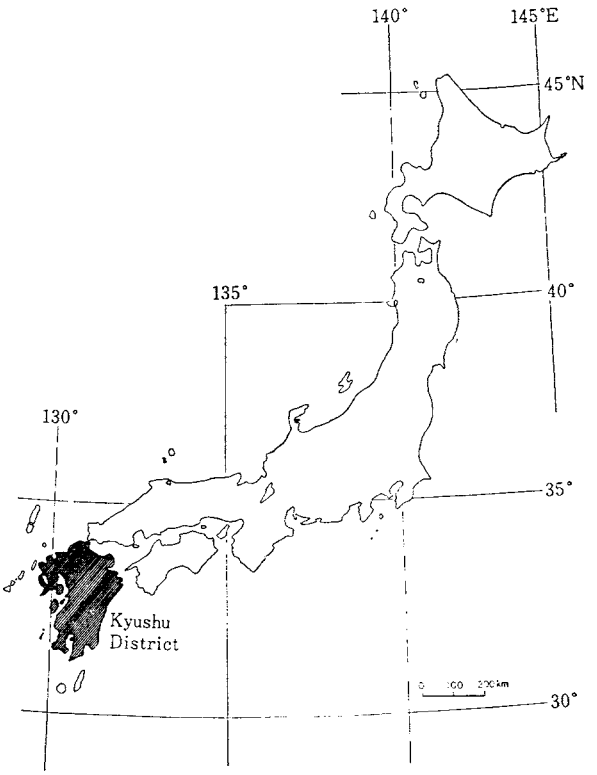


Figure 2. Distribution of Observed Location

1 Kitakyushu
2 Genkai
3 Munakata
4 Nogata
5 Iizuka

6 Fukuoka
7 Shima
8 Maebaru
9 Ono
10 Kurume

11 Okawa
12 Omuta
13 Yame
14 Amagi
15 Kaho

16 Buzen
17 Yukuhashi
18 Saga
19 Taku
20 Karatsu

21 Genkai
22 Imari
23 Takeo
24 Matsuura
25 Tabira

26 Emukae
27 Saseho
28 Higashisonogi
29 Omura
30 Isahaya

31 Nagasaki
32 Shimabara
33 Ichinomiya
34 Aso
35 Oguni

36 Otsu
37 Kikuchi
38 Yamaga
39 Tamana
40 Kumamoto

41 Uto
42 Misumi
43 Matsushima
44 Hondo
45 Yatsushiro

46 Taura
47 Minamata
48 Hitoyoshi
49 Nakatsu
50 Yabakei

51 Ita
52 Taketa
53 Ume
54 Kamae
55 Saiki

56 Tsukumi
57 Usuki
58 Oita
59 Beppu
60 Yamaga

61 Usa
62 Nobeoka
63 Hinokage
64 Takachiho
65 Gokase

66 Shiiba
67 Ebino
68 Kobayashi
69 Miyakonojo
70 Kushima

71 Nichinan
72 Takaoka
73 Miyazaki
74 Saito
75 Tsuno

76 Hyuga
77 Kirishima
78 Kurino
79 Oguchi
80 Izumi

81 Akune
82 Sendai
83 Sendai Kumizaki
84 Kushikino
85 Kaseda

86 Makurazaki
87 Ibusuki
88 Kiire
89 Kagoshima Kagehara
90 Kagoshima

91 Kaziki
92 Kokubu
93 Tarumizu
94 Kanoya
95 Sata

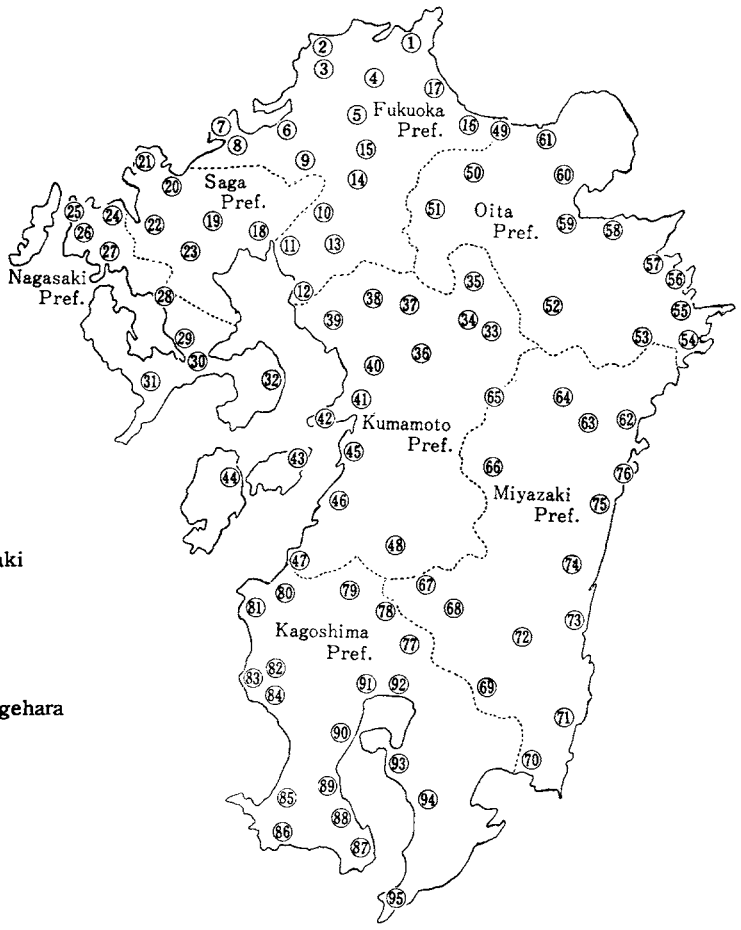


Table 1. Gamma-ray Exposure Rates due to Natural Radiation in each Location
—May, 1968 and Oct. 1969—

By S. Abe, N. Sekiguchi, K. Shimizu and I. Suyama
(National Institute of Radiological Sciences)

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus	Number of Sites measured in each Location
Fukuoka	1 Kitakyushu	11.6	A B	4
	2 Genkai	8.2	B	1
	3 Munakata	12.5	B	1
	4 Nogata	8.6	B	1
	5 Iizuka	12.3	B	1
	6 Fukuoka	10.2	A B	3
	7 Shima	13.3	B	1
	8 Maebaru	10.2	A B	1
	9 Ono	11.2	B	1
	10 Kurume	9.4	B	1
	11 Okawa	9.5	B	1
	12 Omuta	9.6	B	1
	13 Yame	10.8	B	1
	14 Amagi	11.1	B	1
	15 Kaho	9.2	B	1
	16 Buzen	12.3	B	1
	17 Yukuhashi	10.4	B	1

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus	Number of Sites measured in each Location
Saga	18 Saga	9.5	A B	4
	19 Taku	9.9	B	1
	20 Karatsu	10.7	A B	1
	21 Genkai	9.1	B	1
	22 Imari	12.5	B	1
	23 Takeo	11.0	B	1
Nagasaki	24 Matsuura	9.3	B	1
	25 Tabira	7.3	B	1
	26 Emukae	10.5	B	1
	27 Saseho	8.9	A B	1
	28 Higashisonogi	10.0	B	1
	29 Omura	8.7	B	1
	30 Isahaya	8.5	B	1
	31 Nagasaki	8.2	A B	2
	32 Shimabara	10.7	B	1
Kumamoto	33 Ichinomiya	7.3	B	1
	34 Aso	7.3	B	1
	35 Oguni	8.7	B	1
	36 Otsu	8.2	B	1
	37 Kikuchi	7.9	B	1
	38 Yamaga	9.8	B	1
	39 Tamana	10.5	B	1
	40 Kumamoto	8.5	A B	3
	41 Uto	8.6	B	1
	42 Misumi	10.5	B	1
	43 Matsushima	6.7	B	1
	44 Hondo	9.3	B	1
	45 Yatsushiro	8.5	B	1
	46 Taura	9.9	B	1
	47 Minamata	8.2	A B	2
	48 Hitoyoshi	10.1	A B	1
Oita	49 Nakatsu	9.0	B	1
	50 Yabakei	11.2	B	1
	51 Hita	9.2	B	1
	52 Taketa	11.0	B	1
	53 Ume	10.0	B	1
	54 Kamae	10.9	B	1
	55 Saiki	9.0	B	1
	56 Tsukumi	11.1	B	1
	57 Usuki	8.5	B	1
	58 Oita	8.8	B	3
	59 Beppu	7.9	B	3
	60 Yamaga	10.2	B	1
	61 Usa	7.9	B	1
Miyazaki	62 Nobeoka	11.6	B	2
	63 Hinokage	8.4	B	1
	64 Takachiho	9.4	B	1
	65 Gokase	11.6	B	1
	66 Shiiba	11.9	B	1
	67 Ebino	9.5	B	1
	68 Kobayashi	6.2	B	1
	69 Miyakonojo	7.5	B	2
	70 Kushima	8.5	B	1
	71 Nichinan	9.6	B	1
	72 Takaoka	10.0	B	1
	73 Miyazaki	8.6	B	4
	74 Saito	11.2	B	1
	75 Tsuno	10.8	B	1
	76 Hyuga	11.6	B	1

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus	Number of Sites measured in each Location
Kagoshima	77 Kirishima	8.2	B	1
	78 Kurino	9.3	B	1
	79 Oguchi	10.0	B	1
	80 Izumi	10.6	B	1
	81 Akune	7.5	B	1
	82 Sendai	9.8	B	1
	83 Sendai Kumizaki	8.5	B	1
	84 Kushikino	9.7	B	1
	85 Kaseda	10.1	B	1
	86 Makurazaki	8.4	B	1
	87 Ibusuki	5.8	B	1
	88 Kiire	10.2	B	1
	89 Kagoshima Kagehara	7.7	B	1
	90 Kagoshima	8.6	A B	4
	91 Kaziki	8.6	B	1
	92 Kokubu	9.7	B	1
	93 Tarumizu	7.0	B	1
	94 Kanoya	8.7	B	1
	95 Sata	7.7	B	1

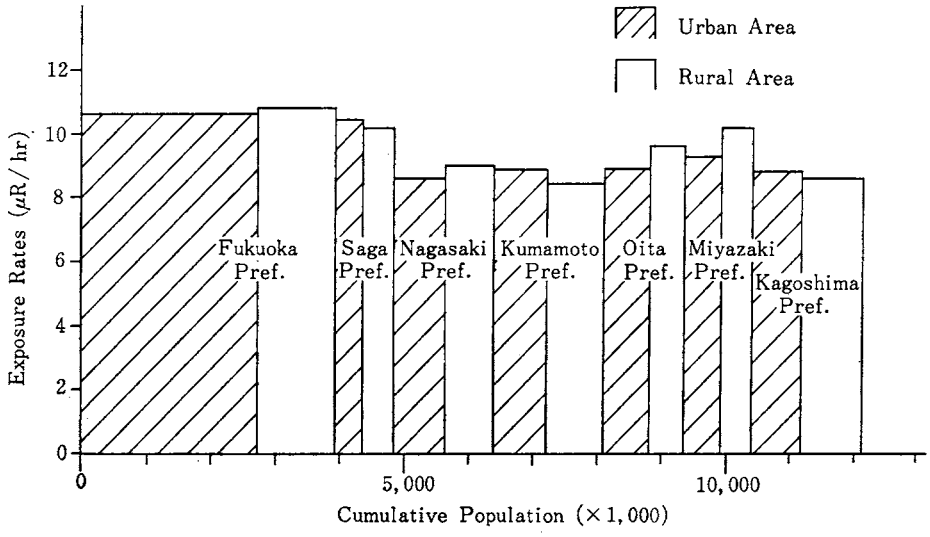
Note. A: Spherical Ionization Chamber
B: Scintillation Surveymeter

Table 2. Population exposure due to Natural Radiation in each Prefecture of the Kyushu district.
By S. Abe, N. Sekiguchi, K. Shimizu and I. Suyama
(National Institute of Radiological Sciences)

Prefecture	Population* (×1,000)	Exposure Rate±Standard Deviation (μR/hr)
Fukuoka	3965	10.8±1.3
Saga	872	10.3±1.1
Nagasaki	1568	8.8±0.8
Kumamoto	1740	8.6±1.0
Oita	1187	9.1±1.0
Miyazaki	1081	9.7±1.4
Kagoshima	1781	8.7±1.1
Kyushu	12194	9.6±1.2

National Census in 1965

Figure 3. Population exposure due to Natural Radiation in each Prefecture of the Kyushu District



Plant Data

Concentration of Carbon-14 in Plant Essential Oil

(National Institute of Radiological Sciences)

In this work, the concentrations of carbon-14 in thymol and menthol were measured by the liquid scintillation counting method and their annual variations were observed from 1942 to 1968. Sampling locations are shown in Figure 4.

Sample materials and counting method:

1. Thymol: Thymol was obtained by the usual method from the essential oil of *Orthodon japonicium* Benth (Labiates). The plant cultivated every year from 1954 to 1968 was harvested in September in the experimental field of Chiba University. The methylation to mask the strong quenching action of thymol owing to its phenolic group was carried out. Eighteen grams of thymol methyl ether was weighed in 20 ml low potassium glass vial and 0.4% of PPO and 0.01% POPOP w/w were dissolved in it.

2. Menthol: Menthol was obtained from *Menta arvensis* cultivated every year from 1942 to 1968 in the east part of Hokkaido and prepared by Kitami Factory of the Federation of Agricultural Cooperative Societies of Hokkaido. In 1963 and 1965, the sample cultivated in field of Okayama Prefecture by Toyo Hakka Co. have been obtained. The conversion of menthol to p-cymene, which is used as an excellent solvent for liquid scintillator was carried out. The samples of p-cymene for liquid scintillation counting were prepared as same as above example. In earlier period, the measurement of radioactivities was carried out using a liqhid scintillation counter TRI-CARB Model 314 A which was manually operated and the counting efficiency was determined by internal standard of benzoic acid-1-C-14. Recently, however, Nuclear Chicago Mark I counter was employed and the counting efficiency was calibrated by external standard method.

Result:

The results obtained are shown in Tables 3 and 4, and the annual variations of carbon-14 concentration in plant essential oil are summarized in Figure 5.

Figure 4. Sampling Location of Plant Essential Oil

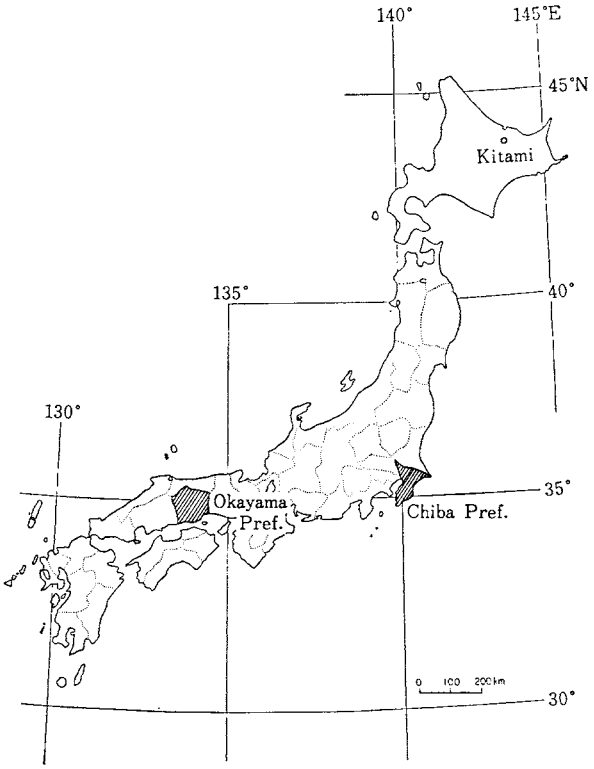


Table 3. Annual Variation of Carbon-14 Concentration in Thymol by Y. Kasida, T. Iwakura and A. Maebayashi —1954 to 1968—
(National Institute of Radiological Sciences)

Year of Harvest	Location			^{14}C concentration (dpm/g of carbon)
1954	Chiba-shi,	Chiba Pref.	A*	14.05***
1956	〃	〃		13.28
1957	〃	〃		15.84
1958	〃	〃		15.16
1959	〃	〃		16.82
1960	〃	〃		17.21
1961	〃	〃		17.49
1962	〃	〃		19.57
1963	〃	〃		26.02
1964	〃	〃		23.97
1965	〃	〃		23.86
〃	〃	〃	B**	23.83
1966	〃	〃	B**	22.46
1967	〃	〃	B**	21.19
1968	〃	〃	B**	19.42

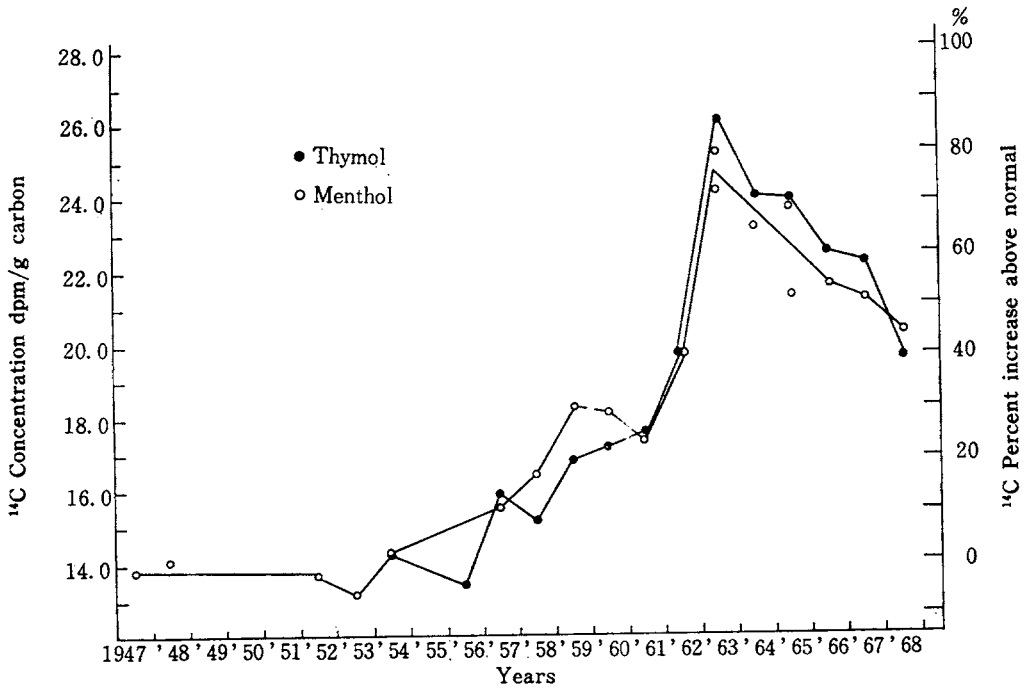
A* : Experimental field of Chiba University.
B** : Experimental field of National Institute of Radiological Sciences.
***: 95% confidence (2 sigma)

Table 4. Annual Variation of Carbon-14 Concentration in Menthol by Y. Kasida, T. Iwakura and A. Maebayashi —1942 to 1968—
(National Institute of Radiological Sciences)

Year of Harvest	Location	^{14}C concentration (dpm/g of carbon)
1942	Kitami, Hokkaido*	13.60***
1947	〃	13.69
1948	〃	13.97
1952	〃	13.61
1953	〃	13.17
1954	〃	14.04
1957	〃	15.46
1958	〃	16.32
1959	〃	18.26
1960	〃	18.06
1961	〃	17.34
1962	〃	19.60
1963	〃	24.16
〃	Okayama Pref.**	25.19
1964	Kitami, Hokkaido	23.01
1965	〃	23.63
1965	Okayama Pref.	21.28
1966	Kitami, Hokkaido	21.52
1967	〃	21.11
1968	〃	20.96

* Farm of the Hokuren Kitami Factory.
** Farm of the Toyo Hakka Co.
*** 95% confidence (2 sigma)

Figure 5. Annual Variation of ^{14}C Concentration in Plant Essential Oil: Thymol and Menthol



DATA OF THE TENTH* NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA

* The ninth nuclear test was conducted *underground* on the 23rd September, 1969. The test site was supposed to be in the neighborhood of Lake Lop Nor. The scale of detonation was equivalent to 20~200 kilotons TNT.

Meteorological Data

Gross Beta-radioactivity in Rain and Dry Fallout

(Meteorological Agency)

Survey of gross beta-activity in rain and dry fallout has been conducted with the network of 13 stations of Meteorological Agency shown in Figure 6.

The processes of sampling and counting are the same ones with that in the explanation on page 2, Issue No. 5 of this publication series.

The tenth nuclear test of the People's Republic of China was carried out on the 29th of September, 1969 according to the news reporting.

The tenth test area is believed to be in the neighborhood of Lake Lop Nor, (40°N. Lat., 90°E. Long.) about 4,000 kilometers west-northwest of Japan.

Results obtained during the period from the 29th September to the 9th October are shown in Table 5 and Table 6.

Now in Japan, abnormal microbarographic record was distinctly observed.

These records are shown in Table 7 and Figure 7.

The meteorological trajectory shown in Figure 8 estimates that the radioactive debris emitted into the troposphere first passed about 10 kilometers of altitude (300mb level) in the northern part of Japan one day after the explosion date. Both radioactivity in rain and suspended dust near the grouned in this test were generally normal in these period.

Figure 6. Fallout Observation Nework of Meteorological Agency

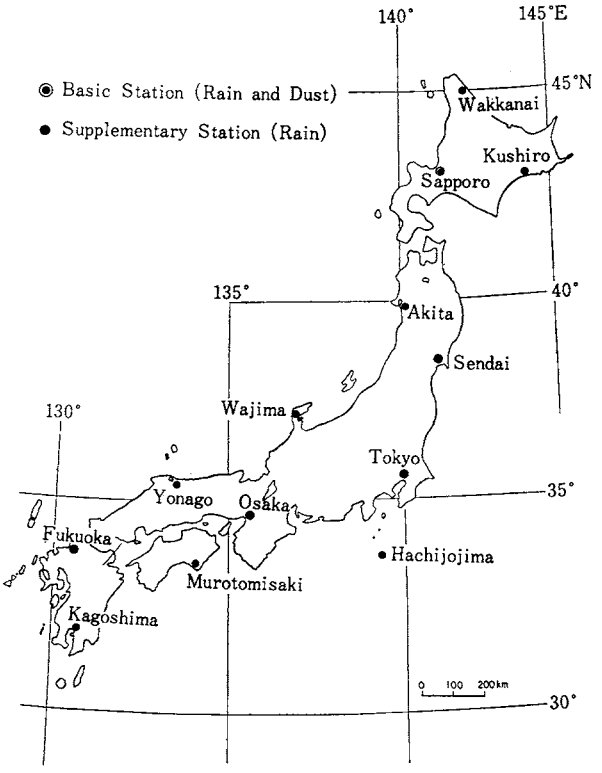


Table 5. Gross β-activity in Rain —Sept. 29 to Oct. 9, 1969—

Compiled by T. Nagai, T. Honda, H. Ueno and K. Matumura

(Meteorological Agency)

Upper Rank: Concentration (pCi/cc)

Lower Rank: Deposition (mCi/km²)

Station \ Date	Sept. 1969 29	30	Oct. 1969 1	2	3	4	5	6	7	8	9
Wakkanai	—	0.1	—	0.0	—	0.3	0.0	0.0	0.1	—	0.0
//		0.4		0.0		0.7	0.0	0.0	0.7		0.0
Sapporo	0.0	0.1	—	0.3	—	—	—	—	0.0	—	0.0
//	0.0	0.5		7.7					0.0		0.0
Kushiro	—	0.0	—	0.7	—	—	—	0.0	—	—	0.1
//		0.0		50.0				0.0			1.0
Sendai	—	—	0.0	0.0	—	—	—	—	—	—	0.0
//	—	—	0.0	0.0							0.0
Akita	0.1	0.1	0.0	—	0.1	—	—	0.1	—	—	0.0
//	0.2	0.2	0.0		0.3			0.4			0.0
Tokyo	—	—	0.1	0.0	—	—	—	—	—	—	0.0
//	—	—	0.4	0.0							0.0
Wajima	—	—	0.0	0.0	—	—	0.0	—	—	—	0.0
//	—	—	0.0	0.0			0.0				0.0
Hachijojima	0.0	0.0	0.1	0.0	—	—	0.0	0.0	—	0.1	0.0
//	0.0	0.0	0.3	0.0			0.0	0.0		2.2	0.0
Osaka	—	—	0.1	0.0	—	—	—	—	—	0.1	0.0
//	—	—	0.8	0.0						0.1	0.0
Yonago	0.1	0.0	0.0	0.3	—	—	0.1	—	—	—	0.1
//	0.2	0.0	0.0	0.4			0.7				0.3
Murotomisaki	0.0	—	0.0	—	—	—		—	—	0.1	0.0
//	0.0	—	0.0							0.2	0.0
Fukuoka	—	—	0.0	—	—	—	—	—	—	—	—
//	—	—	0.0								
Kagoshima	0.0	0.0	0.0	—	0.0	0.0	—	—	—	—	—
//	0.0	0.0	0.0		0.0	0.0					

Table 6. Gross β-activity in Dust —Sept. 29th to Oct. 8th, 1969—

Compiled by T. Nagai, T. Honda H. Ueno and K. Matumura

(Meteorological Agency)

(pCi/m³)

Station	Sept. 1969 29	30	Oct. 1969 1	2	3	4	5	6	7	8
Sapporo	0.2		0.2	0.0	0.2			0.2		0.2
Sendai	0.5	0.2	0.2	0.2	0.2			0.2		0.7
Tokyo	0.5		0.4	0.4	0.4			0.2		0.4
Osaka	0.2		1.2	0.2	0.7			0.2		0.2
Fukuoka	0.7	1.2	0.0	0.5	0.7			0.5		1.0

Table 7. The Microbarographic Records Produced by the 10th Nuclear Test of The People's Republic of China —Sept. 29, 1969—

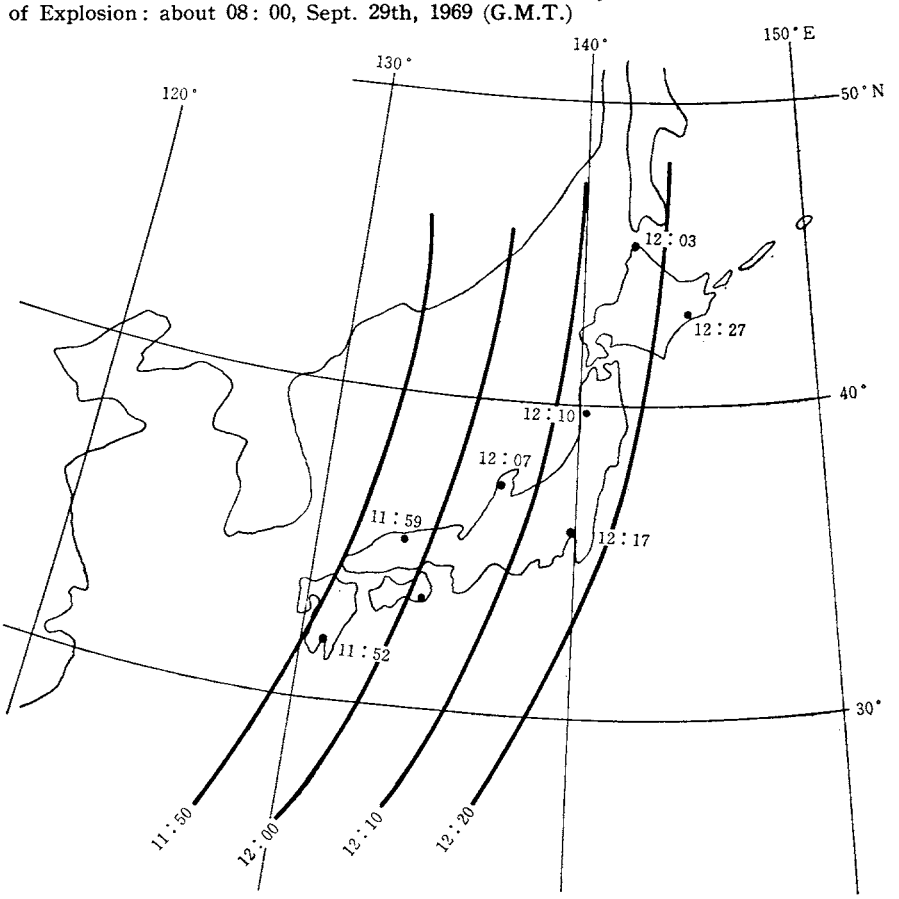
Compiled by T. Nagai, T. Honda, H. Ueno and K. Matumura

(Meteorological Agency)

Station	LAT	LONG	T (G.M.T.)	A (mb)	P (min)	D (min)
Wakkanai	45°25′N	141°41′E	12: 13	0.2	1	19
Kushiro	42°59′N	144°24′E	12: 27	0.2	2	56
Akita	39°43′N	140°06′E	12: 10	0.1	1	22
Wajima	37°23′N	136°54′E	12: 07	0.1	4	43
Tokyo	35°41′N	139°46′E	12: 17	0.2	5	52
Yonago	35°26′N	133°21′E	11: 59	0.1	2	16
Murotomisaki	33°15′N	134°11′E	—	—	—	—
Kagoshima	31°34′N	130°33′E	11: 52	0.4	3	27

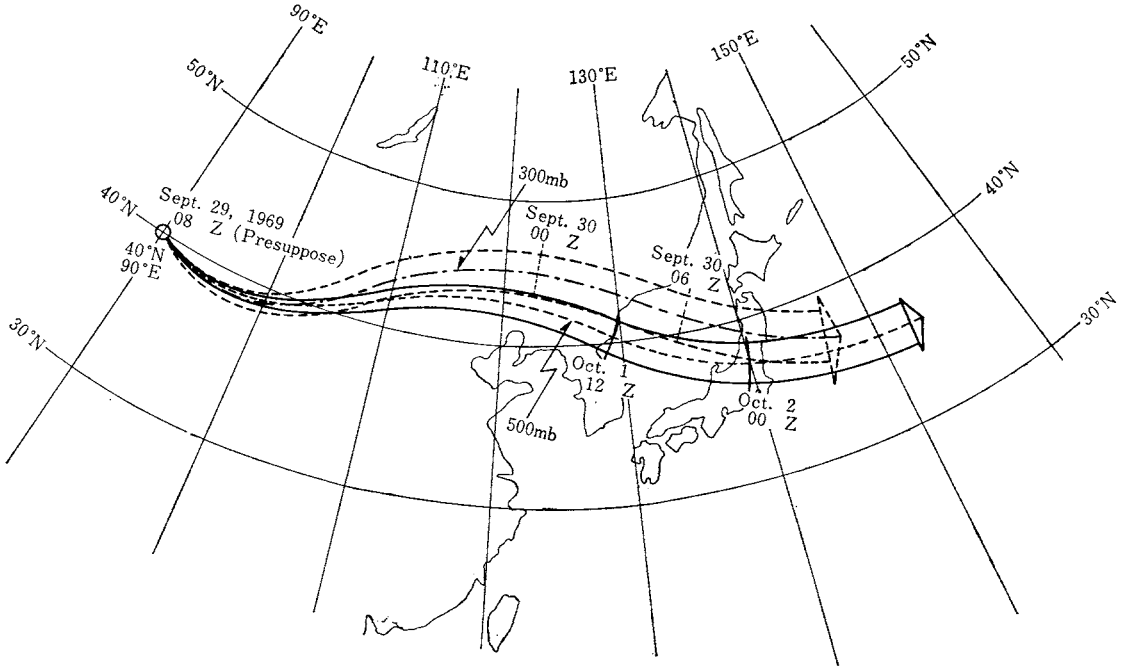
Note. T means Time, A: Amplitude, P: Period, D: Duration, respectively.

Figure 7. Isochrones of the First Shock Wave Test Site: the Neighborhood of Lak Lop Nor (40°N. 90°E)
Time of Explosion: about 08: 00, Sept. 29th, 1969 (G.M.T.)



* Numeral indicates the arrival time of the first shock. (G.M.T.)

Figure 8. The Meteorological Trajectory at the Time when the 10th Nuclear Test was carried out by the People's Republic of China



Gross Beta-Radioactivity in Upper Air

(Research and Development H.Q., Japan Defense Agency)

Since 1960, Research and Development H. Q., Japan Defense Agency has measured the beta-activity of dust in the lower layer of the stratosphere and tropopause using aircraft as collectors.

The samples were taken over three areas of Japan using both dust samplers attached under the aircraft wings and gummed papers attached in front of them.

The sampling flight with gummed papers was made using two aircraft at the same time, one of which made a normal sampling flight and the other only upward and downward flight. The difference between the amounts of radioactivity of the samples collected by the two aircraft is taken as the value at the flight altitude.

Figure 9 shows three sampling areas of Japan.

As to the tenth nuclear test, aircraft detected little amount of radioactivity over three sampling areas of Japan, except the North area, Tohoku, on the morning of the 1st, October, 1969. So it is assumed that the radioactive cloud passed over the North of Japan.

Results obtained is shown in Table 8. Figure 10 shows the temporal variation of gross beta-activity in upper air at altitudes from about 6 km to 10 km.

Figure 9. Three sampling Area of Japan

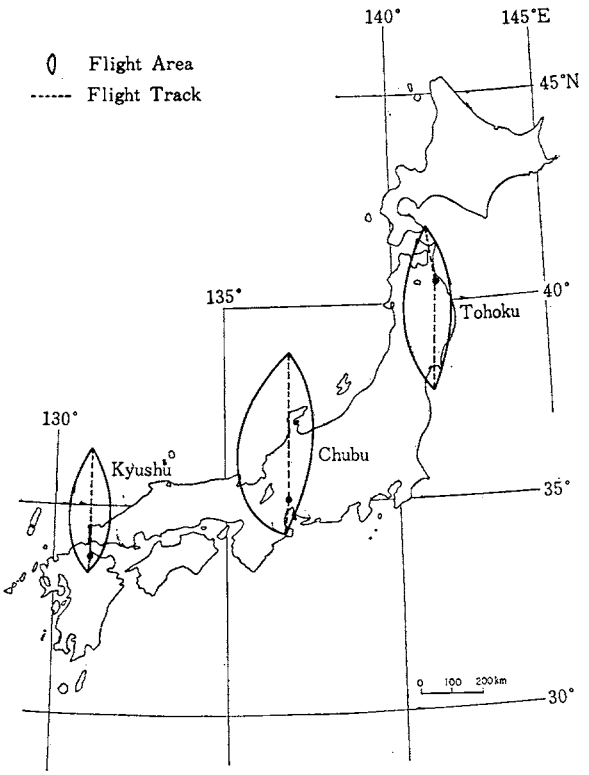


Table 8. Gross β-activity in Upper Air —Sept. 30th to Oct. 2nd, 1969—
By K. Kenmochi, S. Igarashi, T. Akimoto and K. Kitazawa
(Research and Development H.Q., Japan Defense Agency)

(pCi/m³)

Sky Area / Date	Tohoku* 10,500 ~12,000 m	Chubu** 10,000	Chubu** 6,000 ~8,000 m	Kyushu*** 9,600 ~10,000 m	Kyushu*** 5,500 ~6,000 m
Sept. 30, 1969					
11.00 a.m.	0.3	0.3			
1.00 p.m.	0.1>	0.1>			
3.00 p.m.	0.1>	0.3			
5.00 p.m.	0.1>	0.1>		0.1>	
7.00 p.m.	0.2				
9.00 p.m.	0.1>				
Oct. 1, 1969					
9.00 a.m.	5.5				
12.00 p.m.					0.1
3.00 p.m.				0.3	
7.00 p.m.			0.1		
Oct. 2, 1969					
7.00 a.m.			0.1		
9.00 a.m.					1.0
10.00 a.m.			0.2		
12.00 p.m.					0.5

Note. * Samples collected by gummed papers.
** // // by dust samplers.
*** // // by gummed papers.

Figure 10. Temporal Variation of Gross β-activity in Upper Air —Sept. 30 to Oct. 2, 1969—