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RADIOACTIVITY SURVEY DATA in Japan

Part 1
=Environmental Materials=

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National Institute of Radiological Sciences
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Radioactivity Survey Data in Japan

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Contents

Environmental and Dietary Materials*

(Japan Chemical Analysis Center)

1. Collection and pretreatment of samples

(1) Rain and dry fallout

Rain and dry fallout was collected monthly on a sampling tray, approximately 5000 cm^2 in area, which was filled with water to a depth of 1 cm at the beginning of every month.

Strontium and cesium carrier solutions were added after the sample was filtered. The tray was washed with 5 ℓ of distilled water and the washing was combined to the filtrate.

The sample was passed through a cation exchange column (500 mℓ of Dowex 50W X8, 50～100 mesh, Na form) at a rate flow of 80 mℓ/min.

(2) Airborne dust

Airborne dust was collected by an electrostatic precipitator or a filter air sampler for every three months at a rate of more than 3000 m^3 per month. The sampling was done 1 to 1.5 meters above the ground.

(3) Service water and freshwater

Service water, 100 ℓ each, was collected at the intake of the water-treatment plant and at the tap after water was left running for five minutes. Strontium and cesium carriers were added to the filtered water sample. The subsequent process was the same as that described in the section (1). Freshwater was treated in the same way as the service water.

(4) Soil

Soil was collected from the location in the spacious and flat area without past surface disturbance caused by duststorms, inflow and outflow due to precipitation, etc.. Any places located under trees in a forest, in a stony area or inside of river banks were avoided. Soil was taken from two layers of different depths, 0-5cm and 5-20cm. The soil lumps were crushed by hands and dried in a drying oven regulated 105 ℃. The soil was then passed through a 2 mm sieve to remove plant roots and pebbles.

(5) Sea water

Sea water was collected at the fixed stations where the effect of terrestrial fresh water from rivers was expected to be negligibly small. A special consideration was also given to weather conditions. The sampling was carried out when there was no rainfall for the last few days. To prevent contamination, water samples were collected at the bow of a sampling boat just before she stood still by scooping surface water using a polyethylene bucket. Immediately after the collection, the samples were acidified to a pH lower than 3 by adding concentrated hydrochloric acid in a ratio of 1 mℓ to 1 ℓ of sea water, and then stored in 20 ℓ polyethylene containers. The sampling equipments as well as containers were thoroughly rinsed with dilute hydrochloric acid and then with distilled water before use. Two hundred milliliters of sea water was also collected at the same stations for the determination of chlorinity.

(6) Sea sediments

Sediment was collected in the same area as that for the sea water sample, taking the following criteria into account:

a. The depth of water exceeds 1 m at low tide.
b. No significant sedimental movement is observed in the vicinity of concern.
c. Mud, silt and fine sand are preferable.

A conventional sediment sampling device was used for collecting the top few centimeters of surface sediment. Approximately 4kg of the sample in wet weight was spread on a stenless steel dish after removed of the pebbles, shells and other foreign materials, and dried in a drying oven regulated at 105℃.

(7) Total diet

A full one day ordinary diet including three meals, water, tea and other in-between snacks for five persons was collected as a sample of "total diet". The sample in a large stainless steel pan was carbonized carefully by direct application of gas flame, and was transfered to a porcelain dish and then ashed at 450 ℃ in an electric muffle furnace.

(8) Rice

Polished rice was collected in producing districts at the harvest and in consuming areas when new crops were first put on sale. The sample was carbonized and ashed in a porcelain dish.

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* Samples were sent to the Center from 32 contracted prefectures.

(9) Milk

Raw milk was collected in producing districts and commercial milk was purchased in consuming districts. Milk in a stainless steel pan or a porcelain dish was evaporated to dryness followed by carbonization and ashing.

(10) Vegetables

Spinach and Japanese radish were selected as the representatives for leaf vegetables and for non-starch roots, respectively. After removing soil, the edible part of vegetable sample was dried and carbonized in a stainless steel pan or a porcelain dish.

(11) Tea

Five hundred grams of manufactured green tea was collected, carbonized and ashed in a stainless steel pan or a porcelain dish.

(12) Fish, shellfish and seaweeds

a. Sea fish and freshwater fish

Fish was rinsed with water and blotted with a filter paper. Only the edible part was used in case of larger sized fish, and the whole part was used in case of smaller ones. Each sample was weighed and placed in a stainless steel pan or a porcelain dish. After carbonized, the sample was ashed in an electric muffle furnace.

b. Shellfish

Approximately 4 kg of shellfish including the shells was collected or purchased. After removing the shells, it was treated in the same way as that for the sea fish.

c. Seaweeds

Edible seaweeds were collected and rinsed with water to remove sand and other adhering matters on the surface. These were removed of excess water, weighed dried and ashed.

Table 1 shows detailes of sample collection.

Table 1 Details of sample collection

Sample	Frequency of sampling	Quantity of sample
=Environmental materials=		
(1) Rain and dry fallout		
1. For domestic program	monthly	
2. For WHO program	monthly	
(2) Airborne dust	quarterly	>3000 m^3/month
(3) Service water and freshwater		
1. Service water (source water)	semiyearly	100 ℓ
2. Service water (tap water)	semiyearly	100 ℓ
3. Freshwater	yearly (fishing season)	100 ℓ
(4) Soil		
1. 0～5 cm	yearly	4 kg
2. 5～20cm	yearly	4 kg
(5) Sea water	yearly	40 ℓ
(6) Sea sediments	yearly	4 kg
=Dietary materials=		
(7) Total diet	semiyearly	daily amount for 5 persons
(8) Rice		
1. Producing districts	yearly (harvesting season)	5 kg (polished rice)
2. Consuming districts	yearly (harvesting season)	5 kg (polished rice)
(9) Milk		
1. Producing districts for WHO program	quarterly (February, May, August and November)	3 ℓ
2. Producing districts for domestic program	semiyearly (February and August)	3 ℓ

Sample	Frequency of sampling	Quantity of sample
3. Consuming districts	semiyearly (February and August)	3 ℓ
4. Powdered milk	semiyearly (April and October)	2～3 kg
(10) Vegetables		
1. Producing districts	yearly (harvesting season)	4 kg
2. Consuming districts	yearly (harvesting season)	4 kg
(11) Tea	yearly (the first harvesting season)	500g (manufactured tea)
(12) Fish, shellfish and seaweeds		
1. Sea fish	yearly (fishing season)	4 kg
2. Freshwater fish	yearly (fishing season)	4 kg
3. Shellfish	yearly (fishing season)	4 kg
4. Seaweeds	yearly (fishing season)	2～3 kg

2. Preparation of samples for analysis

(1) Rain, service water and freshwater

Strontium and cesium were eluted with hydrochloric acid from the cation exchange column. The residue of rain sample on the filter paper was ashed in an electric muffle furnace and the ash was dissolved in hydrochloric acid. The insoluble part was filtered and washed. The filtrate and the washings were combined to the previous eluate and used for radiochemical analysis.

(2) Soil and Sea sediment

Dried soil was crushed to smaller ones than 0.25 mm in size by a crusher. The sieved sample was ashed in an electric muffle furnace regulated at 450℃ . The sample was then heated with hydrochloric acid, strontium and cesium carrier solutions and the mixture was heated. The insoluble constituent was filtered off and washed with water.

The dried sample was crushed to smaller ones than 0.25 mm by a crushing machine. The further preparation of the sample was the same as that described in the section 2-(2).

(3) Rice

The ashed sample was pulverized with a porcelain mortar and passed through a 0.35 mm sieve. The sieved sample to which both strontium and cesium carriers were added, was digested with nitric acid by heating. After the sample was heated again with nitric acid to dryness,strontium and cesium were extracted with hydrochloric acid and water. The insoluble constituent was filtered and washed. The filtrate and washings were combined for subsequent radiochemical analysis.

(4) Airborne dust, diet, milk, vegetables, fish and shellfish, seaweeds, tea and others

These ashed samples were treated with the same procedure as that described in the section 2-(4).

3. Separation of strontium-90 and cesium-137

(1) Strontium-90

Sample solutions, prepared as in the foregoing sections 2-(1) through 2-(4), were neutralized with sodium hydroxide. After sodium carbonate was added, the precipitate of strontium and calcium carbonates was separated. The supernatant solution was retained for cesium-137 determination. The carbonates were dissolved in hydrochloric acid and strontium and calcium were precipitated as oxalates. The precipitate was dissolved in nitric acid and strontium was separated from calcium by successive fuming nitric acid separation. Iron scavenge was made after addition of ferric iron carrier followed by barium chromate separation after addition of barium carrier to remove radium, its daughters and lead. Strontium was recovered as carbonate, and the precipitate was dried and weighed to determine strontium recovery. The strontium carbonate was dissolved in hydrochloric acid and iron carrier was added. The solution was allowed to stand for two weeks for strontium-90 and yttrium-90 to attain equilibrium. Yttrium-90 was coprecipitated with ferric hydroxide and the precipitate was filtered off, washed and counted.

(2) Cesium-137

The supernatant separated from the strontium fraction was acidified with hydrochloric acid. While stirring, cesium was adsorbed on the ammonium molyb-

dophosphate added.

After filtered off and washed with hydrochlotric acid the precipitate was dissolved in 2.5N sodium hydroxide solution. The solution was adjusted to pH 8.2 with hydrochloric acid and allowed to cool. Resultant molybdenum hydroxide which separated out in the solution, was filtered off and washed with water. EDTA was added to the filtrate and washings. Cesium and rubidium were adsorbed on a cation exchange column and cesium was separated from rubidium by eluting with hydrochloric acid.

The eluate was evaporated to dryness and was dissolved. The solution was filtered. Chloroplatinic acid was added to precipitate cesium. The precipitate was filtered onto a tared paper using a demountable filter and washed with water and then ethanol. After drying, the chemical yield of cesium was determined by weighing the precipitate. Cesium-137 radioactivity was measured for this precipitate.

4. Determination of stable strontium, calcium and potassium

A weighed amount of soil or sea sediment was heated in a electric muffle furnace at 450 ℃ and then treated with hydrochloric acid for extraction. A weighed aliquot of ashed samples of total diet, vegetables, milk, fish, shellfish or seaweeds was digested with hydrofluoric acid and nitric acid.
The extract was made up to an appropriate volume with dilute hydrochloric acid. The sample solution was analyzed for calcium by titration with standard potassium permanganate solution after separating calcium as oxalate. Atomic absorption spectroscopy was applied when appropriate. Stable strontium and potassium were determined by atomic absorption and flame emission spectrometry, respectively.

5. Counting

After the radiochemical separation the mounted precipitates were counted for activity using low background beta counters normally for 60 to 90 min. Net sample counting rates were corrected for counter efficiency, recovery, self-absorption and decay to obtain the content of strontium-90 and cesium-137 per sample aliquot. From the results, concentrations of these nuclides in the original samples were calculated.

6. Results

(1)-1 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for domestic program)
(from Apr. 1986 to Dec. 1986)

-continued from NO. 76 of this publication-

Table (1)-1: Strontium-90 and Cesium-137 in Rain and Dry Fallout

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
April, 1986				
Matsue, SHIMANE	31	79.3	0.003 ± 0.0007	0.003 ± 0.0005
June, 1986				
Matsue, SHIMANE	40	200.3	0.010 ± 0.0010	0.41 ± 0.005
JUly, 1986				
Sapporo, HOKKAIDO	32	76.5	0.001 ± 0.0006	0.039 ± 0.0016
Aomori, AOMORI	32	118.0	0.006 ± 0.0008	0.074 ± 0.0021
Onagawa-machi, MIYAGI	31	171.3	0.001 ± 0.0006	0.019 ± 0.0011
Yamagata, YAMAGATA	32	195.3	0.001 ± 0.0006	0.047 ± 0.0018
Ookuma-machi, FUKUSHIMA	33	135.5	0.002 ± 0.0006	0.070 ± 0.0021
Mito, IBARAGI	32	108.5	0.002 ± 0.0005	0.009 ± 0.0008
Shinjuku, TOKYO	32	140.2	0.003 ± 0.0006	0.046 ± 0.0017
Yokohama, KANAGAWA	32	94.4	0.002 ± 0.0006	0.092 ± 0.0024
Fukui, FUKUI	31	299.1	0.001 ± 0.0005	0.081 ± 0.0023
Shizuoka, SHIZUOKA	32	272.0	0.001 ± 0.0005	0.061 ± 0.0019
Kyoto, KYOTO	32	393.2	0.001 ± 0.0005	0.022 ± 0.0012
Wakayama, WAKAYAMA	29	135.1	0.001 ± 0.0007	0.026 ± 0.0014
Tottori, TOTTORI	33	271.3	0.004 ± 0.0007	0.037 ± 0.0016
Matsuyama, EHIME	32	102.0	0.001 ± 0.0005	0.005 ± 0.0007
Dazaifu, FUKUOKA	32	458.7	0.001 ± 0.0005	0.013 ± 0.0010
Saga, SAGA	32	553.1	0.003 ± 0.0007	0.023 ± 0.0012
Nagasaki, NAGASAKI	32	231.0	0.001 ± 0.0006	0.017 ± 0.0011
Yonagusuku-mura, OKINAWA	36	58.5	0.002 ± 0.0006	0.036 ± 0.0015
August, 1986				
Sapporo, HOKKAIDO	32	72.0	0.001 ± 0.0005	0.014 ± 0.0010
Aomori, AOMORI	34	121.5	0.008 ± 0.0009	0.026 ± 0.0012
Onagawa-machi, MIYAGI	32	235.6	0.002 ± 0.0005	0.013 ± 0.0009
Yamagata, YAMAGATA	32	176.4	0.001 ± 0.0005	0.014 ± 0.0010
Ookuma-machi, FUKUSHIMA	32	349.9	0.001 ± 0.0005	0.041 ± 0.0015
Mito, IBARAGI	32	293.0	0.002 ± 0.0005	0.009 ± 0.0008
Shinjuku, TOKYO	32	244.0	0.001 ± 0.0005	0.016 ± 0.0010

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Yokohama, KANAGAWA	33	251.9	0.002 ± 0.0005	0.049 ± 0.0017
Fukui, FUKUI	34	23.2	0.001 ± 0.0005	0.009 ± 0.0009
Shizuoka, SHIZUOKA	32	255.5	0.001 ± 0.0006	0.032 ± 0.0014
Nagoya, AICHI	32	11.1	0.004 ± 0.0006	0.010 ± 0.0009
Kyoto, KYOTO	32	13.6	0.001 ± 0.0006	0.005 ± 0.0009
Kobe, HYOGO	31	20.4	0.001 ± 0.0006	0.007 ± 0.0008
Wakayama, WAKAYAMA	36	42.8	0.003 ± 0.0007	0.007 ± 0.0009
Tottori, TOTTORI	32	75.7	0.008 ± 0.0009	0.012 ± 0.0010
Hiroshima, HIROSHIMA	32	44.0	0.006 ± 0.0008	0.005 ± 0.0008
Matsuyama, EHIME	32	15.0	0.001 ± 0.0005	0.006 ± 0.0008
Dazaifu, FUKUOKA	33	75.9	0.002 ± 0.0007	0.005 ± 0.0008
Saga, SAGA	33	58.7	0.002 ± 0.0007	0.005 ± 0.0008
Nagasaki, NAGASAKI	32	36.5	0.000 ± 0.0005	0.005 ± 0.0007
Yonagusuku-mura, OKINAWA	30	405.5	0.001 ± 0.0006	0.016 ± 0.0010
September, 1986				
Sapporo, HOKKAIDO	31	186.0	0.001 ± 0.0005	0.014 ± 0.0010
Aomori, AOMORI	29	94.5	0.003 ± 0.0006	0.011 ± 0.0008
Onagawa-machi, MIYAGI	32	79.5	0.001 ± 0.0005	0.005 ± 0.0006
Yamagata, YAMAGATA	31	61.0	0.001 ± 0.0006	0.008 ± 0.0007
Ookuma-machi, FUKUSHIMA	31	73.6	0.001 ± 0.0006	0.011 ± 0.0009
Mito, IBARAGI	31	95.0	0.002 ± 0.0006	0.004 ± 0.0006
Shinjuku, TOKYO	31	207.9	0.001 ± 0.0006	0.008 ± 0.0008
Yokohama, KANAGAWA	30	196.4	0.002 ± 0.0006	0.016 ± 0.0011
Fukui, FUKUI	30	113.2	0.000 ± 0.0007	0.009 ± 0.0008
Shizuoka, SHIZUOKA	31	172.5	0.001 ± 0.0005	0.017 ± 0.0010
Nagoya, AICHI	31	71.6	0.001 ± 0.0006	0.008 ± 0.0007
Kyoto, KYOTO	31	66.2	0.001 ± 0.0005	0.005 ± 0.0007
Kobe, HYOGO	32	60.0	0.000 ± 0.0006	0.006 ± 0.0007
Wakayama, WAKAYAMA	28	138.0	0.002 ± 0.0006	0.006 ± 0.0007
Tottori, TOTTORI	31	109.8	0.005 ± 0.0007	0.006 ± 0.0008
Hiroshima, HIROSHIMA	31	113.8	0.005 ± 0.0007	0.005 ± 0.0007
Matsuyama, EHIME	31	149.0	0.002 ± 0.0006	0.002 ± 0.0006
Dazaifu, FUKUOKA	31	225.8	0.001 ± 0.0006	0.001 ± 0.0005
Saga, SAGA	31	258.4	0.002 ± 0.0006	0.003 ± 0.0006
Nagasaki, NAGASAKI	31	186.0	0.001 ± 0.0006	0.002 ± 0.0006
Yonagusuku-mura, OKINAWA	29	141.0	0.001 ± 0.0006	0.007 ± 0.0008
October, 1986				
Sapporo, HOKKAIDO	31	164.0	0.001 ± 0.0006	0.008 ± 0.0007

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Aomori, AOMORI	32	74.0	0.002 ± 0.0006	0.008 ± 0.0008
Onagawa-machi, MIYAGI	30	145.1	0.003 ± 0.0006	0.005 ± 0.0006
Yamagata, YAMAGATA	32	61.6	0.001 ± 0.0006	0.004 ± 0.0007
Ookuma-machi, FUKUSHIMA	32	173.7	0.002 ± 0.0006	0.005 ± 0.0007
Mito, IBARAGI	32	73.5	0. ± 0.	0.003 ± 0.0005
Shinjuku, TOKYO	32	76.5	0.002 ± 0.0006	0.006 ± 0.0006
Yokohama, KANAGAWA	32	109.7	0.001 ± 0.0006	0.011 ± 0.0008
Fukui, FUKUI	31	242.6	0.002 ± 0.0007	0.007 ± 0.0008
Shizuoka, SHIZUOKA	32	72.0	0.001 ± 0.0006	0.013 ± 0.0009
Nagoya, AICHI	35	56.5	0.001 ± 0.0006	0.007 ± 0.0008
Kyoto, KYOTO	32	68.5	0.001 ± 0.0006	0.003 ± 0.0007
Kobe, HYOGO	32	81.8	0.001 ± 0.0005	0.010 ± 0.0009
Wakayama, WAKAYAMA	34	76.6	0.002 ± 0.0006	0.004 ± 0.0007
Tottori, TOTTORI	32	186.1	0.004 ± 0.0008	0.008 ± 0.0009
Hiroshima, HIROSHIMA	35	58.9	0.004 ± 0.0008	0.005 ± 0.0007
Matsuyama, EHIME	32	32.5	0.002 ± 0.0007	0.004 ± 0.0007
Dazaifu, FUKUOKA	31	51.0	0.001 ± 0.0007	0.003 ± 0.0007
Saga, SAGA	32	47.8	0.001 ± 0.0006	0.000 ± 0.0005
Nagasaki, NAGASAKI	32	81.5	0.001 ± 0.0006	0.002 ± 0.0006
Yonagusuku-mura, OKINAWA	32	54.5	0.000 ± 0.0007	0.005 ± 0.0008
November, 1986				
Sapporo, HOKKAIDO	32	47.5	0.001 ± 0.0006	0.010 ± 0.0009
Aomori, AOMORI	33	92.5	0.002 ± 0.0006	0.016 ± 0.0011
Onagawa-machi, MIYAGI	34	47.2	0.004 ± 0.0007	0.010 ± 0.0009
Yamagata, YAMAGATA	31	55.1	0.001 ± 0.0006	0.007 ± 0.0007
Ookuma-machi, FUKUSHIMA	31	34.5	0.001 ± 0.0006	0.010 ± 0.0008
Mito, IBARAGI	31	38.0	0.001 ± 0.0006	0.002 ± 0.0005
Shinjuku, TOKYO	31	46.2	0.002 ± 0.0006	0.003 ± 0.0006
Yokohama, KANAGAWA	31	47.4	0.002 ± 0.0006	0.006 ± 0.0007
Fukui, FUKUI	32	78.1	0.003 ± 0.0007	0.004 ± 0.0007
Shizuoka, SHIZUOKA	31	28.5	0.002 ± 0.0006	0.007 ± 0.0007
Nagoya, AICHI	28	37.4	0.002 ± 0.0007	0.006 ± 0.0007
Kyoto, KYOTO	31	22.4	0.002 ± 0.0005	0.002 ± 0.0005
Kobe, HYOGO	29	18.6	0.002 ± 0.0006	0.003 ± 0.0005
Wakayama, WAKAYAMA	28	28.8	0.002 ± 0.0007	0.004 ± 0.0006
Tottori, TOTTORI	31	96.7	0.004 ± 0.0007	0.005 ± 0.0006
Hiroshima, HIROSHIMA	31	16.2	0.004 ± 0.0007	0.001 ± 0.0004
Matsuyama, EHIME	31	9.0	0.002 ± 0.0006	0.001 ± 0.0004
Dazaifu, FUKUOKA	32	27.2	0.001 ± 0.0008	0.003 ± 0.0005

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Saga, SAGA	32	24.2	0.002 ± 0.0006	0.002 ± 0.0004
Nagasaki, NAGASAKI	31	18.0	0.002 ± 0.0006	0.001 ± 0.0004
Yonagusuku-mura, OKINAWA	32	154.0	0.002 ± 0.0006	0.006 ± 0.0006
December, 1986				
Sapporo, HOKKAIDO	26	43.0	0.001 ± 0.0006	0.006 ± 0.0008
Aomori, AOMORI	36	101.5	0.004 ± 0.0007	0.013 ± 0.0010
Onagawa-machi, MIYAGI	35	64.2	0.002 ± 0.0007	0.008 ± 0.0008
Yamagata, YAMAGATA	36	33.8	0.002 ± 0.0007	0.007 ± 0.0008
Yamagata, YAMAGATA	37	76.0	0.001 ± 0.0006	0.003 ± 0.0006
Ookuma-machi, FUKUSHIMA	26	43.8	0.001 ± 0.0005	0.004 ± 0.0006
Shinjuku, TOKYO	36	141.4	0.003 ± 0.0007	0.014 ± 0.0010
Yokohama, KANAGAWA	32	133.1	0.001 ± 0.0006	0.011 ± 0.0009
Fukui, FUKUI	36	177.6	0.001 ± 0.0006	0.006 ± 0.0007
Shizuoka, SHIZUOKA	36	207.0	0.000 ± 0.0005	0.008 ± 0.0009
Nagoya, AICHI	36	111.7	0.001 ± 0.0006	0.007 ± 0.0007
Kyoto, KYOTO	36	42.1	0.001 ± 0.0006	0.003 ± 0.0007
Kobe, HYOGO	29	61.5	0.002 ± 0.0006	0.003 ± 0.0006
Wakayama, WAKAYAMA	38	108.0	0.001 ± 0.0006	0.005 ± 0.0008
Tottori, TOTTORI	37	195.7	0.003 ± 0.0007	0.008 ± 0.0009
Hiroshima, HIROSHIMA	37	69.0	0.004 ± 0.0007	0.002 ± 0.0005
Matsuyama, EHIME	36	66.5	0.001 ± 0.0006	0.003 ± 0.0007
Dazaifu, FUKUOKA	36	77.4	0.002 ± 0.0006	0.002 ± 0.0007
Saga, SAGA	35	92.7	0.002 ± 0.0006	0.002 ± 0.0007
Nagasaki, NAGASAKI	36	94.5	0.002 ± 0.0006	0.002 ± 0.0006
Yonagusuku-mura, OKINAWA	37	173.0	0.002 ± 0.0006	0.003 ± 0.0007

(1)-2 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for WHO program)
(from Jan. 1986 to Dec. 1986)

-continued from NO. 76 of this publication-

Table (1)-2: Strontium-90 and Cesium-137 in Rain and Dry Fallout

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
January, 1986				
Chiba, CHIBA	29	46.5	0.000 ± 0.0005	0.004 ± 0.0005
JUly, 1986				
Niigata, NIIGATA	32	99.1	0.002 ± 0.0006	0.037 ± 0.0015
Kanazawa, ISHIKAWA	33	333.5	0.001 ± 0.0006	0.036 ± 0.0016
Nagano, NAGANO	32	141.9	0.001 ± 0.0006	0.023 ± 0.0013
Okayama, OKAYAMA	32	100.1	0.002 ± 0.0006	0.020 ± 0.0012
Yamaguchi, YAMAGUCHI	32	399.0	0.002 ± 0.0006	0.033 ± 0.0015
Kochi, KOCHI	33	271.0	0.003 ± 0.0006	0.097 ± 0.0024
Kagoshima, KAGOSHIMA	32	371.5	0.003 ± 0.0006	0.006 ± 0.0007
August, 1986				
Akita, AKITA	20	109.4	0.002 ± 0.0005	0.016 ± 0.0011
Chiba, CHIBA	29	246.9	0.002 ± 0.0006	0.021 ± 0.0011
Niigata, NIIGATA	32	42.2	0.002 ± 0.0006	0.011 ± 0.0009
Kanazawa, ISHIKAWA	29	34.5	0.001 ± 0.0006	0.012 ± 0.0010
Nagano, NAGANO	32	121.4	0.004 ± 0.0007	0.014 ± 0.0010
Osaka, OSAKA	33	105.5	0.001 ± 0.0006	0.008 ± 0.0008
Okayama, OKAYAMA	32	34.5	0.000 ± 0.0005	0.005 ± 0.0007
Yamaguchi, YAMAGUCHI	33	80.0	0.003 ± 0.0007	0.026 ± 0.0013
Kochi, KOCHI	32	199.2	0.005 ± 0.0007	0.024 ± 0.0012
Kagoshima, KAGOSHIMA	32	66.5	0.004 ± 0.0008	0.005 ± 0.0007
September, 1986				
Akita, AKITA	43	197.8	0.001 ± 0.0005	0.027 ± 0.0012
Chiba, CHIBA	31	212.2	0.001 ± 0.0006	0.006 ± 0.0006
Niigata, NIIGATA	31	87.9	0.003 ± 0.0006	0.010 ± 0.0008
Kanazawa, ISHIKAWA	33	121.0	0.003 ± 0.0010	0.012 ± 0.0012
Nagano, NAGANO	31	119.4	0.000 ± 0.0006	0.005 ± 0.0006
Osaka, OSAKA	30	89.6	0.002 ± 0.0006	0.006 ± 0.0006
Okayama, OKAYAMA	31	100.3	0.000 ± 0.0005	0.004 ± 0.0007
Yamaguchi, YAMAGUCHI	31	286.0	0.002 ± 0.0006	0.006 ± 0.0007
Kochi, KOCHI	31	248.4	0.002 ± 0.0006	0.009 ± 0.0008
Kagoshima, KAGOSHIMA	31	173.5	0.002 ± 0.0006	0.002 ± 0.0006

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
October, 1986				
Akita, AKITA	32	126.8	0.002 ± 0.0006	0.015 ± 0.0010
Chiba, CHIBA	35	125.8	0.001 ± 0.0008	0.003 ± 0.0007
Niigata, NIIGATA	32	101.3	0.002 ± 0.0006	0.012 ± 0.0009
Kanazawa, ISHIKAWA	36	245.5	0.002 ± 0.0006	0.012 ± 0.0009
Nagano, NAGANO	35	23.4	0.002 ± 0.0006	0.004 ± 0.0005
Osaka, OSAKA	32	80.8	0.002 ± 0.0006	0.005 ± 0.0007
Okayama, OKAYAMA	32	30.1	0.001 ± 0.0006	0.006 ± 0.0008
Yamaguchi, YAMAGUCHI	32	49.5	0.001 ± 0.0007	0.005 ± 0.0008
Kochi, KOCHI	32	72.5	0.003 ± 0.0022	0.005 ± 0.0007
Kagoshima, KAGOSHIMA	32	71.5	0.003 ± 0.0007	0.002 ± 0.0006
November, 1986				
Akita, AKITA	31	200.7	0.002 ± 0.0006	0.024 ± 0.0012
Chiba, CHIBA	28	35.8	0.000 ± 0.0005	0.003 ± 0.0005
Niigata, NIIGATA	31	68.1	0.001 ± 0.0006	0.007 ± 0.0007
Kanazawa, ISHIKAWA	26	117.0	0.002 ± 0.0006	0.005 ± 0.0007
Nagano, NAGANO	28	11.2	0.002 ± 0.0006	0.003 ± 0.0006
Osaka, OSAKA	32	25.4	0.001 ± 0.0005	0.004 ± 0.0006
Okayama, OKAYAMA	31	12.0	0.001 ± 0.0006	0.001 ± 0.0004
Yamaguchi, YAMAGUCHI	31	13.5	0.002 ± 0.0006	0.002 ± 0.0005
Kochi, KOCHI	31	27.7	0.004 ± 0.0006	0.002 ± 0.0005
Kagoshima, KAGOSHIMA	31	26.5	0.004 ± 0.0006	0.003 ± 0.0005
December, 1986				
Akita, AKITA	32	125.1	0.001 ± 0.0007	0.012 ± 0.0010
Chiba, CHIBA	36	107.9	0.002 ± 0.0007	0.005 ± 0.0007
Niigata, NIIGATA	37	82.3	0.003 ± 0.0007	0.006 ± 0.0007
Kanazawa, ISHIKAWA	38	256.5	0.002 ± 0.0007	0.011 ± 0.0009
Nagano, NAGANO	35	38.5	0.000 ± 0.0005	0.007 ± 0.0008
Osaka, OSAKA	37	81.1	0.001 ± 0.0006	0.003 ± 0.0007
Okayama, OKAYAMA	36	49.2	0.000 ± 0.0006	0.005 ± 0.0008
Yamaguchi, YAMAGUCHI	36	87.0	0.001 ± 0.0006	0.003 ± 0.0007
Kochi, KOCHI	37	157.8	0.004 ± 0.0007	0.009 ± 0.0009
Kagoshima, KAGOSHIMA	36	109.5	0.003 ± 0.0007	0.001 ± 0.0006

(2) Strontium-90 and Cesium-137 in Airborne Dust
(from Apr. 1986 to Dec. 1986)

-continued from NO. 76 of this publication-

Table (2): Strontium-90 and Cesium-137 in Airborne Dust

Location	Sampling period	Absorption volume (m^3)	^{90}Sr ($10^{-3}pCi/m^3$)	^{137}Cs ($10^{-3}pCi/m^3$)
April～JUly, 1986				
Ookuma-machi, FUKUSHIMA	4～7	12,744	0.3 ± 0.03	13. ± 0.1
Niigata, NIIGATA	4～7	13,251	0.1 ± 0.02	11. ± 0.1
JUly～October, 1986				
Ookuma-machi, FUKUSHIMA	7～10	12,208	0.02 ± 0.02	0.1 ± 0.02
Niigata, NIIGATA	7～10	13,874	0.01 ± 0.02	0.1 ± 0.01
Fukui, FUKUI	7～10	15,873	0.01 ± 0.01	0.1 ± 0.01
Hamaoka-machi, SHIZUOKA	7～10	10,900	0.0 ± 0.02	0.1 ± 0.02
Nagoya, AICHI	7～10	9,079	0.0 ± 0.03	0.1 ± 0.02
Kyoto, KYOTO	7～10	6,729	0.03 ± 0.04	0.2 ± 0.04
Osaka, OSAKA	7～10	13,709	0.01 ± 0.02	0.1 ± 0.01
Kobe, HYOGO	7～10	10,365	0.0 ± 0.02	0.1 ± 0.02
Tottori, TOTTORI	7～10	11,172	0.0 ± 0.02	0.2 ± 0.02
Hiroshima, HIROSHIMA	7～10	11,044	0.02 ± 0.02	0.1 ± 0.02
Nagasaki, NAGASAKI	7～10	10,012	0.03 ± 0.03	0.02 ± 0.02
October～December, 1986				
Fukui, FUKUI	10～12	17,546	0.01 ± 0.01	0.04 ± 0.01
Hamaoka-machi, SHIZUOKA	10～12	12,536	0.02 ± 0.02	0.3 ± 0.03
Nagoya, AICHI	10～12	9,602	0.04 ± 0.03	0.1 ± 0.02
Kobe, HYOGO	10～12	9,752	0.0 ± 0.03	0.0 ± 0.02
Hiroshima, HIROSHIMA	10～12	11,468	0.0 ± 0.02	0.1 ± 0.02

(3) Strontium-90 and Cesium-137 in Service Water
(from Jul. 1986 to Dec. 1986)

-continued from NO. 76 of this publication-

Table (3): Strontium-90 and Cesium-137 in Service Water

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
(Source Water)			
August, 1986			
Kyoto, KYOTO	7.6	0.16 ± 0.007	0.06 ± 0.004
December, 1986			
Tsukui-machi, KANAGAWA	8.1	0.02 ± 0.003	0.002 ± 0.002
Nagano, NAGANO	7.1	0.05 ± 0.005	0.01 ± 0.002
Inuyama, AICHI	6.9	0.11 ± 0.006	0.01 ± 0.002
Moriguchi, OSAKA	7.0	0.13 ± 0.007	0.02 ± 0.003
(Tap Water)			
JUly, 1986			
Fukushima, FUKUSHIMA	6.6	0.13 ± 0.006	0.02 ± 0.003
August, 1986			
Kyoto, KYOTO	7.5	0.16 ± 0.007	0.04 ± 0.004
October, 1986			
Sendai, MIYAGI	6.7	0.08 ± 0.005	0.01 ± 0.003
December, 1986			
Wakkanai, HOKKAIDO	6.6	0.07 ± 0.005	0.003 ± 0.003
Aomori, AOMORI	7.2	0.04 ± 0.004	0.01 ± 0.002
Akita, AKITA	6.9	0.11 ± 0.006	0.01 ± 0.002
Fukushima, FUKUSHIMA	6.5	0.14 ± 0.007	0.01 ± 0.002
Mito, IBARAGI	7.7	0.07 ± 0.005	0.01 ± 0.003
Yokohama, KANAGAWA	7.0	0.02 ± 0.003	0.01 ± 0.002
Niigata, NIIGATA	7.1	0.13 ± 0.007	0.01 ± 0.003
Kanazawa, ISHIKAWA	7.2	0.12 ± 0.007	0.01 ± 0.003
Fukui, FUKUI	7.2	0.01 ± 0.003	0.004 ± 0.003
Nagano, NAGANO	7.0	0.04 ± 0.004	0.01 ± 0.002
Shizuoka, SHIZUOKA	7.2	0.04 ± 0.005	0.00 ± 0.003
Nagoya, AICHI	6.9	0.09 ± 0.007	0.02 ± 0.003
Osaka, OSAKA	6.8	0.12 ± 0.006	0.01 ± 0.002
Kobe, HYOGO	6.9	0.11 ± 0.006	0.01 ± 0.003
Tottori, TOTTORI	7.5	0.08 ± 0.006	0.002 ± 0.002
Okayama, OKAYAMA	6.8	0.08 ± 0.006	0.01 ± 0.002

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
Ube, YAMAGUCHI	6.8	0.07 ± 0.006	0.004 ± 0.002
Matsuyama, EHIME	7.4	0.05 ± 0.005	0.003 ± 0.003
Kochi, KOCHI	7.3	0.06 ± 0.005	0.002 ± 0.003
Naha, OKINAWA	7.7	0.22 ± 0.009	0.004 ± 0.003

(4) Strontium-90 and Cesium-137 in Freshwater (from Aug. 1986 to Dec. 1986)

-continued from NO. 76 of this publication-

Table (4): Strontium-90 and Cesium-137 in Freshwater

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
(Freshwater)			
August, 1986			
Akita, AKITA	6.8	0.15 ± 0.007	0.04 ± 0.005
September, 1986			
Fukushima, FUKUSHIMA	6.7	0.06 ± 0.005	0.02 ± 0.003
November, 1986			
Toyanogata, NIIGATA	6.9	0.18 ± 0.008	0.04 ± 0.004
Shobara, HIROSHIMA	6.9	0.06 ± 0.005	0.01 ± 0.003
December, 1986			
Turuga, FUKUI	7.0	0.21 ± 0.009	0.15 ± 0.006
Suwa-lake, NAGANO	8.2	0.04 ± 0.004	0.02 ± 0.003
Uji, KYOTO	6.4	0.01 ± 0.003	0.01 ± 0.002

(5) Strontium-90 and Cesium-137 in Soil
(from Jun. 1986 to Sep. 1986)

-continued from NO. 76 of this publication-

Table (5): Strontium-90 and Cesium-137 in Soil

Location	Sampling Depth (cm)	^{90}Sr (pCi/Kg)	^{90}Sr (mCi/Km^2)	^{137}Cs (pCi/Kg)	^{137}Cs (mCi/Km^2)
June, 1986					
Fukushima, FUKUSHIMA	0～5	100 ± 6	1.9±0.11	430 ±11	8.1±0.20
〃	5～20	36 ± 4.0	2.7±0.31	48 ± 3.9	3.7±0.30
JUly, 1986					
Yamagata, YAMAGATA	0～5	150 ± 7	6.0±0.28	690 ±12	28 ±0.5
〃	5～20	48 ± 4.7	11 ±1.0	83 ± 4.3	18 ±0.9
Katsushika, TOKYO	0～5	42 ± 4.4	2.0±0.21	360 ± 9	18 ±0.4
〃	5～20	120 ± 7	21 ±1.2	250 ± 7	46 ±1.3
Yokohama, KANAGAWA	0～5	320 ±12	8.8±0.33	1200 ±20	35 ±0.5
〃	5～20	190 ± 9	18 ±0.9	210 ± 8	20 ±0.7
Kashiwazaki, NIIGATA	0～5	58 ± 4.8	3.9±0.33	840 ±15	57 ±1.0
〃	5～20	390 ±11	43 ±1.3	1600 ±20	180 ±2
Fukui, FUKUI	0～5	36 ± 3.7	1.4±0.14	280 ± 8	11 ±0.3
〃	5～20	25 ± 3.6	3.1±0.43	58 ± 4.1	7.0±0.49
Gotenba, SHIZUOKA	0～5	45 ± 4.1	1.2±0.11	460 ±10	12 ±0.3
〃	5～20	48 ± 4.4	5.6±0.51	200 ± 7	23 ±0.8
Miyazu, KYOTO	0～5	65 ± 5.1	2.6±0.21	1700 ±20	68 ±0.9
〃	5～20	73 ± 5.4	17 ±1.3	220 ± 8	52 ±1.9
Kumatori-machi, OSAKA	0～5	79 ± 5.3	4.5±0.30	86 ± 5.5	4.9±0.31
〃	5～20	28 ± 4.0	4.4±0.64	46 ± 4.1	7.4±0.66
Oota, SHIMANE	0～5	1100 ±20	21 ±0.3	3100 ±30	64 ±0.7
〃	5～20	470 ±12	20 ±0.5	1500 ±30	62 ±1.2
Tsuyama, OKAYAMA	0～5	23 ± 3.4	0.8±0.12	210 ± 7	7.3±0.24
〃	5～20	28 ± 3.7	2.5±0.33	80 ± 4.7	7.2±0.42
Hiroshima, HIROSHIMA	0～5	70 ± 4.7	6.6±0.45	270 ± 8	26 ±0.7
〃	5～20	64 ± 4.6	13 ±0.9	92 ± 4.8	18 ±0.9
Hagi, YAMAGUCHI	0～5	71 ± 4.8	3.6±0.25	240 ± 7	12 ±0.4
〃	5～20	57 ± 4.7	16 ±1.3	160 ± 6	45 ±1.7

Location	Sampling Depth (cm)	^{90}Sr (pCi/Kg)	^{90}Sr (mCi/Km^2)	^{137}Cs (pCi/Kg)	^{137}Cs (mCi/Km^2)
Matsuyama, EHIME	0～5	63 ± 4.6	2.7±0.20	1100 ±10	45 ±0.6
〃	5～20	10 ± 2.8	1.7±0.46	85 ± 4.6	14 ±0.8
Kochi, KOCHI	0～5	280 ±10	14 ±0.5	940 ±14	48 ±0.7
〃	5～20	190 ± 9	25 ±1.2	280 ± 8	36 ±1.1
Fukuoka, FUKUOKA	0～5	250 ± 9	9.7±0.36	890 ±17	35 ±0.7
〃	5～20	160 ± 8	23 ±1.1	68 ± 4.9	9.9±0.72
August, 1986					
Sapporo, HOKKAIDO	0～5	340 ±10	13 ±0.4	840 ±15	31 ±0.5
〃	5～20	280 ± 9	38 ±1.2	340 ±10	45 ±1.3
Aomori, AOMORI	0～5	23 ± 3.5	0.9±0.13	59 ± 4.4	2.2±0.17
〃	5～20	6.0± 3.1	0.6±0.35	3.0± 1.9	0.3±0.21
Sendai, MIYAGI	0～5	73 ± 5.1	2.9±0.20	120 ± 6	4.7±0.23
〃	5～20	47 ± 4.9	7.1±0.73	37 ± 3.5	5.7±0.52
Kawabe-machi, AKITA	0～5	770 ±15	17 ±0.3	1800 ±20	41 ±0.4
〃	5～20	630 ±14	69 ±1.6	1000 ±10	110 ±2
Kanazawa, ISHIKAWA	0～5	490 ±12.0	20 ±0.5	1600 ±20	65 ±0.8
〃	5～20	380 ±10.0	58 ±1.6	700 ±14	110 ±2
Nagano, NAGANO	0～5	110 ± 6.0	5.4±0.32	400 ± 9	19 ±0.4
〃	5～20	94 ± 6.2	11 ±0.7	170 ± 6	20 ±0.7
Kobe, HYOGO	0～5	27 ± 3.6	1.2±0.16	320 ± 8	14 ±0.4
〃	5～20	60 ± 4.8	7.6±0.62	430 ±10	55 ±1.2
Kokufu-machi, TOTTORI	0～5	8.0± 3.0	0.6±0.21	41 ± 4.0	2.9±0.28
〃	5～20	20 ± 3.5	1.7±0.29	48 ± 4.3	4.0±0.36
Obama-machi, NAGASAKI	0～5	220 ± 9	5.6±0.24	1300 ±20	32 ±0.5
〃	5～20	100 ± 6	9.9±0.59	720 ±14	70 ±1.4
Kaimon-machi, KAGOSHIMA	0～5	15 ± 3.1	0.7±0.14	35 ± 3.5	1.6±0.16
〃	5～20	6.0± 2.8	0.7±0.35	8.0± 2.3	1.0±0.28
September, 1986					
Saga, SAGA	0～5	21 ± 3.3	1.0±0.16	35 ± 4.1	1.6±0.19
〃	5～20	27 ± 3.8	4.6±0.63	150 ± 7	25 ±1.1

(6) Strontium-90 and Cesium-137 in Sea Water (from Jul. 1986 to Nov. 1986)

-continued from NO. 76 of this publication-

Table (6): Strontium-90 and Cesium-137 in Sea Water

Location	Sample volume analyzed (ℓ)	Cl (‰)	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
JUly, 1986				
Off-Niigata-Port, NIIGATA	42.2	18.26	0.10±0.010	0.19±0.013
Off-Moji-Port, FUKUOKA	40	17.59	0.08±0.010	0.13±0.012
August, 1986				
Off-Tomari, HOKKAIDO	40	18.72	0.10±0.009	0.21±0.014
Mutsu-bay, AOMORI	40	15.6	0.10±0.010	0.20±0.013
Off-Matsukawaura, FUKUSHIMA	40	17.7	0.08±0.009	0.17±0.013
Odawa-bay, KANAGAWA	40	15.87	0.09±0.009	0.16±0.012
Ise-bay, AICHI	40	16.3	0.08±0.010	0.16±0.012
Off-Osaka-Port, OSAKA	40	12.4	0.10±0.010	0.09±0.011
Yamaguchi-bay, YAMAGUCHI	40	18.0	0.09±0.010	0.15±0.012
Off-kaseda, KAGOSHIMA	40	18.3	0.10±0.010	0.14±0.012
November, 1986				
Kinnakagusuku-bay, OKINAWA	40	19.16	0.08±0.010	0.11±0.011

(7) Strontium-90 and Cesium-137 in Sea Sediments (from May 1986 to Nov. 1986)

-continued from NO. 76 of this publication-

Table (7): Strontium-90 and Cesium-137 in Sea Sediments

Location	Depth (m)	^{90}Sr (pCi/Kg)	^{137}Cs (pCi/Kg)
May, 1986			
Mutsu-bay, AOMORI	-	1 ± 2.1	12 ± 2.7
JUly, 1986			
Off-Tokai, IBARAGI	7	5 ± 2.3	18 ± 3.1
Off-Niigata-Port, NIIGATA	30	4 ± 2.2	94 ± 5.6
Off-Moji-Port, FUKUOKA	8	4 ± 2.6	100 ± 6
August, 1986			
Off-Tomari, HOKKAIDO	7	4 ± 2.3	24 ± 3.3
Mutsu-bay, AOMORI	11	9 ± 2.7	200 ± 8
Off-Matsukawaura, FUKUSHIMA	5	4 ± 2.3	14 ± 2.7
Odawa-bay, KANAGAWA	7.5	5 ± 2.3	89 ± 5.6
Ise-bay, AICHI	20	6 ± 2.4	120 ± 7
Off-Osaka-Port, OSAKA	10.3	2 ± 2.6	150 ± 7
Yamaguchi-bay, YAMAGUCHI	10	3 ± 2.6	120 ± 6
Off-kaseda, KAGOSHIMA	17	1 ± 2.5	11 ± 2.5
November, 1986			
Kinnakagusuku-bay, OKINAWA	13.8	4 ± 2.8	14 ± 2.7

* * * Rain and Dry Fallout (for domestic program) * * *

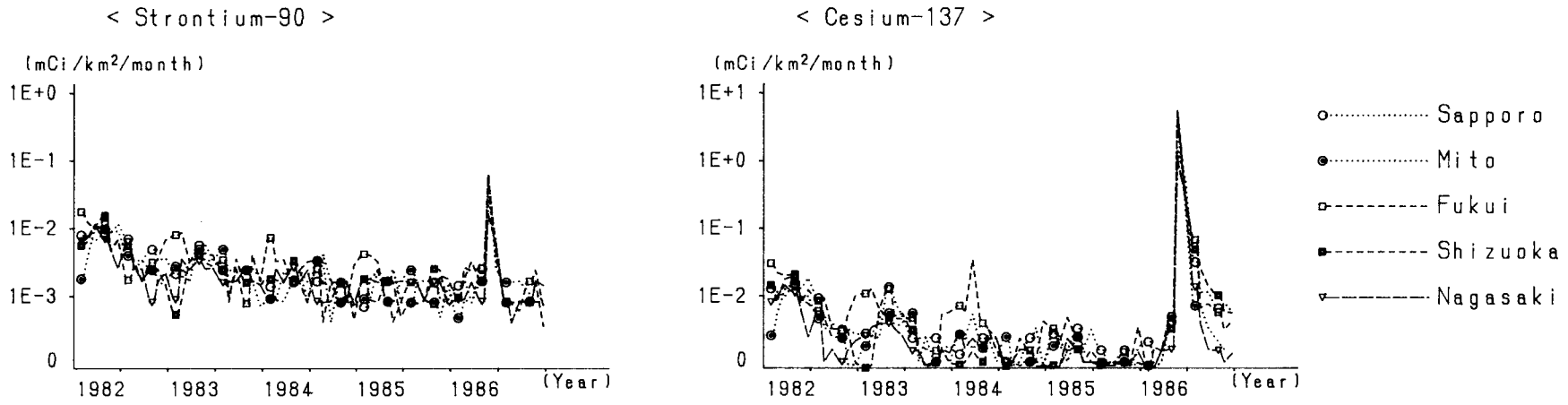


Fig. 1-1

* * * Rain and Dry Fallout (for WHO program) * * *

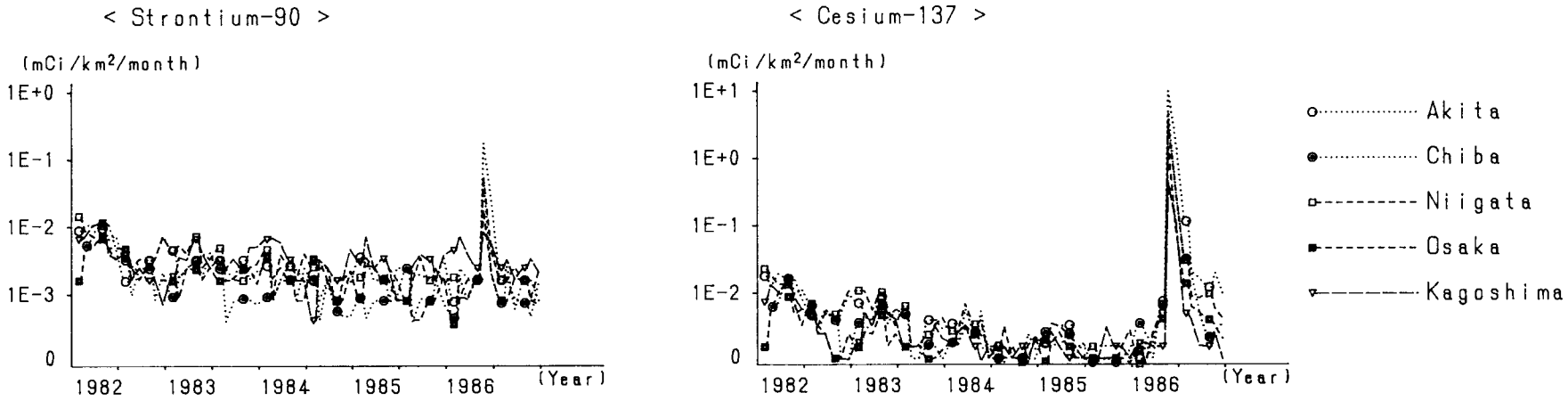


Fig. 1-2

* * * Airborne Dust * * *

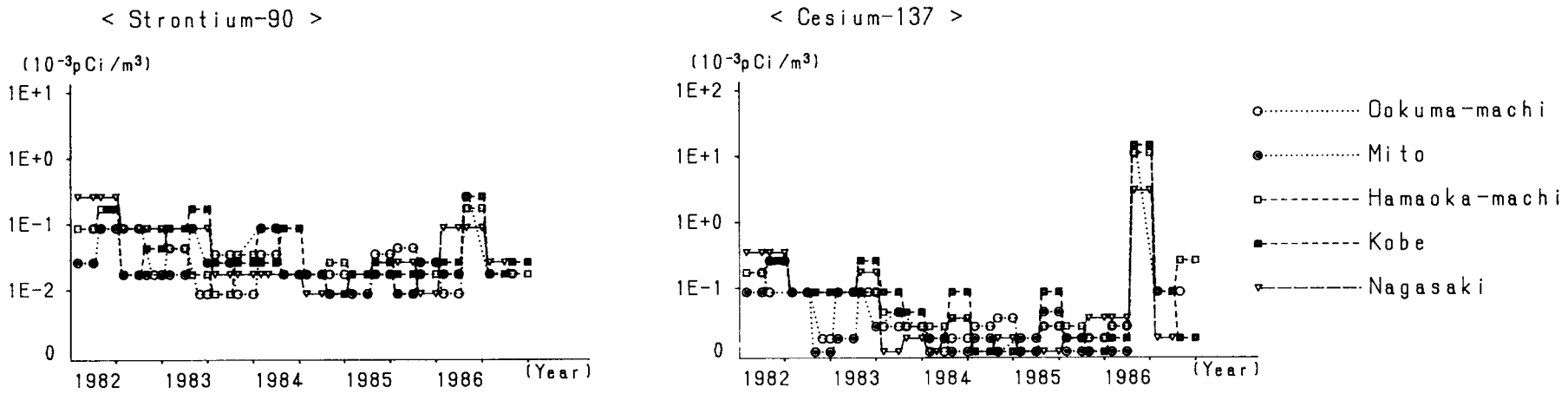


Fig.2

* * * Service Water (tap water) * * *

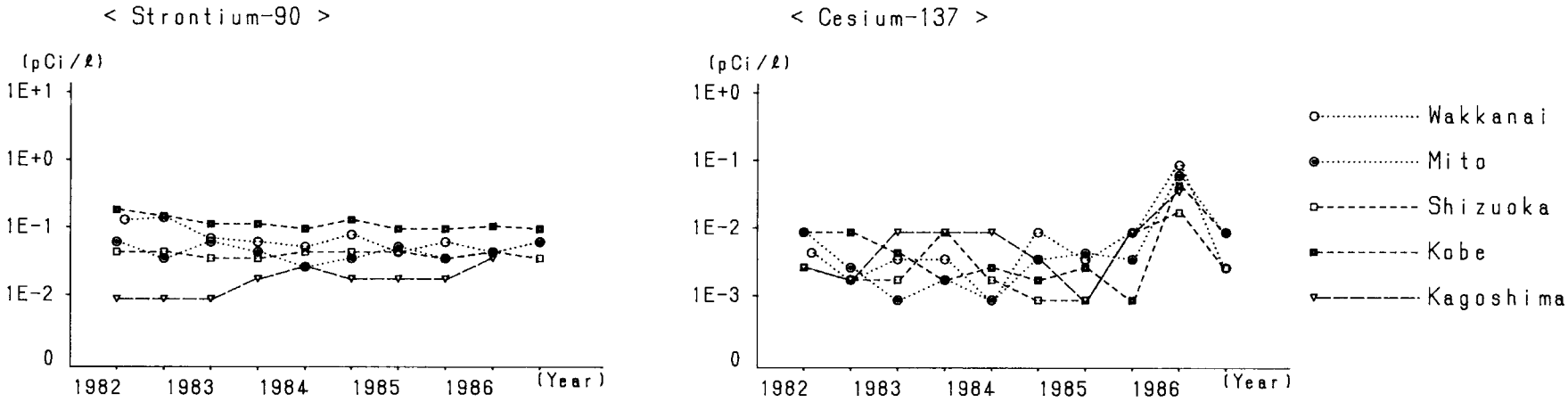


Fig. 3

* * * Service Water (freshwater) * * *

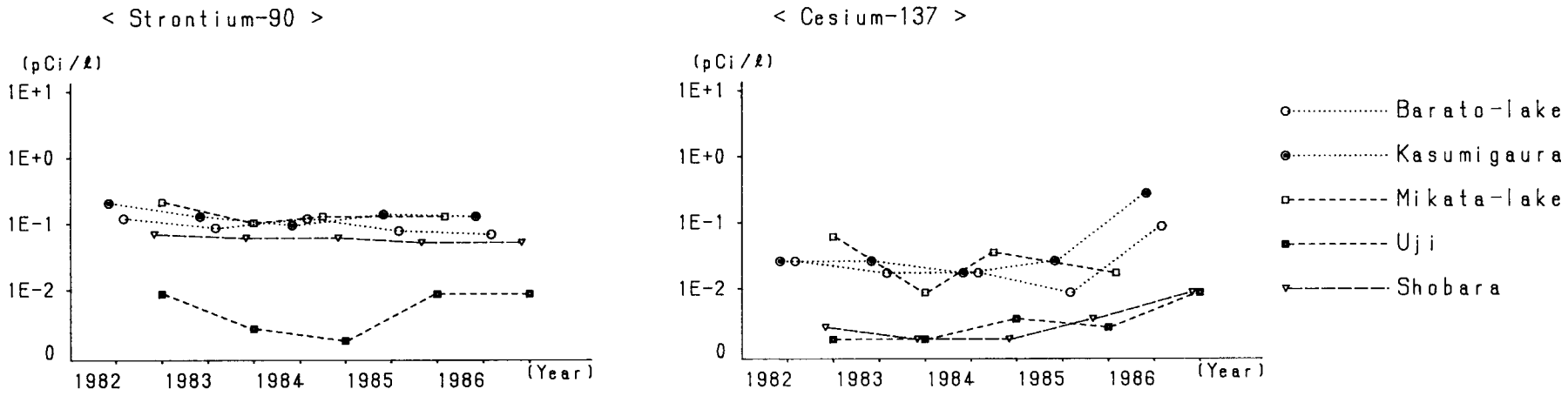


Fig. 4

* * *　Soil　* * *

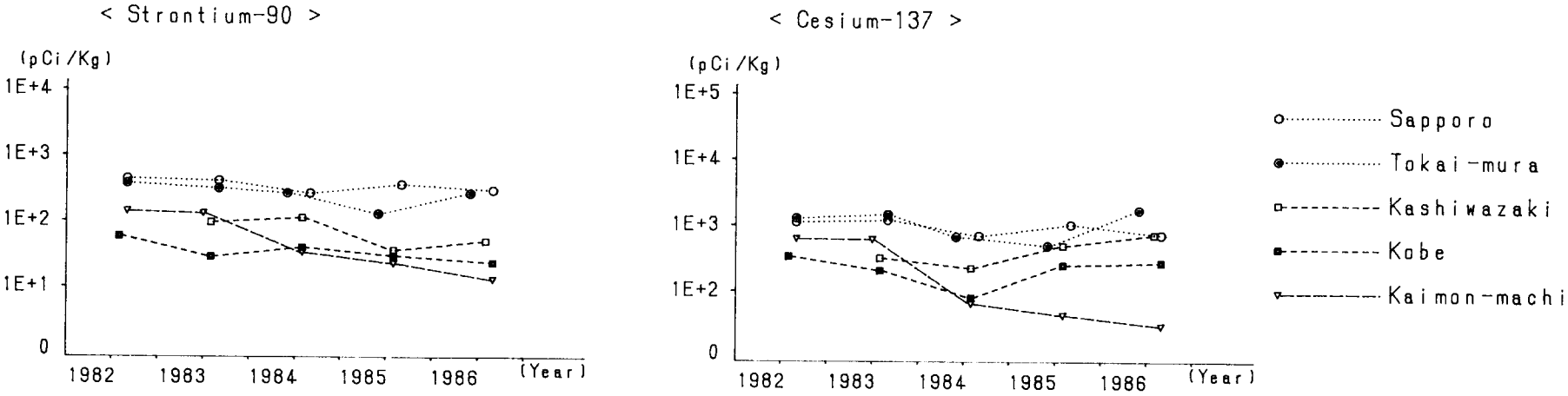

< Strontium-90 >
(pCi/Kg)
1E+4
1E+3
1E+2
1E+1
0
1982
1983
1984
1985
1986
(Year)
< Cesium-137 >
(pCi/Kg)
1E+5
1E+4
1E+3
1E+2
0
1982
1983
1984
1985
1986
(Year)
Sapporo
Tokai-mura
Kashiwazaki
Kobe
Kaimon-machi

Fig.5

＊＊＊　Sea Water　＊＊＊

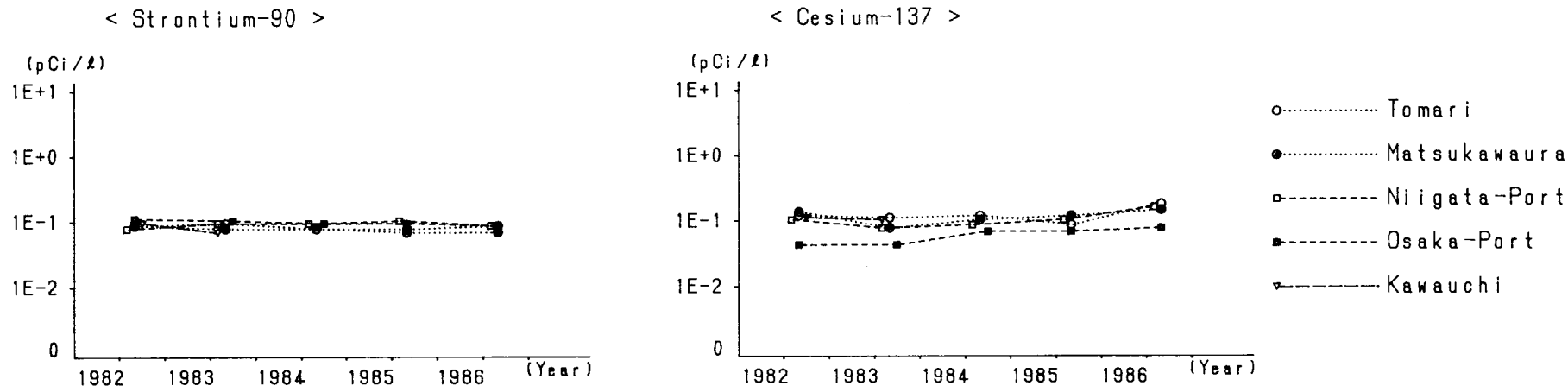


Fig.6

* * * Sea Sediments * * *

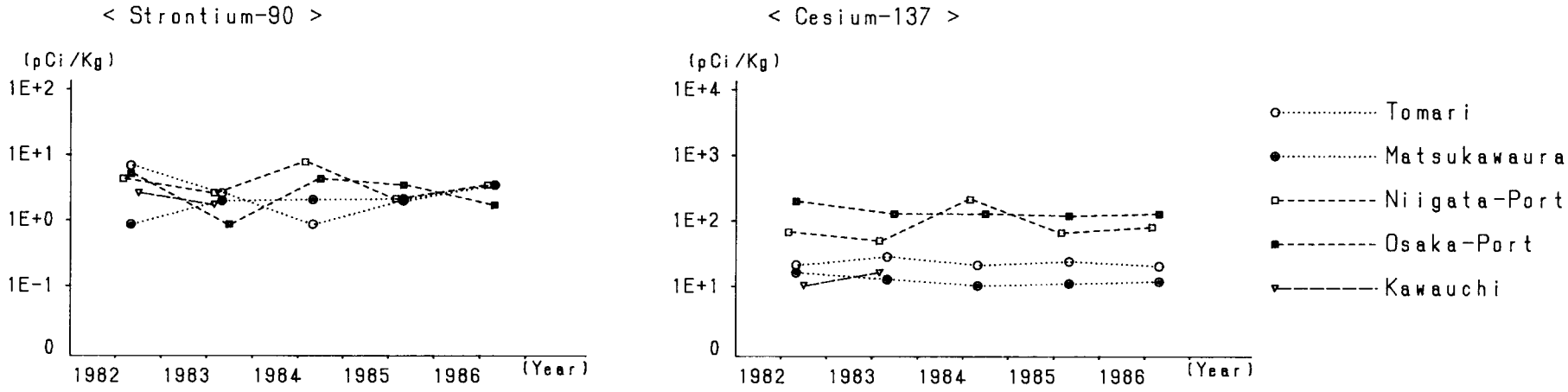
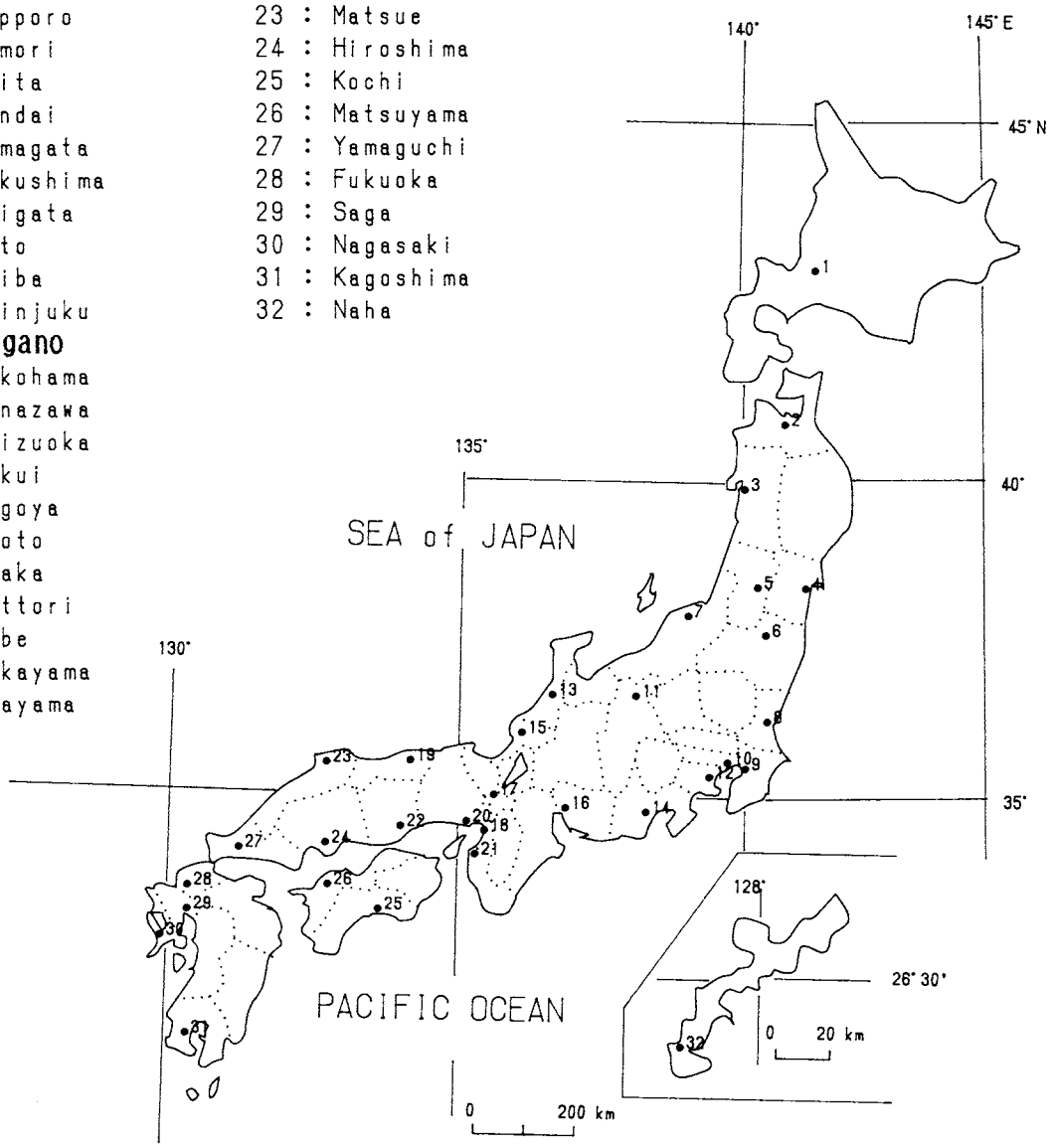


Fig.7

** Sampling Locations in Japan **

1 : Sapporo
2 : Aomori
3 : Akita
4 : Sendai
5 : Yamagata
6 : Fukushima
7 : Niigata
8 : Mito
9 : Chiba
10 : Shinjuku
11 : **Nagano**
12 : Yokohama
13 : Kanazawa
14 : Shizuoka
15 : Fukui
16 : Nagoya
17 : Kyoto
18 : Osaka
19 : Tottori
20 : Kobe
21 : Wakayama
22 : Okayama
23 : Matsue
24 : Hiroshima
25 : Kochi
26 : Matsuyama
27 : Yamaguchi
28 : Fukuoka
29 : Saga
30 : Nagasaki
31 : Kagoshima
32 : Naha



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