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RADIOACTIVITY SURVEY DATA in Japan

Part 1
=Environmental Materials=

NUMBER 88
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National Institute of Radiological Sciences
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Contents

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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.

(1)-1 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for domestic program)
(from Aug. 1988 to Jul. 1989)

-continued from NO. 86 of this publication-

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

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
August, 1988				
Morioka, IWATE	32	261.8	0.01 ± 0.017	0.04 ± 0.022
September, 1988				
Morioka, IWATE	31	115.1	0.00 ± 0.016	0.002 ± 0.020
October, 1988				
Morioka, IWATE	32	75.1	0.01 ± 0.018	0.01 ± 0.021
Tsu, MIE	32	93.0	0.03 ± 0.019	0.06 ± 0.022
Kyoto, KYOTO	33	47.9	0.04 ± 0.019	0.02 ± 0.020
Wakayama, WAKAYAMA	30	44.1	0.03 ± 0.022	0.01 ± 0.014
November, 1988				
Morioka, IWATE	31	98.7	0.02 ± 0.019	0.08 ± 0.023
Tsu, MIE	31	40.0	0.03 ± 0.018	0.11 ± 0.024
Kyoto, KYOTO	31	30.5	0.00 ± 0.018	0.03 ± 0.013
Wakayama, WAKAYAMA	44	28.8	0.02 ± 0.023	0.02 ± 0.015
Matsue, SHIMANE	31	126.8	0.05 ± 0.013	0.14 ± 0.016
December, 1988				
Sapporo, HOKKAIDO	28	80.0	0.01 ± 0.018	0.10 ± 0.018
Morioka, IWATE	36	38.8	0.01 ± 0.017	0.07 ± 0.023
Ookuma-machi, FUKUSHIMA	27	6.2	0.05 ± 0.021	0.07 ± 0.023
Mito, IBARAGI	36	2.0	0.01 ± 0.019	0.06 ± 0.022
Utsunomiya, TOCHIGI	36	0.0	0.01 ± 0.018	0.03 ± 0.015
KKosugi-machi, TOYAMA	35	212.5	0.05 ± 0.021	0.05 ± 0.016
Tsu, MIE	35	3.0	0.03 ± 0.018	0.09 ± 0.024
Kyoto, KYOTO	35	12.6	0.05 ± 0.019	0.03 ± 0.014
Wakayama, WAKAYAMA	23	17.1	0.00 ± 0.030	0.05 ± 0.023
Matsue, SHIMANE	28	52.1	0.01 ± 0.007	0.08 ± 0.016
Saga, SAGA	35	24.9	0.01 ± 0.016	0.00 ± 0.021
January, 1989				
Sapporo, HOKKAIDO	36	30.0	0.06 ± 0.025	0.05 ± 0.019
Aomori, AOMORI	29	42.5	0.03 ± 0.018	0.10 ± 0.018
Onagawa-machi, MIYAGI	27	119.6	0.02 ± 0.019	0.05 ± 0.016

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
Morioka, IWATE	28	54.1	0.003 ± 0.018	0.08 ± 0.018
Yamagata, YAMAGATA	29	50.5	0.01 ± 0.023	0.10 ± 0.019
Ookuma-machi, FUKUSHIMA	37	84.0	0.08 ± 0.025	0.24 ± 0.030
Mito, IBARAGI	28	92.5	0.01 ± 0.019	0.05 ± 0.023
Shinjuku, TOKYO	29	110.2	0.01 ± 0.016	0.07 ± 0.017
Yokohama, KANAGAWA	35	114.9	0.07 ± 0.020	0.20 ± 0.023
Utsunomiya, TOCHIGI	28	38.3	0.00 ± 0.016	0.001 ± 0.012
KKosugi-machi, TOYAMA	29	176.0	0.00 ± 0.018	0.09 ± 0.019
Fukui, FUKUI	28	185.4	0.00 ± 0.085	0.03 ± 0.064
Koufu, YAMANASHI	29	69.0	0.01 ± 0.017	0.04 ± 0.021
Shizuoka, SHIZUOKA	28	174.0	0.00 ± 0.018	0.15 ± 0.020
Nagoya, AICHI	28	110.0	0.08 ± 0.022	0.08 ± 0.023
Tsu, MIE	29	132.0	0.04 ± 0.024	0.08 ± 0.023
Kyoto, KYOTO	29	75.4	0.02 ± 0.020	0.09 ± 0.018
Kobe, HYOGO	35	93.3	0.00 ± 0.016	0.05 ± 0.015
Wakayama, WAKAYAMA	28	111.1	0.04 ± 0.023	0.05 ± 0.016
Tottori, TOTTORI	29	145.5	0.14 ± 0.026	0.11 ± 0.019
Matsue, SHIMANE	36	154.4	0.03 ± 0.009	0.10 ± 0.017
Hiroshima, HIROSHIMA	28	98.0	0.11 ± 0.023	0.06 ± 0.016
Matsuyama, EHIME	29	171.0	0.03 ± 0.016	0.02 ± 0.022
Takamatsu, KAGAWA	33	66.5	0.01 ± 0.016	0.04 ± 0.023
Dazaifu, FUKUOKA	29	116.9	0.01 ± 0.018	0.05 ± 0.016
Saga, SAGA	29	124.0	0.03 ± 0.018	0.03 ± 0.022
Nagasaki, NAGASAKI	29	135.0	0.03 ± 0.015	0.03 ± 0.014
Ooita, OOITA	29	83.5	0.04 ± 0.021	0.00 ± 0.022
Miyazaki, MIYAZAKI	29	99.5	0.00 ± 0.017	0.09 ± 0.025
Yonagusuku-mura, OKINAWA	27	121.0	0.01 ± 0.016	0.01 ± 0.014
February, 1989				
Sapporo, HOKKAIDO	29	14.0	0.04 ± 0.016	0.06 ± 0.025
Aomori, AOMORI	29	39.0	0.03 ± 0.021	0.05 ± 0.018
Onagawa-machi, MIYAGI	31	95.7	0.01 ± 0.025	0.06 ± 0.020
Morioka, IWATE	29	42.5	0.02 ± 0.021	0.05 ± 0.017
Yamagata, YAMAGATA	29	46.3	0.01 ± 0.021	0.07 ± 0.020
Ookuma-machi, FUKUSHIMA	29	108.5	0.07 ± 0.019	0.25 ± 0.032
Mito, IBARAGI	29	141.5	0.003 ± 0.018	0.03 ± 0.021
Shinjuku, TOKYO	29	138.3	0.04 ± 0.024	0.04 ± 0.017
Yokohama, KANAGAWA	29	139.3	0.05 ± 0.022	0.16 ± 0.023
Utsunomiya, TOCHIGI	29	94.4	0.02 ± 0.019	0.04 ± 0.015
KKosugi-machi, TOYAMA	29	221.0	0.00 ± 0.019	0.22 ± 0.024

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
Fukui, FUKUI	29	213.8	0.05 ±0.084	0.14 ±0.083
Shizuoka, SHIZUOKA	29	323.5	0.04 ±0.021	0.07 ±0.015
Nagoya, AICHI	29	163.7	0.004±0.020	0.09 ±0.018
Tsu, MIE	29	134.0	0.08 ±0.027	0.08 ±0.023
Kyoto, KYOTO	29	109.4	0.01 ±0.019	0.02 ±0.013
Kobe, HYOGO	29	128.1	0.03 ±0.019	0.08 ±0.018
Wakayama, WAKAYAMA	34	230.6	0.00 ±0.020	0.03 ±0.015
Tottori, TOTTORI	29	268.9	0.10 ±0.027	0.04 ±0.017
Matsue, SHIMANE	29	183.5	0.02 ±0.008	0.06 ±0.016
Hiroshima, HIROSHIMA	29	143.5	0.08 ±0.022	0.02 ±0.014
Matsuyama, EHIME	29	128.0	0.03 ±0.019	0.01 ±0.022
Takamatsu, KAGAWA	29	99.0	0.03 ±0.017	0.04 ±0.023
Dazaifu, FUKUOKA	29	176.6	0.05 ±0.020	0.03 ±0.022
Saga, SAGA	29	164.2	0.03 ±0.013	0.03 ±0.014
Nagasaki, NAGASAKI	29	191.5	0.04 ±0.020	0.05 ±0.022
Ooita, OOITA	29	34.5	0.02 ±0.021	0.03 ±0.025
Miyazaki, MIYAZAKI	29	113.1	0.002±0.010	0.16 ±0.027
Yonagusuku-mura, OKINAWA	29	13.0	0.00 ±0.021	0.07 ±0.031
March, 1989				
Sapporo, HOKKAIDO	31	30.0	0.04 ±0.027	0.07 ±0.025
Aomori, AOMORI	32	38.5	0.17 ±0.026	0.16 ±0.027
Onagawa-machi, MIYAGI	33	49.4	0.06 ±0.017	0.180±0.027
Morioka, IWATE	31	50.3	0.04 ±0.020	0.08 ±0.018
Yamagata, YAMAGATA	32	47.6	0.03 ±0.016	0.13 ±0.029
Ookuma-machi, FUKUSHIMA	31	83.1	0.01 ±0.018	0.11 ±0.019
Mito, IBARAGI	32	97.5	0.04 ±0.017	0.13 ±0.026
Shinjuku, TOKYO	32	114.9	0.05 ±0.023	0.05 ±0.018
Yokohama, KANAGAWA	32	163.1	0.05 ±0.016	0.17 ±0.029
Utsunomiya, TOCHIGI	32	100.1	0.04 ±0.018	0.07 ±0.015
KKosugi-machi, TOYAMA	32	119.5	0.05 ±0.019	0.25 ±0.028
Fukui, FUKUI	35	141.2	0.00 ±0.078	0.23 ±0.081
Koufu, YAMANASHI	32	92.0	0.02 ±0.017	0.11 ±0.025
Shizuoka, SHIZUOKA	34	397.5	0.00 ±0.017	0.11 ±0.019
Nagoya, AICHI	32	92.7	0.00 ±0.019	0.04 ±0.015
Tsu, MIE	32	79.5	0.00 ±0.019	0.25 ±0.026
Kyoto, KYOTO	32	45.6	0.003±0.019	0.04 ±0.015
Kobe, HYOGO	32	58.9	0.04 ±0.019	0.08 ±0.026
Wakayama, WAKAYAMA	29	64.8	0.05 ±0.023	0.06 ±0.017
Tottori, TOTTORI	32	105.4	0.08 ±0.019	0.16 ±0.029

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
Matsue, SHIMANE	32	80.3	0.01 ±0.008	0.12 ±0.018
Hiroshima, HIROSHIMA	32	80.0	0.08 ±0.022	0.03 ±0.013
Matsuyama, EHIME	32	73.5	0.01 ±0.017	0.03 ±0.023
Takamatsu, KAGAWA	32	48.5	0.003±0.010	0.04 ±0.022
Dazaifu, FUKUOKA	31	139.9	0.05 ±0.026	0.11 ±0.022
Saga, SAGA	32	100.5	0.03 ±0.013	0.04 ±0.014
Nagasaki, NAGASAKI	32	152.5	0.03 ±0.015	0.06 ±0.024
Miyazaki, MIYAZAKI	32	65.9	0.02 ±0.018	0.22 ±0.029
Yonagusuku-mura, OKINAWA	32	43.0	0.03 ±0.019	0.09 ±0.024
April, 1989				
Sapporo, HOKKAIDO	32	47.0	0.05 ±0.018	0.09 ±0.027
Aomori, AOMORI	31	62.5	0.19 ±0.028	0.12 ±0.027
Yamagata, YAMAGATA	31	154.3	0.02 ±0.020	0.21 ±0.024
Ookuma-machi, FUKUSHIMA	32	186.0	0.03 ±0.016	0.11 ±0.026
Mito, IBARAGI	31	137.0	0.02 ±0.019	0.09 ±0.024
Shinjuku, TOKYO	31	176.3	0.07 ±0.025	0.10 ±0.025
Yokohama, KANAGAWA	32	235.9	0.03 ±0.021	0.35 ±0.032
Utsunomiya, TOCHIGI	31	211.3	0.00 ±0.020	0.14 ±0.027
KKosugi-machi, TOYAMA	31	84.0	0.07 ±0.020	0.13 ±0.022
Fukui, FUKUI	30	122.7	0.11 ±0.100	0.03 ±0.072
Shizuoka, SHIZUOKA	29	262.0	0.03 ±0.019	0.18 ±0.025
Nagoya, AICHI	31	160.3	0.03 ±0.020	0.07 ±0.019
Tsu, MIE	31	141.0	0.01 ±0.019	0.17 ±0.027
Kobe, HYOGO	29	78.7	0.00 ±0.021	0.05 ±0.023
Tottori, TOTTORI	31	74.9	0.14 ±0.029	0.15 ±0.030
Hiroshima, HIROSHIMA	31	54.2	0.11 ±0.025	0.05 ±0.015
Matsuyama, EHIME	31	48.0	0.04 ±0.021	0.05 ±0.016
Takamatsu, KAGAWA	31	49.5	0.05 ±0.017	0.09 ±0.025
Dazaifu, FUKUOKA	32	32.4	0.03 ±0.024	0.04 ±0.022
Saga, SAGA	31	33.4	0.05 ±0.024	0.05 ±0.018
Nagasaki, NAGASAKI	31	36.0	0.08 ±0.027	0.02 ±0.017
Miyazaki, MIYAZAKI	31	182.4	0.06 ±0.023	0.36 ±0.029
Yonagusuku-mura, OKINAWA	29	68.5	0.00 ±0.018	0.04 ±0.016
May, 1989				
Sapporo, HOKKAIDO	32	41.5	0.05 ±0.024	0.09 ±0.019
Yamagata, YAMAGATA	32	84.0	0.02 ±0.014	0.03 ±0.025
Ookuma-machi, FUKUSHIMA	32	143.4	0.02 ±0.018	0.08 ±0.019
Mito, IBARAGI	32	148.0	0.01 ±0.018	0.06 ±0.018
Shinjuku, TOKYO	32	197.8	0.05 ±0.021	0.04 ±0.024

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
Yokohama, KANAGAWA	31	157.0	0.06 ± 0.017	0.07 ± 0.024
Utsunomiya, TOCHIGI	32	193.5	0.03 ± 0.014	0.07 ± 0.024
KKosugi-machi, TOYAMA	32	105.0	0.03 ± 0.019	0.14 ± 0.022
Fukui, FUKUI	32	110.5	0.00 ± 0.054	0.00 ± 0.11
Shizuoka, SHIZUOKA	32	180.5	0.01 ± 0.018	0.06 ± 0.018
Nagoya, AICHI	32	193.5	0.02 ± 0.019	0.09 ± 0.020
Tsu, MIE	32	269.5	0.03 ± 0.020	0.05 ± 0.017
Kobe, HYOGO	34	138.8	0.02 ± 0.013	0.04 ± 0.024
Tottori, TOTTORI	32	127.6	0.10 ± 0.021	0.06 ± 0.026
Hiroshima, HIROSHIMA	32	151.9	0.08 ± 0.018	0.03 ± 0.023
Matsuyama, EHIME	32	181.0	0.03 ± 0.014	0.02 ± 0.022
Takamatsu, KAGAWA	32	171.0	0.05 ± 0.018	0.03 ± 0.023
Dazaifu, FUKUOKA	31	194.7	0.02 ± 0.014	0.06 ± 0.025
Saga, SAGA	32	228.0	0.08 ± 0.023	0.05 ± 0.018
Nagasaki, NAGASAKI	32	236.5	0.03 ± 0.019	0.06 ± 0.024
Miyazaki, MIYAZAKI	32	405.5	0.00 ± 0.016	0.63 ± 0.041
Yonagusuku-mura, OKINAWA	34	310.0	0.03 ± 0.014	0.01 ± 0.022
June, 1989				
Yamagata, YAMAGATA	31	66.8	0.01 ± 0.020	0.00 ± 0.014
Shinjuku, TOKYO	31	228.5	0.03 ± 0.014	0.00 ± 0.021
Yokohama, KANAGAWA	32	265.2	0.03 ± 0.015	0.07 ± 0.025
Fukui, FUKUI	30	160.4	0.19 ± 0.074	0.02 ± 0.064
Tsu, MIE	31	369.0	0.004 ± 0.019	0.03 ± 0.016
Kobe, HYOGO	31	230.8	0.03 ± 0.020	0.01 ± 0.015
Tottori, TOTTORI	34	98.9	0.15 ± 0.024	0.01 ± 0.023
Hiroshima, HIROSHIMA	31	132.8	0.07 ± 0.017	0.03 ± 0.013
Matsuyama, EHIME	31	128.5	0.01 ± 0.013	0.06 ± 0.016
Takamatsu, KAGAWA	31	97.0	0.00 ± 0.017	0.01 ± 0.015
Dazaifu, FUKUOKA	31	123.0	0.02 ± 0.015	0.03 ± 0.024
Saga, SAGA	33	208.9	0.03 ± 0.020	0.01 ± 0.014
Nagasaki, NAGASAKI	31	212.5	0.09 ± 0.024	0.07 ± 0.024
Miyazaki, MIYAZAKI	31	298.1	0.02 ± 0.014	0.06 ± 0.016
Yonagusuku-mura, OKINAWA	31	122.0	0.004 ± 0.013	0.02 ± 0.013
July, 1989				
Yamagata, YAMAGATA	32	43.7	0.00 ± 0.017	0.04 ± 0.017

(1)-2 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for WHO program)
(from Nov. 1988 to Jul. 1989)

-continued from NO. 86 of this publication-

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

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
November, 1988				
Niigata, NIIGATA	31	278.7	0.01 ± 0.019	0.05 ± 0.017
December, 1988				
Niigata, NIIGATA	35	142.1	0.02 ± 0.020	0.10 ± 0.019
Nagano, NAGANO	35	13.2	0.05 ± 0.023	0.00 ± 0.021
Yamaguchi, YAMAGUCHI	34	22.5	0.02 ± 0.020	0.03 ± 0.014
January, 1989				
Akita, AKITA	34	115.0	0.09 ± 0.023	0.11 ± 0.020
Niigata, NIIGATA	29	90.6	0.05 ± 0.018	0.07 ± 0.025
Kanazawa, ISHIKAWA	35	196.0	0.06 ± 0.020	0.07 ± 0.016
Nagano, NAGANO	29	70.4	0.00 ± 0.016	0.01 ± 0.022
Okayama, OKAYAMA	28	64.8	0.05 ± 0.020	0.08 ± 0.017
Yamaguchi, YAMAGUCHI	30	112.5	0.03 ± 0.021	0.02 ± 0.014
Kochi, KOCHI	28	187.9	0.15 ± 0.024	0.10 ± 0.018
Kagoshima, KAGOSHIMA	36	138.0	0.16 ± 0.024	0.07 ± 0.027
February, 1989				
Akita, AKITA	29	72.8	0.05 ± 0.022	0.06 ± 0.020
Niigata, NIIGATA	29	67.2	0.07 ± 0.019	0.07 ± 0.024
Kanazawa, ISHIKAWA	29	242.0	0.02 ± 0.021	0.12 ± 0.021
Nagano, NAGANO	29	82.8	0.03 ± 0.018	0.04 ± 0.023
Osaka, OSAKA	29	210.3	0.02 ± 0.018	0.04 ± 0.015
Okayama, OKAYAMA	29	135.8	0.02 ± 0.025	0.03 ± 0.016
Yamaguchi, YAMAGUCHI	28	180.0	0.05 ± 0.023	0.03 ± 0.024
Kochi, KOCHI	29	158.5	0.07 ± 0.022	0.06 ± 0.023
Kagoshima, KAGOSHIMA	29	217.5	0.07 ± 0.017	0.04 ± 0.024
March, 1989				
Akita, AKITA	32	158.8	0.04 ± 0.024	0.08 ± 0.021
Niigata, NIIGATA	32	80.3	0.06 ± 0.021	0.10 ± 0.018
Kanazawa, ISHIKAWA	31	134.5	0.04 ± 0.016	0.11 ± 0.026
Nagano, NAGANO	32	55.4	0.02 ± 0.013	0.03 ± 0.023
Osaka, OSAKA	32	119.1	0.04 ± 0.018	0.06 ± 0.018
Okayama, OKAYAMA	32	60.8	0.01 ± 0.024	0.08 ± 0.020

Location	Duration (days)	Precipitation (mm)	^{90}Sr (MBq/Km^2)	^{137}Cs (MBq/Km^2)
Yamaguchi, YAMAGUCHI	32	110.5	0.01 ± 0.012	0.08 ± 0.017
Kochi, KOCHI	34	264.2	0.13 ± 0.022	0.08 ± 0.025
Kagoshima, KAGOSHIMA	29	112.5	0.23 ± 0.025	0.08 ± 0.017
April, 1989				
Akita, AKITA	31	200.9	0.03 ± 0.026	0.30 ± 0.031
Kanazawa, ISHIKAWA	29	103.0	0.07 ± 0.024	0.12 ± 0.022
Nagano, NAGANO	31	83.6	0.03 ± 0.022	0.05 ± 0.024
Osaka, OSAKA	32	92.2	0.01 ± 0.019	0.05 ± 0.015
Okayama, OKAYAMA	31	56.0	0.02 ± 0.024	0.02 ± 0.022
Yamaguchi, YAMAGUCHI	31	60.5	0.01 ± 0.022	0.00 ± 0.022
Kochi, KOCHI	29	167.4	0.13 ± 0.029	0.05 ± 0.022
Kagoshima, KAGOSHIMA	31	47.5	0.12 ± 0.022	0.13 ± 0.020
May, 1989				
Akita, AKITA	32	36.8	0.02 ± 0.015	0.07 ± 0.025
Kanazawa, ISHIKAWA	34	126.5	0.03 ± 0.015	0.11 ± 0.025
Nagano, NAGANO	32	106.9	0.02 ± 0.012	0.04 ± 0.014
Osaka, OSAKA	31	204.7	0.02 ± 0.012	0.06 ± 0.023
Okayama, OKAYAMA	32	184.2	0.001 ± 0.012	0.05 ± 0.024
Yamaguchi, YAMAGUCHI	32	195.5	0.03 ± 0.015	0.02 ± 0.022
Kochi, KOCHI	32	289.0	0.06 ± 0.021	0.05 ± 0.024
Kagoshima, KAGOSHIMA	34	292.0	0.08 ± 0.019	0.10 ± 0.019
June, 1989				
Akita, AKITA	30	82.4	0.03 ± 0.021	0.01 ± 0.013
Kanazawa, ISHIKAWA	31	125.0	0.04 ± 0.020	0.01 ± 0.021
Nagano, NAGANO	31	99.1	0.02 ± 0.012	0.02 ± 0.013
Osaka, OSAKA	31	189.5	0.02 ± 0.012	0.04 ± 0.014
Okayama, OKAYAMA	31	121.3	0.04 ± 0.021	0.03 ± 0.021
Yamaguchi, YAMAGUCHI	31	209.5	0.03 ± 0.020	0.06 ± 0.018
Kochi, KOCHI	33	456.4	0.08 ± 0.023	0.02 ± 0.020
July, 1989				
Osaka, OSAKA	32	106.7	0.05 ± 0.022	0.03 ± 0.016

(2) Strontium-90 and Cesium-137 in Airborne Dust
(from Jul. 1988 to Jan. 1989)

-continued from NO. 86 of this publication-

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

Location	Sampling period	Absorption volume (m^3)	^{90}Sr (mBq/m^3)	^{137}Cs (mBq/m^3)
July～September, 1988				
Morioka, IWATE	7～9	14,032	0.000 ± 0.0005	0.0002 ± 0.0006
October～December, 1988				
Morioka, IWATE	10～12	12,915	0.0003 ± 0.0005	0.000 ± 0.0005
Ookuma-machi, FUKUSHIMA	10～12	11,858	0.0003 ± 0.0006	0.000 ± 0.0006
Utsunomiya, TOCHIGI	10～12	9,954	0.000 ± 0.0007	0.001 ± 0.0008
Niigata, NIIGATA	10～12	10,968	0.000 ± 0.0005	0.002 ± 0.0007
Nagano, NAGANO	10～12	15,662	0.0005 ± 0.0005	0.0004 ± 0.0005
Kyoto, KYOTO	10～12	5,258	0.000 ± 0.0012	0.001 ± 0.0016
November, 1989 ～January, 1989				
Yamaguchi, YAMAGUCHI	11～1	4,927	0.002 ± 0.0016	0.000 ± 0.0015

(3) Strontium-90 and Cesium-137 in Service Water
(from Nov. 1988 to Jul. 1989)

-continued from NO. 86 of this publication-

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

Location	pH	^{90}Sr (mBq/ ℓ)	^{137}Cs (mBq/ ℓ)
(Source Water)			
December, 1988			
Inuyama, AICHI	6.9	2.9 ±0.21	0.4 ±0.12
January, 1989			
Sapporo, HOKKAIDO	7.1	2.1 ±0.20	0.2 ±0.07
Nagano, NAGANO	7.1	1.3 ±0.18	0.1 ±0.11
Kyoto, KYOTO	7.5	4.7 ±0.25	0.2 ±0.11
June, 1989			
Katsushika, TOKYO	7.3	1.9 ±0.16	0.3 ±0.12
Tsukui-machi, KANAGAWA	8.2	0.4 ±0.11	0.1 ±0.11
Nagano, NAGANO	7.1	1.1 ±0.15	0.2 ±0.11
Moriguchi, OSAKA	7.2	5.0 ±0.26	0.1 ±0.08
Fukuoka, FUKUOKA	7.0	2.0 ±0.17	0.2 ±0.11
July, 1989			
Sapporo, HOKKAIDO	7.1	1.7 ±0.16	0.5 ±0.13
(Tap Water)			
November, 1988			
Tsu, MIE	6.9	2.5 ±0.18	0.0 ±0.06
December, 1988			
Morioka, IWATE	7.2	1.6 ±0.15	0.04 ±0.11
Utsunomiya, TOCHIGI	7.1	0.6 ±0.13	0.1 ±0.12
Niigata, NIIGATA	7.0	4.0 ±0.22	0.1 ±0.11
Nagano, NAGANO	7.2	0.8 ±0.14	0.2 ±0.11
Koufu, YAMANASHI	7.5	1.2 ±0.15	0.03 ±0.06
Shizuoka, SHIZUOKA	7.6	1.1 ±0.14	0.01 ±0.06
Nagoya, AICHI	6.8	2.8 ±0.22	0.5 ±0.13
Matsue, SHIMANE	7.0	4.0 ±0.22	0.2 ±0.12
January, 1989			
Kyoto, KYOTO	7.4	5.4 ±0.27	0.0 ±0.11
February, 1989			
Tsu, MIE	6.9	2.2 ±0.17	0.1 ±0.07

Location	pH	^{90}Sr (mBq/ℓ)	^{137}Cs (mBq/ℓ)
Sshinguu, WAKAYAMA	6.8	1.1 ±0.15	0.2 ±0.11
June, 1989			
Wakkanai, HOKKAIDO	6.7	1.7 ±0.17	0.0 ±0.10
Yamagata, YAMAGATA	7.2	2.4 ±0.26	0.02 ±0.13
Fukushima, FUKUSHIMA	6.9	3.9 ±0.21	0.1 ±0.11
Katsushika, TOKYO	7.3	2.1 ±0.17	0.2 ±0.11
Yokohama, KANAGAWA	6.9	0.5 ±0.11	0.1 ±0.11
Utsunomiya, TOCHIGI	7.2	0.8 ±0.12	0.2 ±0.11
KKosugi-machi, TOYAMA	7.2	1.7 ±0.16	0.2 ±0.11
Kanazawa, ISHIKAWA	7.5	1.8 ±0.43	0.1 ±0.08
Fukui, FUKUI	6.9	0.9 ±0.15	0.02 ±0.07
Nagano, NAGANO	7.0	1.1 ±0.14	0.02 ±0.10
Shizuoka, SHIZUOKA	8.0	1.4 ±0.15	0.0 ±0.07
Osaka, OSAKA	6.9	3.9 ±0.22	0.1 ±0.07
Kobe, HYOGO	7.6	3.5 ±0.21	0.1 ±0.08
Tottori, TOTTORI	7.6	2.9 ±0.20	0.02 ±0.11
Okayama, OKAYAMA	6.8	2.9 ±0.19	0.0 ±0.10
Hiroshima, HIROSHIMA	7.0	2.4 ±0.19	0.0 ±0.10
Ube, YAMAGUCHI	6.5	2.1 ±0.19	0.1 ±0.11
Matsuyama, EHIME	7.8	1.8 ±0.17	0.1 ±0.11
Kochi, KOCHI	7.0	1.7 ±0.15	0.0 ±0.10
Takamatsu, KAGAWA	7.3	3.2 ±0.26	0.0 ±0.10
Fukuoka, FUKUOKA	6.9	3.1 ±0.20	0.1 ±0.11
Saga, SAGA	7.5	1.7 ±0.20	0.0 ±0.10
Nagasaki, NAGASAKI	7.0	1.8 ±0.16	0.05 ±0.10
Miyazaki, MIYAZAKI	7.0	1.5 ±0.18	0.04 ±0.10
Kagoshima, KAGOSHIMA	6.8	0.6 ±0.12	0.2 ±0.12

(4) Strontium-90 and Cesium-137 in Freshwater
(from Nov. 1988 to Jul. 1989)

-continued from NO. 86 of this publication-

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

Location	pH	^{90}Sr (mBq/ℓ)	^{137}Cs (mBq/ℓ)
(Freshwater)			
November, 1988			
Toyanogata, NIIGATA	6.6	5.3 ± 0.25	0.8 ± 0.14
December, 1988			
Uji, KYOTO	6.3	0.02 ± 0.09	0.0 ± 0.11
May, 1989			
Kasumigaura, IBARAGI	9.0	3.6 ± 0.22	0.6 ± 0.13
July, 1989			
Barato-lake, HOKKAIDO	8.3	3.2 ± 0.21	0.6 ± 0.13

(5) Strontium-90 and Cesium-137 in Soil
(Aug. 1988)

-continued from NO. 86 of this publication-

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

Location	Sampling Depth (cm)	^{90}Sr (Bq/Kg) (dried Soil)	^{90}Sr (MBq/Km^2)	^{137}Cs (Bq/Kg) (dried Soil)	^{137}Cs (MBq/Km^2)
August, 1988					
Tsu, MIE	0～5	0.6 ± 0.11	36 ± 6.2	3.1 ± 0.21	180 ± 12
〃	5～20	0.3 ± 0.08	44 ± 13	0.6 ± 0.13	88 ± 20

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

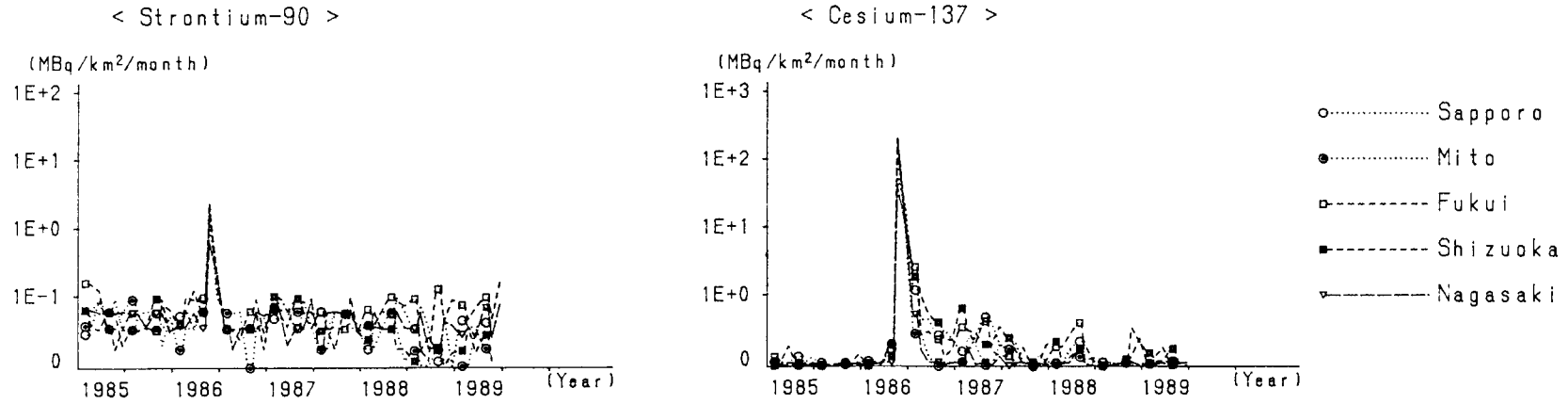

Fig.1-1

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

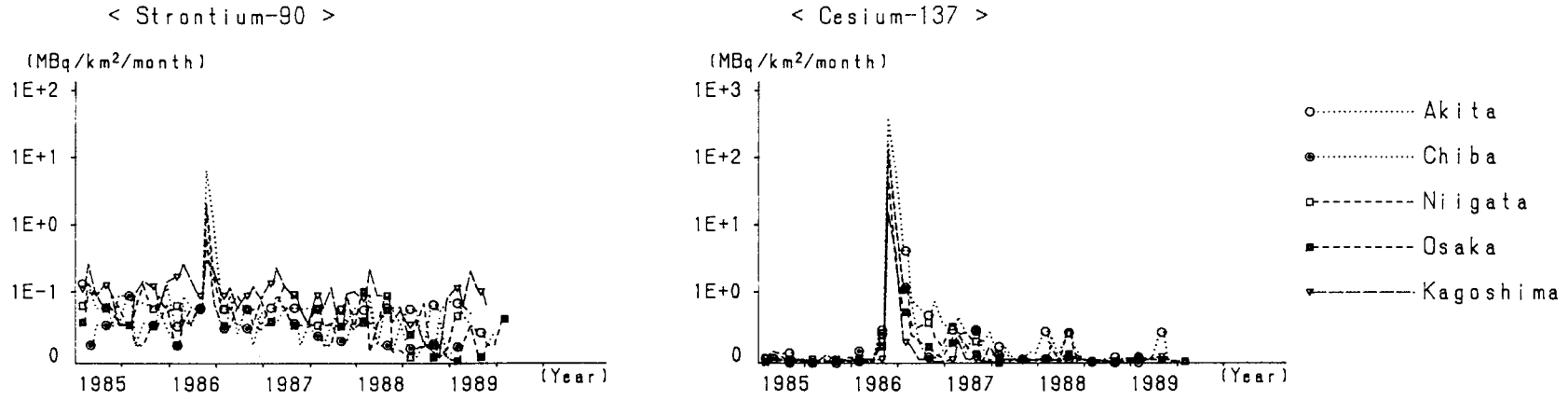

Fig. 1-2

＊＊＊　Airborne Dust　＊＊＊

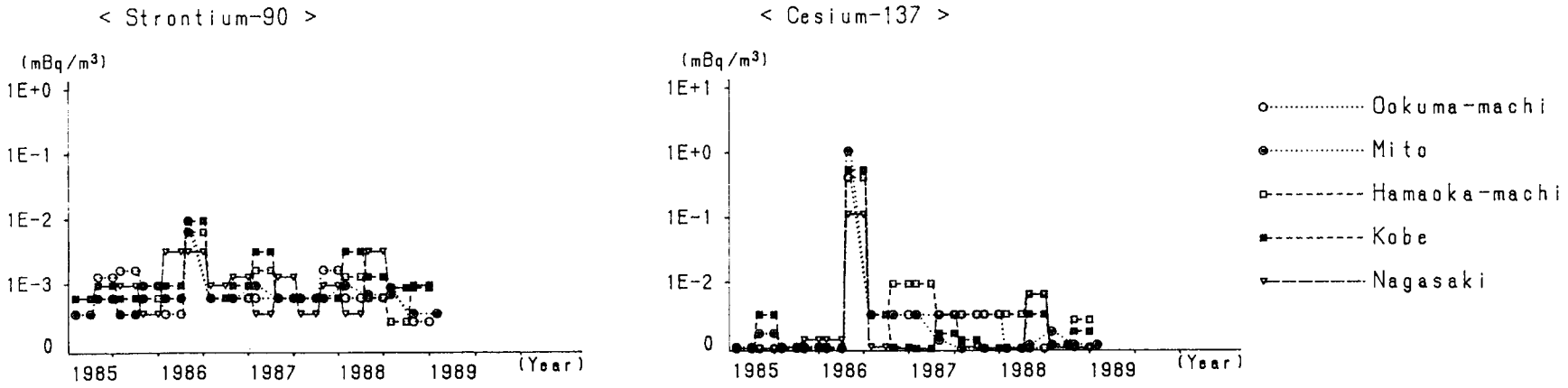

Fig.2

* * * Tap water * * *

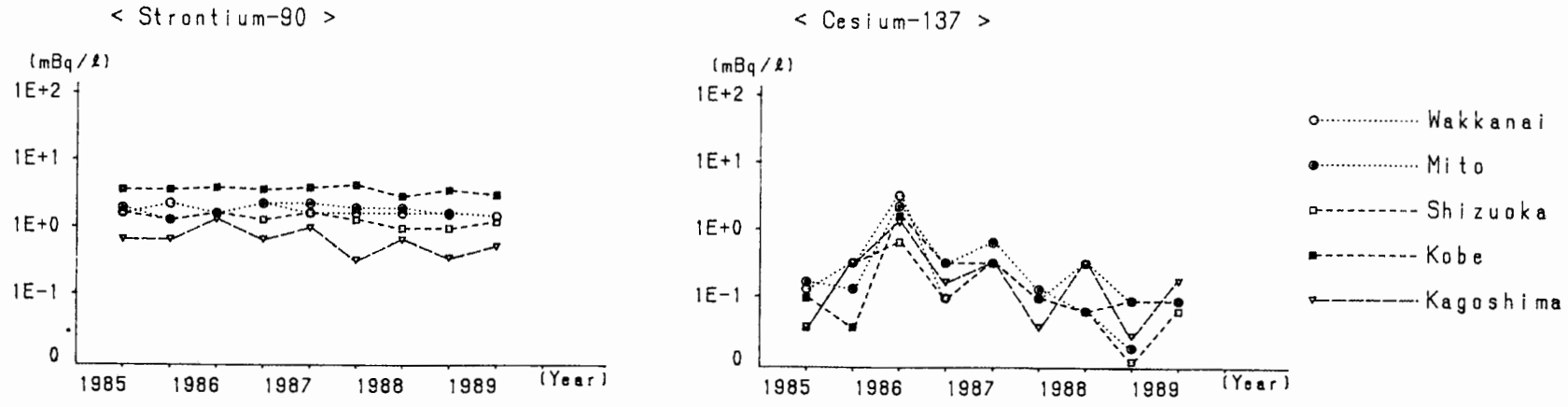

Fig.3

＊＊＊　Freshwater　＊＊＊

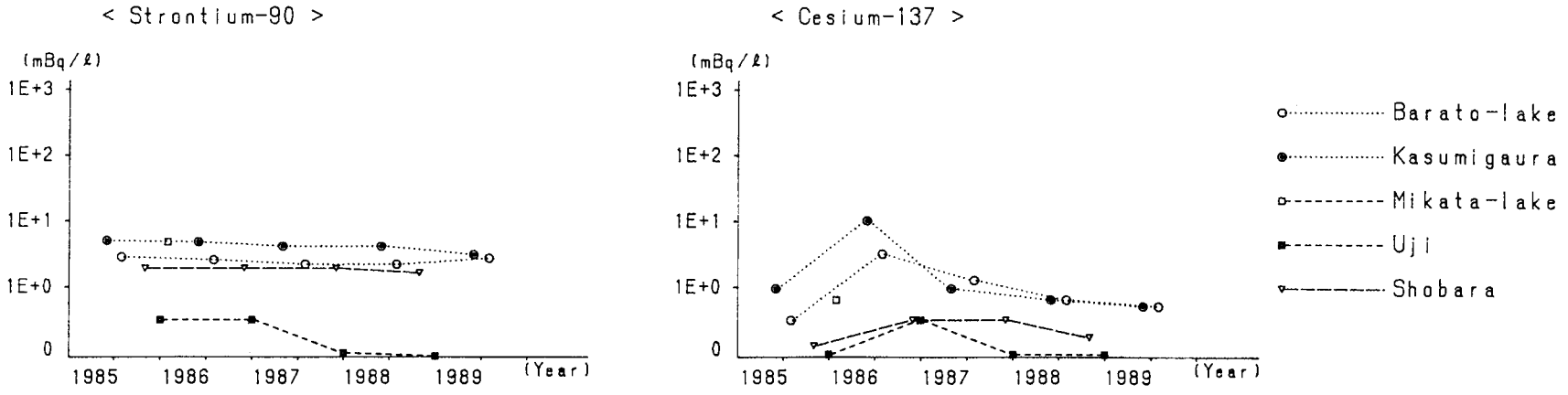

Fig.4

* * *　Soil　* * *

Sampling Depth (0~5cm)

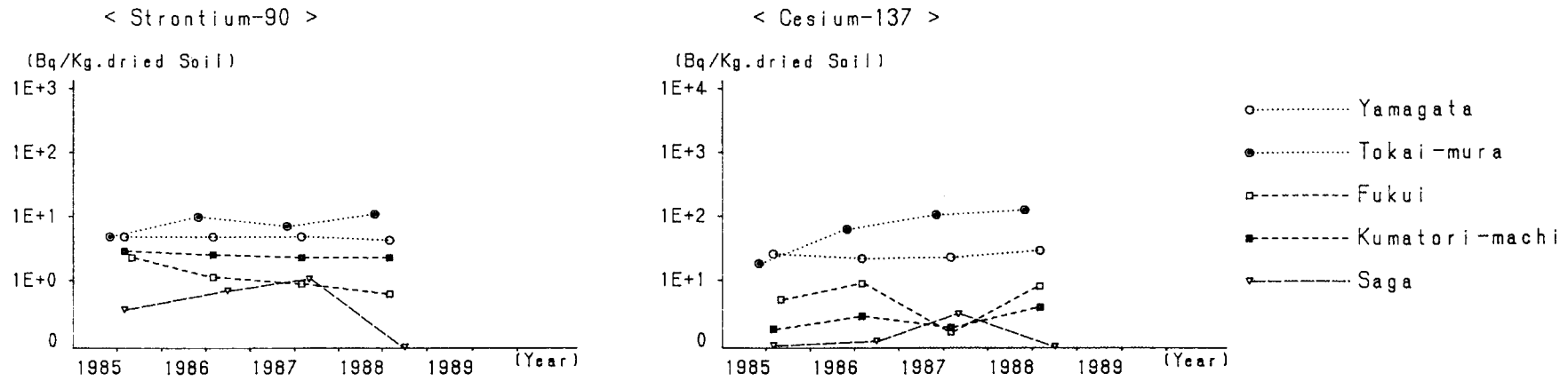

Fig.5-1

＊ ＊ ＊　　Soil　　＊ ＊ ＊

Sampling Depth (5~20cm)

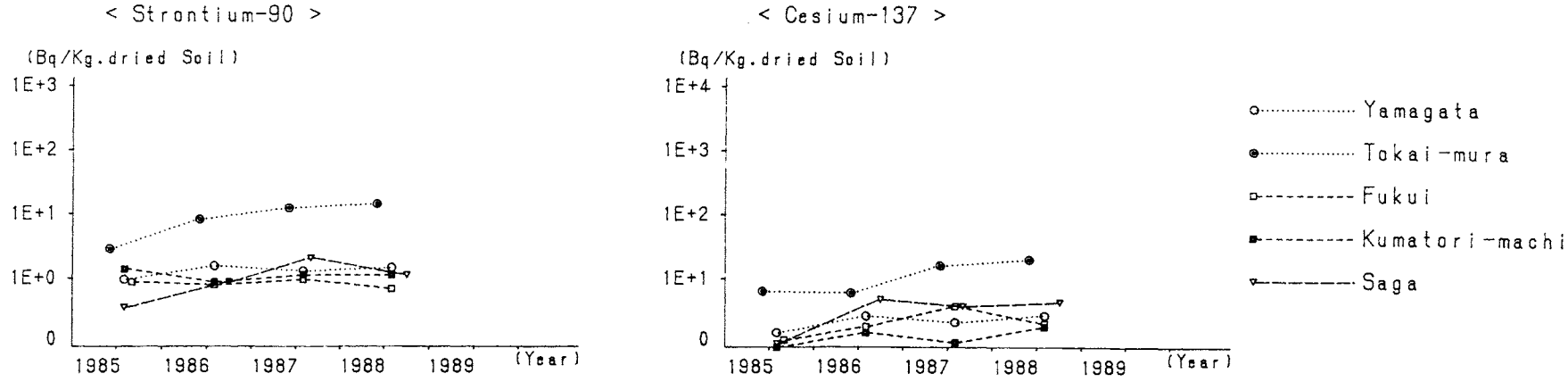

Fig.5-2

** Sampling Locations in Japan **

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