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RADIOACTIVITY SURVEY DATA in Japan

Part 1
= Environmental Materials =

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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.

6. Results

(1)-1 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for domestic program)
(from Sep. 1987 to Jun. 1988)

-continued from NO. 82 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)
September, 1987				
Matsue, SHIMANE	30	51.3	0.000 ± 0.0005	0.001 ± 0.0005
October, 1987				
Matsue, SHIMANE	32	135.4	0.001 ± 0.0005	0.002 ± 0.0005
November, 1987				
Matsue, SHIMANE	31	83.7	0.001 ± 0.0006	0.002 ± 0.0005
Saga, SAGA	33	77.3	0.003 ± 0.0006	0.000 ± 0.0004
December, 1987				
Nagoya, AICHI	36	15.0	0.000 ± 0.0005	0.001 ± 0.0005
Kyoto, KYOTO	35	12.6	0.001 ± 0.0006	0.001 ± 0.0005
Matsue, SHIMANE	31	67.3	0.002 ± 0.0005	0.003 ± 0.0006
January, 1988				
Sapporo, HOKKAIDO	36	43.5	0.000 ± 0.0005	0.002 ± 0.0006
Aomori, AOMORI	30	69.5	0.002 ± 0.0006	0.005 ± 0.0007
Yamagata, YAMAGATA	29	85.7	0.001 ± 0.0005	0.004 ± 0.0007
Mito, IBARAGI	28	19.0	0.001 ± 0.0005	0.001 ± 0.0005
Shinjuku, TOKYO	29	31.7	0.001 ± 0.0005	0.002 ± 0.0005
Yokohama, KANAGAWA	33	36.9	0.001 ± 0.0005	0.007 ± 0.0007
Utsunomiya, TOCHIGI	29	27.0	0.000 ± 0.0005	0.003 ± 0.0006
Kosugi-machi, TOYAMA	29	275.5	0.000 ± 0.0020	0.006 ± 0.0020
Fukui, FUKUI	29	259.8	0.002 ± 0.0006	0.005 ± 0.0006
Kouhu, YAMANASHI	32	190.0	0.000 ± 0.0024	0.011 ± 0.0029
Shizuoka, SHIZUOKA	28	27.5	0.000 ± 0.0007	0.006 ± 0.0007
Nagoya, AICHI	28	22.7	0.001 ± 0.0006	0.000 ± 0.0005
Kyoto, KYOTO	29	30.7	0.000 ± 0.0005	0.001 ± 0.0005
Kobe, HYOGO	32	29.8	0.001 ± 0.0005	0.003 ± 0.0006
Wakayama, WAKAYAMA	28	27.3	0.001 ± 0.0005	0.002 ± 0.0005
Tottori, TOTTORI	28	94.3	0.003 ± 0.0006	0.006 ± 0.0007
Matsue, SHIMANE	32	61.4	0.002 ± 0.0006	0.006 ± 0.0007
Matsuyama, EHIME	29	43.5	0.000 ± 0.0005	0.002 ± 0.0005
Dazaifu, FUKUOKA	29	47.3	0.001 ± 0.0006	0.001 ± 0.0006

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Saga, SAGA	29	35.7	0.001 ± 0.0005	0.002 ± 0.0005
Nagasaki, NAGASAKI	29	52.0	0.001 ± 0.0005	0.000 ± 0.0005
Ooita, OOITA	32	11.0	0.000 ± 0.0006	0.000 ± 0.0005
Yonagusuku-mura, OKINAWA	28	96.0	0.001 ± 0.0006	0.002 ± 0.0005
February, 1988				
Sapporo, HOKKAIDO	30	66.5	0.001 ± 0.0005	0.001 ± 0.0005
Aomori, AOMORI	30	103.5	0.002 ± 0.0006	0.004 ± 0.0006
Onagawa-machi, MIYAGI	31	22.9	0.001 ± 0.0006	0.003 ± 0.0006
Morioka, IWATE	16	0.5	0.000 ± 0.0023	0.000 ± 0.0018
Yamagata, YAMAGATA	30	59.2	0.001 ± 0.0005	0.004 ± 0.0006
Ookuma-machi, FUKUSHIMA	29	4.6	0.001 ± 0.0006	0.005 ± 0.0007
Mito, IBARAGI	30	3.5	0.000 ± 0.0005	0.001 ± 0.0005
Shinjuku, TOKYO	30	22.0	0.000 ± 0.0005	0.001 ± 0.0005
Yokohama, KANAGAWA	29	21.6	0.002 ± 0.0006	0.003 ± 0.0006
Utsunomiya, TOCHIGI	30	3.5	0.002 ± 0.0006	0.007 ± 0.0008
Kosugi-machi, TOYAMA	30	108.5	0.001 ± 0.0005	0.004 ± 0.0007
Fukui, FUKUI	29	189.5	0.001 ± 0.0005	0.005 ± 0.0007
Kouhu, YAMANASHI	30	215.0	0.000 ± 0.0005	0.000 ± 0.0005
Shizuoka, SHIZUOKA	30	65.0	0.002 ± 0.0006	0.003 ± 0.0006
Nagoya, AICHI	30	50.1	0.001 ± 0.0005	0.003 ± 0.0006
Kyoto, KYOTO	31	34.8	0.001 ± 0.0005	0.002 ± 0.0005
Kobe, HYOGO	33	14.1	0.000 ± 0.0004	0.005 ± 0.0007
Wakayama, WAKAYAMA	29	18.8	0.000 ± 0.0005	0.002 ± 0.0006
Tottori, TOTTORI	30	192.6	0.004 ± 0.0007	0.006 ± 0.0007
Matsue, SHIMANE	31	95.4	0.001 ± 0.0005	0.006 ± 0.0008
Hiroshima, HIROSHIMA	32	46.8	0.004 ± 0.0007	0.002 ± 0.0005
Matsuyama, EHIME	30	43.0	0.001 ± 0.0005	0.002 ± 0.0005
Dazaifu, FUKUOKA	30	38.0	0.000 ± 0.0005	0.002 ± 0.0005
Saga, SAGA	30	49.4	0.000 ± 0.0005	0.000 ± 0.0004
Nagasaki, NAGASAKI	30	59.5	0.001 ± 0.0005	0.001 ± 0.0005
Ooita, OOITA	30	25.5	0.002 ± 0.0008	0.002 ± 0.0006
Yonagusuku-mura, OKINAWA	29	156.5	0.001 ± 0.0005	0.001 ± 0.0005
March, 1988				
Sapporo, HOKKAIDO	31	31.0	0.002 ± 0.0006	0.005 ± 0.0007
Aomori, AOMORI	30	43.5	0.004 ± 0.0006	0.004 ± 0.0006
Onagawa-machi, MIYAGI	31	115.5	0.002 ± 0.0005	0.004 ± 0.0006
Morioka, IWATE	32	71.0	0.002 ± 0.0006	0.006 ± 0.0008
Yamagata, YAMAGATA	32	41.0	0.001 ± 0.0005	0.008 ± 0.0008
Mito, IBARAGI	32	153.5	0.001 ± 0.0005	0.005 ± 0.0007

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Shinjuku, TOKYO	32	203.9	0.002 ± 0.0005	0.004 ± 0.0007
Yokohama, KANAGAWA	32	213.4	0.002 ± 0.0005	0.008 ± 0.0008
Utsunomiya, TOCHIGI	32	105.7	0.000 ± 0.0004	0.003 ± 0.0006
Fukui, FUKUI	31	193.4	0.002 ± 0.0006	0.008 ± 0.0008
Shizuoka, SHIZUOKA	32	208.5	0.001 ± 0.0005	0.004 ± 0.0007
Kyoto, KYOTO	31	91.9	0.002 ± 0.0005	0.002 ± 0.0006
Kobe, HYOGO	32	63.5	0.001 ± 0.0005	0.001 ± 0.0006
Wakayama, WAKAYAMA	32	102.0	0.002 ± 0.0005	0.003 ± 0.0006
Tottori, TOTTORI	32	181.3	0.004 ± 0.0006	0.007 ± 0.0008
Matsue, SHIMANE	32	100.8	0.002 ± 0.0005	0.009 ± 0.0009
Hiroshima, HIROSHIMA	30	114.9	0.003 ± 0.0006	0.001 ± 0.0005
Matsuyama, EHIME	32	110.0	0.001 ± 0.0005	0.001 ± 0.0005
Dazaifu, FUKUOKA	31	132.5	0.002 ± 0.0006	0.003 ± 0.0006
Saga, SAGA	31	161.8	0.001 ± 0.0005	0.001 ± 0.0009
Nagasaki, NAGASAKI	32	177.0	0.001 ± 0.0005	0.002 ± 0.0005
Yonagusuku-mura, OKINAWA	32	170.0	0.001 ± 0.0005	0.001 ± 0.0004
April, 1988				
Sapporo, HOKKAIDO	33	53.5	0.002 ± 0.0006	0.007 ± 0.0009
Aomori, AOMORI	31	30.5	0.003 ± 0.0006	0.006 ± 0.0008
Onagawa-machi, MIYAGI	28	153.2	0.001 ± 0.0005	0.003 ± 0.0007
Yamagata, YAMAGATA	32	89.5	0.001 ± 0.0006	0.010 ± 0.0010
Ookuma-machi, FUKUSHIMA	31	124.9	0.005 ± 0.0007	0.010 ± 0.0010
Mito, IBARAGI	32	106.0	0.002 ± 0.0006	0.004 ± 0.0006
Shinjuku, TOKYO	32	109.1	0.002 ± 0.0006	0.003 ± 0.0007
Yokohama, KANAGAWA	31	166.3	0.002 ± 0.0005	0.006 ± 0.0008
Utsunomiya, TOCHIGI	32	128.6	0.002 ± 0.0006	0.005 ± 0.0007
Fukui, FUKUI	30	94.0	0.003 ± 0.0030	0.012 ± 0.0032
Shizuoka, SHIZUOKA	32	237.5	0.001 ± 0.0006	0.005 ± 0.0007
Kobe, HYOGO	29	81.4	0.000 ± 0.0005	0.003 ± 0.0006
Tottori, TOTTORI	31	113.0	0.006 ± 0.0007	0.010 ± 0.0010
Hiroshima, HIROSHIMA	32	139.3	0.003 ± 0.0006	0.005 ± 0.0007
Matsuyama, EHIME	32	115.0	0.001 ± 0.0005	0.003 ± 0.0006
Dazaifu, FUKUOKA	33	157.1	0.001 ± 0.0005	0.005 ± 0.0008
Nagasaki, NAGASAKI	32	169.5	0.001 ± 0.0005	0.005 ± 0.0007
Yonagusuku-mura, OKINAWA	33	418.0	0.003 ± 0.0007	0.003 ± 0.0007
May, 1988				
Sapporo, HOKKAIDO	31	80.5	0.003 ± 0.0006	0.003 ± 0.0007
Aomori, AOMORI	33	61.5	0.005 ± 0.0007	0.006 ± 0.0008

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Onagawa-machi, MIYAGI	35	139.2	0.001 ± 0.0005	0.003 ± 0.0007
Yamagata, YAMAGATA	31	76.3	0.001 ± 0.0006	0.007 ± 0.0009
Ookuma-machi, FUKUSHIMA	33	97.4	0.002 ± 0.0005	0.006 ± 0.0007
Mito, IBARAGI	31	178.5	0.001 ± 0.0005	0.003 ± 0.0005
Shinjuku, TOKYO	31	145.4	0.001 ± 0.0004	0.002 ± 0.0005
Yokohama, KANAGAWA	32	135.0	0.002 ± 0.0005	0.005 ± 0.0007
Utsunomiya, TOCHIGI	31	138.1	0.000 ± 0.0004	0.003 ± 0.0005
Fukui, FUKUI	33	211.4	0.000 ± 0.0026	0.000 ± 0.0024
Shizuoka, SHIZUOKA	31	118.5	0.000 ± 0.0005	0.006 ± 0.0008
Kobe, HYOGO	33	162.4	0.000 ± 0.0005	0.004 ± 0.0006
Tottori, TOTTORI	32	146.5	0.005 ± 0.0007	0.004 ± 0.0006
Hiroshima, HIROSHIMA	33	267.0	0.001 ± 0.0005	0.003 ± 0.0007
Matsuyama, EHIME	31	162.0	0.001 ± 0.0005	0.002 ± 0.0006
Dazaifu, FUKUOKA	31	176.9	0.009 ± 0.0010	0.004 ± 0.0007
Nagasaki, NAGASAKI	31	251.5	0.002 ± 0.0005	0.001 ± 0.0005
Yonagusuku-mura, OKINAWA	30	288.0	0.003 ± 0.0006	0.001 ± 0.0005
June, 1988				
Sapporo, HOKKAIDO	31	91.0	0.002 ± 0.0006	0.002 ± 0.0008
Onagawa-machi, MIYAGI	31	242.9	0.001 ± 0.0005	0.001 ± 0.0005
Yamagata, YAMAGATA	31	81.1	0.002 ± 0.0006	0.003 ± 0.0007
Shinjuku, TOKYO	31	235.1	0.001 ± 0.0005	0.000 ± 0.0005
Yokohama, KANAGAWA	31	235.2	0.000 ± 0.0005	0.004 ± 0.0007
Fukui, FUKUI	33	325.4	0.000 ± 0.0022	0.004 ± 0.0021
Kobe, HYOGO	32	348.2	0.001 ± 0.0005	0.002 ± 0.0006
Tottori, TOTTORI	31	214.2	0.003 ± 0.0006	0.003 ± 0.0007
Hiroshima, HIROSHIMA	29	216.4	0.002 ± 0.0005	0.001 ± 0.0005
Matsuyama, EHIME	31	453.0	0.000 ± 0.0005	0.001 ± 0.0005
Nagasaki, NAGASAKI	31	554.5	0.001 ± 0.0006	0.000 ± 0.0004
Yonagusuku-mura, OKINAWA	31	153.0	0.000 ± 0.0004	0.000 ± 0.0004

(1)-2 Strontium-90 and Cesium-137 in Rain and Dry Fallout(for WHO program)
(from Nov. 1987 to Jun. 1988)

-continued from NO. 82 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)
November, 1987				
Nagano, NAGANO	30	15.7	0.000 ± 0.0005	0.000 ± 0.0005
December, 1987				
Nagano, NAGANO	35	19.9	0.001 ± 0.0005	0.003 ± 0.0006
January, 1988				
Niigata, NIIGATA	29	104.2	0.001 ± 0.0005	0.002 ± 0.0006
Kanazawa, ISHIKAWA	33	197.5	0.001 ± 0.0006	0.005 ± 0.0007
Nagano, NAGANO	29	28.9	0.001 ± 0.0005	0.001 ± 0.0005
Okayama, OKAYAMA	28	22.4	0.002 ± 0.0006	0.001 ± 0.0005
Yamaguchi, YAMAGUCHI	29	38.0	0.001 ± 0.0006	0.002 ± 0.0005
Kochi, KOCHI	28	38.3	0.003 ± 0.0006	0.002 ± 0.0005
Kagoshima, KAGOSHIMA	36	42.5	0.003 ± 0.0006	0.002 ± 0.0005
February, 1988				
Akita, AKITA	30	88.8	0.002 ± 0.0006	0.003 ± 0.0006
Chiba, CHIBA	30	16.4	0.003 ± 0.0007	0.007 ± 0.0007
Niigata, NIIGATA	30	85.9	0.001 ± 0.0005	0.005 ± 0.0007
Kanazawa, ISHIKAWA	32	122.5	0.001 ± 0.0005	0.004 ± 0.0007
Nagano, NAGANO	30	19.7	0.001 ± 0.0005	0.003 ± 0.0006
Osaka, OSAKA	29	19.3	0.000 ± 0.0004	0.003 ± 0.0006
Okayama, OKAYAMA	30	20.7	0.001 ± 0.0005	0.001 ± 0.0005
Yamaguchi, YAMAGUCHI	30	49.0	0.001 ± 0.0006	0.001 ± 0.0005
Kochi, KOCHI	30	32.7	0.003 ± 0.0006	0.002 ± 0.0005
Kagoshima, KAGOSHIMA	30	51.5	0.007 ± 0.0008	0.003 ± 0.0006
March, 1988				
Akita, AKITA	32	80.3	0.000 ± 0.0005	0.004 ± 0.0007
Chiba, CHIBA	32	167.7	0.000 ± 0.0005	0.002 ± 0.0005
Niigata, NIIGATA	32	80.6	0.001 ± 0.0005	0.003 ± 0.0006
Kanazawa, ISHIKAWA	32	131.0	0.001 ± 0.0005	0.004 ± 0.0006
Nagano, NAGANO	32	86.5	0.000 ± 0.0006	0.002 ± 0.0006
Osaka, OSAKA	32	122.9	0.001 ± 0.0005	0.003 ± 0.0006
Okayama, OKAYAMA	32	119.4	0.001 ± 0.0005	0.001 ± 0.0005

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Yamaguchi, YAMAGUCHI	32	154.0	0.001 ± 0.0005	0.003 ± 0.0006
Kochi, KOCHI	31	226.1	0.003 ± 0.0006	0.001 ± 0.0005
Kagoshima, KAGOSHIMA	32	109.0	0.003 ± 0.0008	0.002 ± 0.0005
April, 1988				
Akita, AKITA	31	115.1	0.002 ± 0.0006	0.008 ± 0.0009
Chiba, CHIBA	28	95.9	0.000 ± 0.0005	0.003 ± 0.0006
Niigata, NIIGATA	32	75.5	0.003 ± 0.0006	0.008 ± 0.0007
Kanazawa, ISHIKAWA	29	93.0	0.003 ± 0.0006	0.008 ± 0.0008
Nagano, NAGANO	32	47.2	0.005 ± 0.0026	0.003 ± 0.0006
Osaka, OSAKA	33	104.0	0.002 ± 0.0005	0.004 ± 0.0007
Okayama, OKAYAMA	32	77.2	0.001 ± 0.0005	0.004 ± 0.0007
Yamaguchi, YAMAGUCHI	32	191.0	0.002 ± 0.0006	0.004 ± 0.0007
Kochi, KOCHI	33	405.1	0.003 ± 0.0006	0.004 ± 0.0007
Kagoshima, KAGOSHIMA	32	173.0	0.003 ± 0.0008	0.004 ± 0.0007
May, 1988				
Akita, AKITA	32	128.3	0.002 ± 0.0006	0.005 ± 0.0004
Chiba, CHIBA	35	160.4	0.000 ± 0.0004	0.004 ± 0.0005
Niigata, NIIGATA	31	90.1	0.000 ± 0.0004	0.004 ± 0.0006
Kanazawa, ISHIKAWA	33	262.5	0.002 ± 0.0005	0.003 ± 0.0006
Nagano, NAGANO	31	105.5	0.001 ± 0.0006	0.002 ± 0.0005
Osaka, OSAKA	31	167.6	0.002 ± 0.0005	0.003 ± 0.0006
Okayama, OKAYAMA	31	145.9	0.003 ± 0.0006	0.003 ± 0.0006
Yamaguchi, YAMAGUCHI	33	310.5	0.002 ± 0.0005	0.001 ± 0.0005
Kochi, KOCHI	31	245.7	0.004 ± 0.0006	0.002 ± 0.0006
Kagoshima, KAGOSHIMA	29	140.7	0.001 ± 0.0005	0.002 ± 0.0005
June, 1988				
Akita, AKITA	31	80.8	0.001 ± 0.0005	0.002 ± 0.0006
Kanazawa, ISHIKAWA	32	240.0	0.002 ± 0.0006	0.001 ± 0.0005
Osaka, OSAKA	30	422.3	0.002 ± 0.0006	0.002 ± 0.0005
Okayama, OKAYAMA	31	291.4	0.001 ± 0.0006	0.002 ± 0.0005
Yamaguchi, YAMAGUCHI	29	226.5	0.001 ± 0.0006	0.001 ± 0.0006
Kochi, KOCHI	31	939.8	0.003 ± 0.0006	0.002 ± 0.0005

(2) Strontium-90 and Cesium-137 in Airborne Dust
(from Oct. 1987 to Jun. 1988)

-continued from NO. 82 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 ($10^{-3}pCi/m^3$)
October～December, 1987				
Ookuma-machi, FUKUSHIMA	10～12	10,395	0.05±0.03	0.1 ±0.02
Mito, IBARAGI	10～12	10,708	0.0 ±0.02	0.01±0.02
Osaka, OSAKA	10～12	13,780	0.04±0.02	0.03±0.01
January～March, 1988				
Ookuma-machi, FUKUSHIMA	1～3	10,392	0.0 ±0.02	0.03±0.02
Mito, IBARAGI	1～3	8,647	0.03±0.02	0.01±0.02
Utsunomiya, TOCHIGI	1～3	11,870	0.02±0.02	0.0 ±0.01
Niigata, NIIGATA	1～3	14,287	0.04±0.02	0.0 ±0.01
Kosugi-machi, TOYAMA	1～3	12,833	0.02±0.02	0.01±0.01
Fukui, FUKUI	1～3	14,293	0.0 ±0.02	0.02±0.01
Kouhu, YAMANASHI	1～3	10,420	0.01±0.02	0.02±0.01
Hamaoka-machi, SHIZUOKA	1～3	10,264	0.04±0.03	0.1 ±0.02
Nagoya, AICHI	1～3	11,743	0.01±0.02	0.01±0.02
Kyoto, KYOTO	1～3	7,277	0.01±0.03	0.1 ±0.02
Osaka, OSAKA	1～3	14,911	0.0 ±0.01	0.02±0.01
Kobe, HYOGO	1～3	10,254	0.1 ±0.03	0.03±0.02
Tottori, TOTTORI	1～3	13,882	0.02±0.02	0.02±0.01
Hiroshima, HIROSHIMA	1～3	10,663	0.03±0.03	0.04±0.02
Nagasaki, NAGASAKI	1～3	9,926	0.01±0.02	0.03±0.02
Ooita, OOITA	1～3	11,391	0.0 ±0.02	0.01±0.01
February～March, 1988				
Morioka, IWATE	2～3	11,145	0.0 ±0.02	0.0 ±0.01
April～June, 1988				
Ookuma-machi, FUKUSHIMA	4～6	10,490	0.0 ±0.02	0.03±0.01
Niigata, NIIGATA	4～6	14,324	0.03±0.02	0.01±0.01
Fukui, FUKUI	4～6	11,484	0.0 ±0.02	0.02±0.01
Hamaoka-machi, SHIZUOKA	4～6	10,462	0.02±0.02	0.2 ±0.03
Osaka, OSAKA	4～6	14,935	0.01±0.02	0.1 ±0.02
Kobe, HYOGO	4～6	9,720	0.04±0.03	0.1 ±0.02
Tottori, TOTTORI	4～6	13,817	0.01±0.02	0.03±0.02
Hiroshima, HIROSHIMA	4～6	12,598	0.0 ±0.02	0.1 ±0.02
Nagasaki, NAGASAKI	4～6	9,516	0.1 ±0.03	0.2 ±0.03

(3) Strontium-90 and Cesium-137 in Service Water
(from Dec. 1987 to Jul. 1988)

-continued from NO. 82 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)			
January, 1988			
Nagano, NAGANO	7.3	0.04±0.004	0.01 ±0.002
Kyoto, KYOTO	6.6	0.15±0.007	0.01 ±0.003
June, 1988			
Katsushika, TOKYO	7.3	0.06±0.005	0.01 ±0.003
Tsukui-machi, KANAGAWA	8.1	0.01±0.003	0.001±0.003
Moriguchi, OSAKA	7.2	0.14±0.006	0.01 ±0.003
July, 1988			
Sapporo, HOKKAIDO	7.2	0.06±0.004	0.01 ±0.003
(Tap Water)			
December, 1987			
Nagano, NAGANO	7.2	0.02±0.003	0.01 ±0.002
Matsue, SHIMANE	7.0	0.09±0.005	0.005±0.002
Saga, SAGA	7.4	0.05±0.004	0.004±0.002
January, 1988			
Morioka, IWATE	6.6	0.05±0.004	0.00 ±0.002
Kyoto, KYOTO	6.4	0.15±0.007	0.004±0.002
Wakayama, WAKAYAMA	7.1	0.07±0.005	0.004±0.002
Naha, OKINAWA	6.8	0.13±0.006	0.00 ±0.002
February, 1988			
Utsunomiya, TOCHIGI	6.8	0.02±0.003	0.003±0.002
Kosugi-machi, TOYAMA	6.8	0.07±0.005	0.003±0.002
March, 1988			
Kouhu, YAMANASHI	6.9	0.03±0.004	0.001±0.002
Ooita, OOITA	7.9	0.02±0.003	0.004±0.002
June, 1988			
Wakkanai, HOKKAIDO	6.8	0.05±0.004	0.01 ±0.003
Aomori, AOMORI	7.4	0.05±0.004	0.01 ±0.003
Yamagata, YAMAGATA	7.1	0.06±0.004	0.01 ±0.003
Mito, IBARAGI	7.7	0.06±0.005	0.002±0.002
Katsushika, TOKYO	7.1	0.16±0.007	0.002±0.002
Kanazawa, ISHIKAWA	7.1	0.08±0.005	0.004±0.003

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
Fukui, FUKUI	7.3	0.03 ± 0.004	0.003 ± 0.002
Shizuoka, SHIZUOKA	7.8	0.03 ± 0.004	0.00 ± 0.002
Osaka, OSAKA	6.8	0.12 ± 0.006	0.001 ± 0.003
Kobe, HYOGO	7.9	0.09 ± 0.005	0.002 ± 0.003
Tottori, TOTTORI	7.5	0.06 ± 0.005	0.01 ± 0.002
Okayama, OKAYAMA	6.8	0.07 ± 0.005	0.003 ± 0.002
Hiroshima, HIROSHIMA	7.1	0.08 ± 0.005	0.00 ± 0.003
Ube, YAMAGUCHI	7.8	0.06 ± 0.005	0.01 ± 0.003
Matsuyama, EHIME	7.5	0.04 ± 0.004	0.004 ± 0.003
Kochi, KOCHI	7.1	0.05 ± 0.004	0.004 ± 0.003
Nagasaki, NAGASAKI	6.8	0.04 ± 0.004	0.00 ± 0.002
Kagoshima, KAGOSHIMA	7.1	0.02 ± 0.004	0.01 ± 0.002
Naha, OKINAWA	7.0	0.07 ± 0.005	0.01 ± 0.003
July, 1988			
Akita, AKITA	6.9	0.13 ± 0.006	0.01 ± 0.003
Yokohama, KANAGAWA	6.6	0.02 ± 0.004	0.002 ± 0.002

(4) Strontium-90 and Cesium-137 in Freshwater
(from Dec. 1987 to Jul. 1988)

-continued from NO. 82 of this publication-

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

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
(Freshwater)			
December, 1987			
Suwa-lake, NAGANO	7.4	0.03 ± 0.004	0.01 ± 0.003
Uji, KYOTO	6.0	0.00 ± 0.002	0.001 ± 0.002
May, 1988			
Kasumigaura, IBARAGI	9.2	0.13 ± 0.006	0.02 ± 0.004
July, 1988			
Barato-lake, HOKKAIDO	7.4	0.07 ± 0.005	0.02 ± 0.004

(5) Strontium-90 and Cesium-137 in Soil
(from Feb. 1988 to May 1988)

-continued from NO. 82 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)
February, 1988					
Imaichi, TOCHIGI	0～5	270 ± 9	5.8 ± 0.19	1000 ± 20	22 ± 0.4
〃	5～20	100 ± 6	4.4 ± 0.25	130 ± 7	5.5 ± 0.3
Kujuu-machi, OOITA	0～5	240 ± 8	7.7 ± 0.26	3100 ± 30	100 ± 1
〃	5～20	140 ± 6	13 ± 0.6	360 ± 11	33 ± 1.0
March, 1988					
Takisawa-mura, IWATE	0～5	550 ± 12	13 ± 0.3	2800 ± 30	66 ± 0.7
〃	5～20	440 ± 11	36 ± 0.9	380 ± 11	31 ± 0.9
Kosugi-machi, TOYAMA	0～5	230 ± 9	14 ± 0.5	630 ± 15	38 ± 0.9
〃	5～20	330 ± 11	46 ± 1.5	180 ± 8	25 ± 1.1
Takane-machi, YAMANASHI	0～5	440 ± 12	27 ± 0.7	1200 ± 20	73 ± 1.2
〃	5～20	230 ± 8	29 ± 1.1	430 ± 12	55 ± 1.6
May, 1988					
Tokai-mura, IBARAGI	0～5	340 ± 12	13 ± 0.5	4000 ± 30	160 ± 1
〃	5～20	450 ± 14	29 ± 0.9	630 ± 13	40 ± 0.9
Akabane-machi, AICHI	0～5	11 ± 3.0	0.7 ± 0.20	100 ± 6	6.9 ± 0.38
〃	5～20	12 ± 3.3	2.7 ± 0.70	28 ± 3.4	6.0 ± 0.74

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

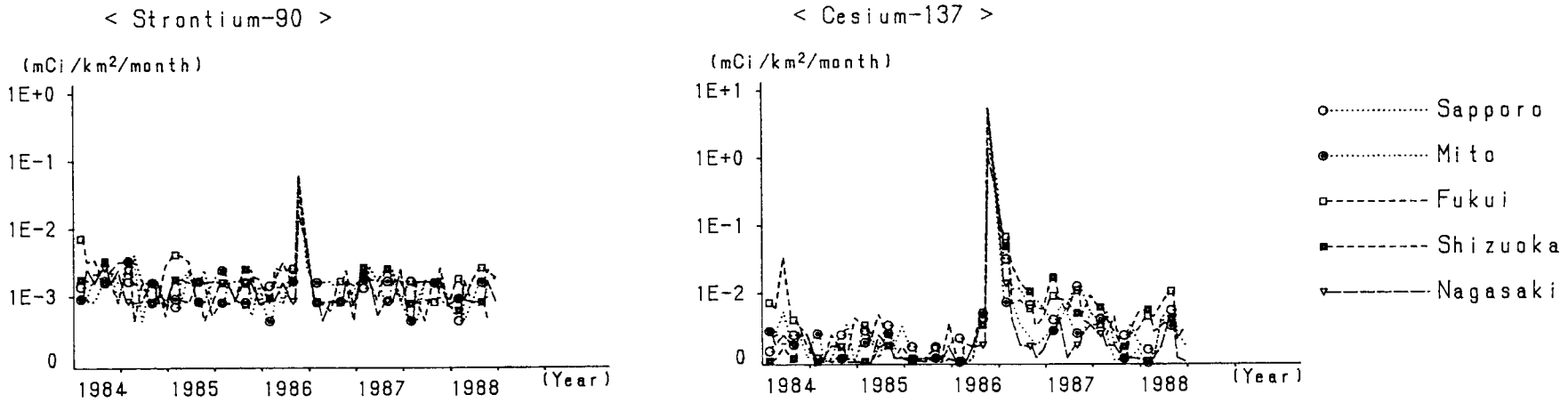

Fig. 1-1

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

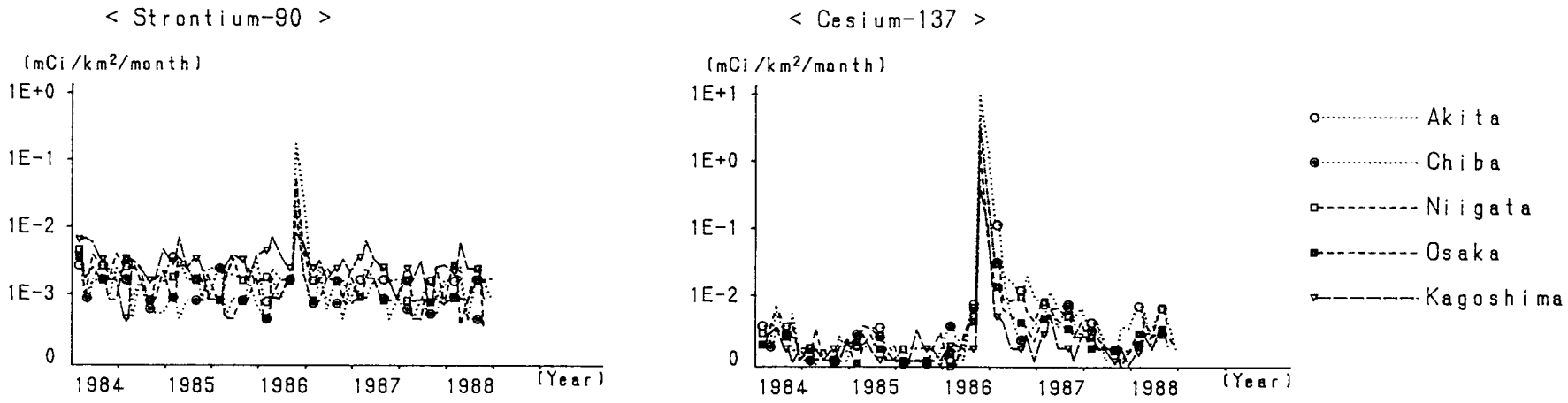

Fig. 1-2

* * * Airborne Dust * * *

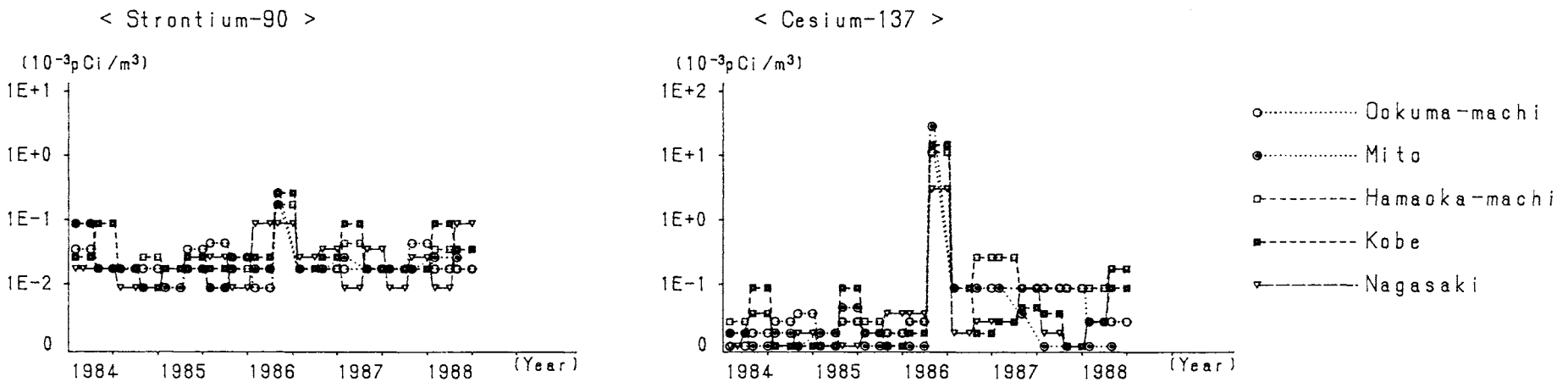

Fig.2

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

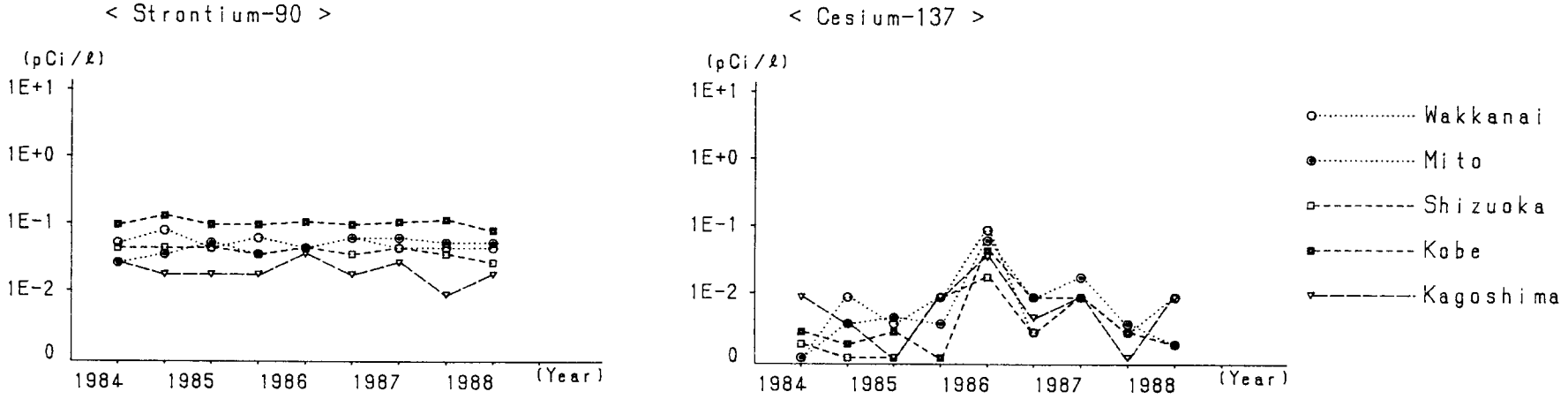

Fig. 3

* * * Service Water (freshwater) * * *

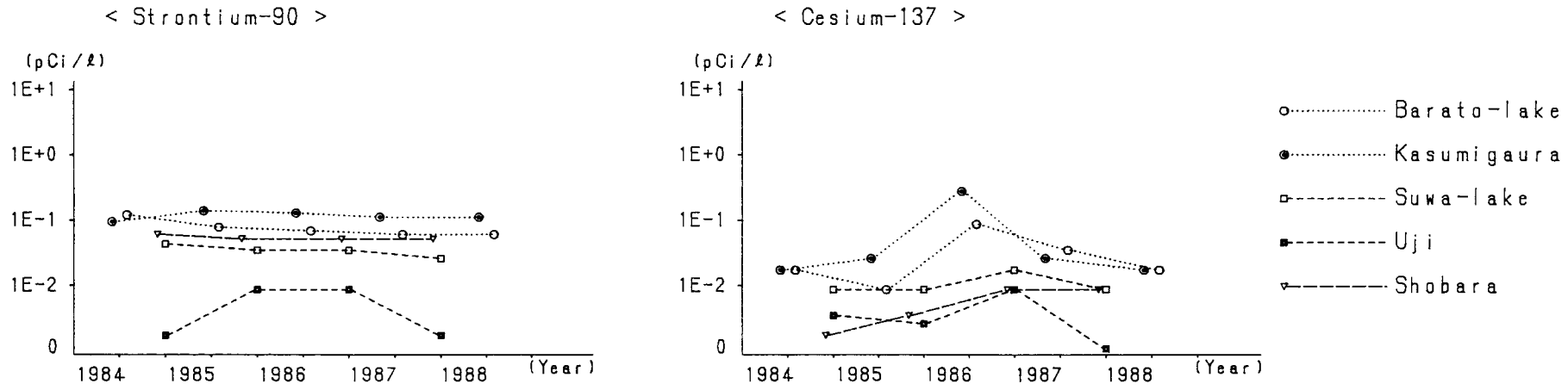

Fig. 4

＊＊＊　Soil　＊＊＊

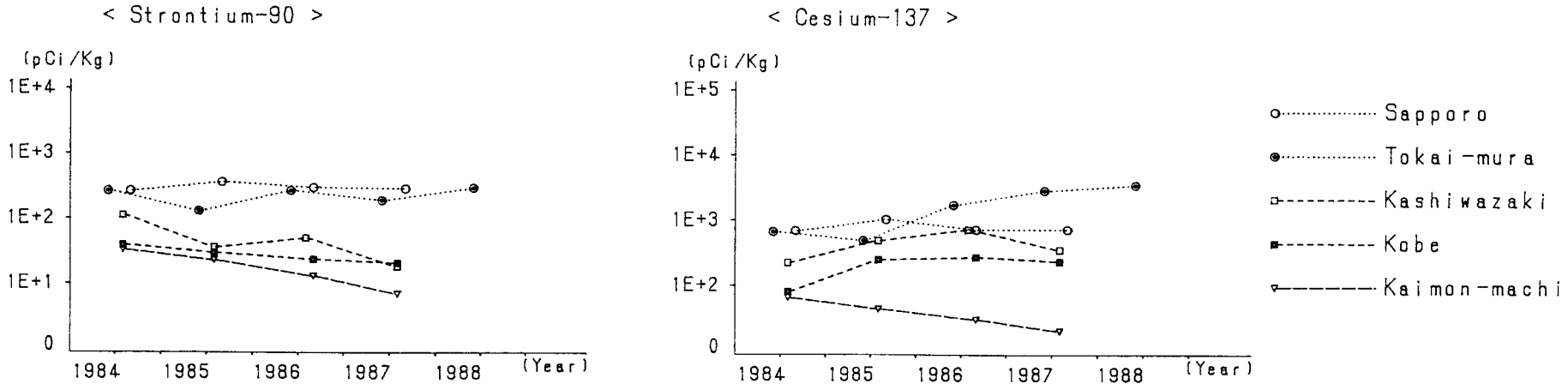
< Strontium-90 >
(pCi/Kg)
1E+4
1E+3
1E+2
1E+1
0
1984
1985
1986
1987
1988
(Year)
< Cesium-137 >
(pCi/Kg)
1E+5
1E+4
1E+3
1E+2
0
1984
1985
1986
1987
1988
(Year)
Sapporo
Tokai-mura
Kashiwazaki
Kobe
Kaimon-machi

Fig.5

** 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