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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, 0~5 cm and 5~20 cm. The soil lumps were crushed by hands and dried in a drying oven regulated 105°C. 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 4 kg 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°C.

(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 °C 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 5~20 cm	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 person
(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 (hervesting season)	4 kg
2 Consuming districts	yearly (harvesting season)	4 kg
(11) Tea	yearly (the first harvesting season)	500 g (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°C. The sample was then heated with hydrochloric acid, strontium and cecium 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 strontiunm-90 and cesium-137

(1) Strontium-90

Sample solutions, prepared as in the foregoing sections 2-(1) through 2-(5), 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°C 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 hydrofloric 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 Nov. 1985 to Jul. 1986)

-continued from NO. 74 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)
November, 1985				
Matsue, SHIMANE	31	109.2	0.002 ± 0.0006	0.002 ± 0.0005
December, 1985				
Sapporo, HOKKAIDO	29	59.5	0.001 ± 0.0006	0.002 ± 0.0005
Aomori, AOMORI	36	128.5	0.002 ± 0.0006	0.003 ± 0.0006
Matsue, SHIMANE	31	101.4	0.001 ± 0.0005	0.004 ± 0.0006
January, 1986				
Sapporo, HOKKAIDO	36	87.5	0.002 ± 0.0006	0.003 ± 0.0006
Aomori, AOMORI	29	107.0	0.002 ± 0.0007	0.000 ± 0.0005
Onagawa-machi, MIYAGI	26	2.8	0.001 ± 0.0006	0.001 ± 0.0005
Yamagata, YAMAGATA	29	77.5	0.001 ± 0.0005	0.000 ± 0.0005
Ookuma-machi, FUKUSHIMA	36	12.1	0.002 ± 0.0006	0.002 ± 0.0005
Mito, IBARAGI	27	2.5	0.000 ± 0.0005	0.001 ± 0.0005
Shinjuku, TOKYO	29	20.0	0.001 ± 0.0006	0.001 ± 0.0005
Yokohama, KANAGAWA	29	23.4	0.001 ± 0.0007	0.002 ± 0.0005
Fukui, FUKUI	27	236.1	0.001 ± 0.0006	0.001 ± 0.0005
Shizuoka, SHIZUOKA	27	26.0	0.001 ± 0.0006	0.000 ± 0.0004
Nagoya, AICHI	29	1.6	0.002 ± 0.0006	0.000 ± 0.0004
Kyoto, KYOTO	27	0.0	0.000 ± 0.0005	0.001 ± 0.0004
KOBE, HYOGO	36	37.4	0.001 ± 0.0006	0.002 ± 0.0005
Wakayama, WAKAYAMA	27	24.9	0.000 ± 0.0006	0.000 ± 0.0004
Tottori, TOTTORI	29	154.4	0.004 ± 0.0007	0.002 ± 0.0006
Matsue, SHIMANE	32	68.5	0.001 ± 0.0005	0.003 ± 0.0005
Hiroshima, HIROSHIMA	27	0.0	0.005 ± 0.0007	0.000 ± 0.0004
Matsuyama, EHIME	29	2.5	0.001 ± 0.0006	0.000 ± 0.0004
Dazaifu, FUKUOKA	27	32.7	0.002 ± 0.0008	0.002 ± 0.0007
Saga, SAGA	29	36.6	0.001 ± 0.0006	0.001 ± 0.0004
Nagasaki, NAGASAKI	29	45.0	0.001 ± 0.0005	0.001 ± 0.0006
Yonagusuku-mura, OKINAWA	25	17.5	0.000 ± 0.0005	0.001 ± 0.0004
February, 1986				
Sapporo, HOKKAIDO	29	35.0	0.002 ± 0.0006	0.001 ± 0.0004

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Aomori, AOMORI	27	96.5	0.004 ± 0.0007	0.000 ± 0.0005
Onagawa-machi, MIYAGI	29	56.0	0.003 ± 0.0007	0.001 ± 0.0005
Yamagata, YAMAGATA	29	30.0	0.001 ± 0.0005	0.001 ± 0.0004
Ookuma-machi, FUKUSHIMA	32	115.2	0.001 ± 0.0005	0.001 ± 0.0004
Mito, IBARAGI	29	36.5	0.001 ± 0.0006	0.001 ± 0.0005
Shinjuku, TOKYO	29	60.6	0.002 ± 0.0006	0.002 ± 0.0005
Yokohama, KANAGAWA	28	36.2	0.003 ± 0.0006	0.003 ± 0.0006
Fukui, FUKUI	29	156.9	0.003 ± 0.0006	0.002 ± 0.0005
Shizuoka, SHIZUOKA	29	56.5	0.002 ± 0.0006	0.001 ± 0.0005
Nagoya, AICHI	29	40.6	0.001 ± 0.0005	0.001 ± 0.0005
Kyoto, KYOTO	29	15.6	0.001 ± 0.0005	0.001 ± 0.0004
KOBE, HYOGO	29	16.0	0.000 ± 0.0006	0.002 ± 0.0005
Wakayama, WAKAYAMA	29	17.6	0.002 ± 0.0006	0.001 ± 0.0004
Tottori, TOTTORI	29	175.1	0.005 ± 0.0007	0.002 ± 0.0006
Matsue, SHIMANE	31	74.1	0.003 ± 0.0006	0.003 ± 0.0005
Hiroshima, HIROSHIMA	27	36.8	0.005 ± 0.0007	0.000 ± 0.0004
Matsuyama, EHIME	29	28.0	0.001 ± 0.0005	0.001 ± 0.0004
Dazaifu, FUKUOKA	28	48.8	0.002 ± 0.0006	0.001 ± 0.0005
Saga, SAGA	29	45.4	0.001 ± 0.0005	0.000 ± 0.0004
Nagasaki, NAGASAKI	29	57.5	0.001 ± 0.0006	0.001 ± 0.0004
Yonagusuku-mura, OKINAWA	29	89.0	0.002 ± 0.0006	0.001 ± 0.0005
March, 1986				
Sapporo, HOKKAIDO	32	33.0	0.001 ± 0.0005	0.001 ± 0.0005
Aomori, AOMORI	32	21.0	0.015 ± 0.0010	0.002 ± 0.0005
Onagawa-machi, MIYAGI	32	137.9	0.003 ± 0.0006	0.003 ± 0.0005
Yamagata, YAMAGATA	32	55.0	0.000 ± 0.0005	0.001 ± 0.0005
Ookuma-machi, FUKUSHIMA	29	189.7	0.002 ± 0.0006	0.002 ± 0.0006
Mito, IBARAGI	32	131.5	0.001 ± 0.0006	0.001 ± 0.0005
Shinjuku, TOKYO	32	230.0	0.002 ± 0.0006	0.003 ± 0.0005
Yokohama, KANAGAWA	32	220.7	0.003 ± 0.0007	0.005 ± 0.0007
Fukui, FUKUI	33	123.2	0.003 ± 0.0006	0.002 ± 0.0005
Shizuoka, SHIZUOKA	32	218.5	0.004 ± 0.0007	0.002 ± 0.0006
Nagoya, AICHI	30	170.6	0.003 ± 0.0007	0.003 ± 0.0006
Kyoto, KYOTO	31	125.2	0.002 ± 0.0006	0.002 ± 0.0005
KOBE, HYOGO	32	108.9	0.001 ± 0.0005	0.004 ± 0.0006
Wakayama, WAKAYAMA	32	146.5	0.002 ± 0.0007	0.003 ± 0.0005
Tottori, TOTTORI	30	117.0	0.004 ± 0.0007	0.003 ± 0.0006
Matsue, SHIMANE	31	92.7	0.002 ± 0.0006	0.002 ± 0.0005

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Hiroshima, HIROSHIMA	32	63.8	0.005 ± 0.0008	0.001 ± 0.0005
Matsuyama, EHIME	31	85.5	0.001 ± 0.0006	0.001 ± 0.0005
Dazaifu, FUKUOKA	33	115.7	0.001 ± 0.0006	0.002 ± 0.0005
Saga, SAGA	29	123.4	0.001 ± 0.0006	0.002 ± 0.0005
Nagasaki, NAGASAKI	32	127.5	0.002 ± 0.0006	0.002 ± 0.0005
Yonagusuku-mura, OKINAWA	32	184.0	0.001 ± 0.0006	0.001 ± 0.0005
April, 1986				
Sapporo, HOKKAIDO	31	57.0	0.003 ± 0.0007	0.005 ± 0.0006
Aomori, AOMORI	31	36.5	0.007 ± 0.0008	0.007 ± 0.0007
Onagawa-machi, MIYAGI	32	93.2	0.003 ± 0.0007	0.005 ± 0.0006
Yamagata, YAMAGATA	31	58.1	0.001 ± 0.0006	0.004 ± 0.0006
Ookuma-machi, FUKUSHIMA	31	73.3	0.002 ± 0.0006	0.005 ± 0.0006
Mito, IBARAGI	31	98.0	0.002 ± 0.0006	0.006 ± 0.0006
Shinjuku, TOKYO	31	94.4	0.003 ± 0.0006	0.003 ± 0.0005
Yokohama, KANAGAWA	31	124.7	0.003 ± 0.0006	0.012 ± 0.0010
Fukui, FUKUI	30	113.8	0.003 ± 0.0006	0.006 ± 0.0007
Shizuoka, SHIZUOKA	31	177.5	0.002 ± 0.0006	0.004 ± 0.0007
Nagoya, AICHI	31	147.4	0.002 ± 0.0006	0.004 ± 0.0006
Kyoto, KYOTO	31	84.0	0.002 ± 0.0006	0.004 ± 0.0006
KOBE, HYOGO	31	135.4	0.001 ± 0.0005	0.002 ± 0.0006
Wakayama, WAKAYAMA	31	95.4	0.002 ± 0.0006	0.002 ± 0.0006
Tottori, TOTTORI	31	133.7	0.006 ± 0.0008	0.008 ± 0.0009
Hiroshima, HIROSHIMA	31	168.4	0.004 ± 0.0007	0.002 ± 0.0006
Matsuyama, EHIME	32	139.5	0.003 ± 0.0006	0.004 ± 0.0006
Dazaifu, FUKUOKA	30	94.5	0.003 ± 0.0007	0.002 ± 0.0006
Saga, SAGA	31	165.7	0.001 ± 0.0006	0.002 ± 0.0006
Nagasaki, NAGASAKI	31	137.5	0.001 ± 0.0006	0.002 ± 0.0006
Yonagusuku-mura, OKINAWA	31	142.5	0.001 ± 0.0006	0.001 ± 0.0005
May, 1986				
Sapporo, HOKKAIDO	23	27.5	0.027 ± 0.0014	1.3 ± 0.01
Aomori, AOMORI	22	56.0	0.045 ± 0.0017	2.7 ± 0.01
Onagawa-machi, MIYAGI	22	92.9	0.027 ± 0.0014	2.1 ± 0.01
Yamagata, YAMAGATA	22	68.7	0.042 ± 0.0017	2.7 ± 0.01
Ookuma-machi, FUKUSHIMA	23	123.4	0.066 ± 0.0021	4.4 ± 0.02
Mito, IBARAGI	22	133.0	0.050 ± 0.0018	3.3 ± 0.01
Shinjuku, TOKYO	22	187.6	0.046 ± 0.0018	4.8 ± 0.02
Yokohama, KANAGAWA	23	191.4	0.063 ± 0.0021	6.0 ± 0.02
Fukui, FUKUI	22	140.7	0.054 ± 0.0019	4.6 ± 0.02

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Shizuoka, SHIZUOKA	22	217.5	0.042 ± 0.0016	4.8 ± 0.02
Nagoya, AICHI	22	175.1	0.055 ± 0.0030	7.5 ± 0.02
Kyoto, KYOTO	23	149.3	0.019 ± 0.0012	1.4 ± 0.01
KOBE, HYOGO	23	209.4	0.025 ± 0.0014	1.3 ± 0.01
Wakayama, WAKAYAMA	22	214.1	0.011 ± 0.0010	0.86 ± 0.007
Tottori, TOTTORI	22	96.9	0.048 ± 0.0020	5.4 ± 0.02
Matsue, SHIMANE	23	115.8	0.034 ± 0.0015	5.3 ± 0.02
Hiroshima, HIROSHIMA	27	158.7	0.020 ± 0.0013	1.4 ± 0.01
Matsuyama, EHIME	22	176.0	0.013 ± 0.0012	1.4 ± 0.01
Dazaifu, FUKUOKA	23	158.6	0.006 ± 0.0008	0.61 ± 0.006
Saga, SAGA	23	221.0	0.011 ± 0.0010	0.59 ± 0.006
Nagasaki, NAGASAKI	22	238.5	0.014 ± 0.0014	0.92 ± 0.009
Yonagusuku-mura, OKINAWA	23	149.5	0.006 ± 0.0008	1.5 ± 0.01
June, 1986				
Sapporo, HOKKAIDO	41	51.5	0.009 ± 0.0010	0.85 ± 0.007
Aomori, AOMORI	40	60.5	0.018 ± 0.0011	0.77 ± 0.006
Onagawa-machi, MIYAGI	42	180.8	0.008 ± 0.0008	0.34 ± 0.004
Yamagata, YAMAGATA	41	131.0	0.013 ± 0.0010	0.78 ± 0.007
Ookuma-machi, FUKUSHIMA	40	128.4	0.004 ± 0.0007	0.65 ± 0.006
Mito, IBARAGI	41	149.5	0.004 ± 0.0007	0.34 ± 0.004
Shinjuku, TOKYO	41	208.1	0.005 ± 0.0007	0.47 ± 0.005
Yokohama, KANAGAWA	40	219.1	0.005 ± 0.0007	1.0 ± 0.01
Fukui, FUKUI	41	178.2	0.006 ± 0.0007	0.43 ± 0.005
Shizuoka, SHIZUOKA	41	185.0	0.009 ± 0.0009	0.60 ± 0.006
Nagoya, AICHI	41	275.3	0.003 ± 0.0006	0.23 ± 0.004
Kyoto, KYOTO	41	223.9	0.004 ± 0.0007	0.18 ± 0.003
KOBE, HYOGO	40	201.4	0.001 ± 0.0005	0.068 ± 0.0019
Wakayama, WAKAYAMA	44	189.8	0.002 ± 0.0006	0.14 ± 0.003
Tottori, TOTTORI	40	219.1	0.007 ± 0.0009	0.26 ± 0.004
Hiroshima, HIROSHIMA	36	392.8	0.005 ± 0.0007	0.24 ± 0.003
Matsuyama, EHIME	41	139.0	0.003 ± 0.0007	0.095 ± 0.0025
Dazaifu, FUKUOKA	40	320.5	0.004 ± 0.0007	0.28 ± 0.004
Saga, SAGA	40	400.7	0.011 ± 0.0009	0.53 ± 0.006
Nagasaki, NAGASAKI	41	432.5	0.009 ± 0.0009	0.47 ± 0.005
Yonagusuku-mura, OKINAWA	40	190.0	0.003 ± 0.0007	0.22 ± 0.003
JUly, 1986				
Nagoya, AICHI	32	338.6	0.001 ± 0.0006	0.033 ± 0.0014
KOBE, HYOGO	32	61.2	0.002 ± 0.0006	0.008 ± 0.0008

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Hiroshima, HIROSHIMA	32	224.0	0.004 ± 0.0007	0.025 ± 0.0012

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

-continued from NO. 74 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				
Akita, AKITA	33	95.5	0.001 ± 0.0006	0.001 ± 0.0005
Niigata, NIIGATA	29	66.1	0.002 ± 0.0006	0.001 ± 0.0005
Kanazawa, ISHIKAWA	35	334.0	0.002 ± 0.0006	0.003 ± 0.0006
Nagano, NAGANO	29	10.4	0.000 ± 0.0005	0.000 ± 0.0004
Osaka, OSAKA	36	34.7	0.000 ± 0.0005	0.002 ± 0.0005
Okayama, OKAYAMA	27	0.0	0.000 ± 0.0005	0.000 ± 0.0004
Yamaguchi, YAMAGUCHI	29	16.5	0.004 ± 0.0008	0.001 ± 0.0005
Kochi, KOCHI	27	0.0	0.004 ± 0.0006	0.000 ± 0.0004
Kagoshima, KAGOSHIMA	29	22.5	0.005 ± 0.0007	0.002 ± 0.0005
February, 1986				
Akita, AKITA	29	73.1	0.002 ± 0.0006	0.002 ± 0.0005
Chiba, CHIBA	32	29.0	0.003 ± 0.0007	0.003 ± 0.0005
Niigata, NIIGATA	29	54.0	0.001 ± 0.0006	0.001 ± 0.0005
Kanazawa, ISHIKAWA	29	177.5	0.003 ± 0.0007	0.000 ± 0.0005
Nagano, NAGANO	29	2.3	0.001 ± 0.0006	0.001 ± 0.0004
Osaka, OSAKA	29	18.1	0.001 ± 0.0006	0.001 ± 0.0005
Okayama, OKAYAMA	29	29.3	0.002 ± 0.0006	0.000 ± 0.0005
Yamaguchi, YAMAGUCHI	29	56.5	0.003 ± 0.0007	0.001 ± 0.0005
Kochi, KOCHI	29	88.5	0.004 ± 0.0006	0.002 ± 0.0005
Kagoshima, KAGOSHIMA	28	64.5	0.008 ± 0.0009	0.002 ± 0.0006
March, 1986				
Akita, AKITA	32	91.1	0.001 ± 0.0006	0.001 ± 0.0005
Chiba, CHIBA	30	213.0	0.002 ± 0.0006	0.002 ± 0.0005
Niigata, NIIGATA	30	58.6	0.001 ± 0.0006	0.003 ± 0.0006
Kanazawa, ISHIKAWA	32	107.0	0.002 ± 0.0006	0.003 ± 0.0006
Nagano, NAGANO	32	30.1	0.001 ± 0.0006	0.001 ± 0.0005
Osaka, OSAKA	32	142.4	0.002 ± 0.0006	0.003 ± 0.0006
Okayama, OKAYAMA	32	113.5	0.003 ± 0.0006	0.001 ± 0.0005
Yamaguchi, YAMAGUCHI	32	95.0	0.002 ± 0.0007	0.002 ± 0.0005
Kochi, KOCHI	31	180.9	0.004 ± 0.0007	0.002 ± 0.0005
Kagoshima, KAGOSHIMA	32	67.0	0.005 ± 0.0008	0.002 ± 0.0005
April, 1986				
Akita, AKITA	31	132.1	0.002 ± 0.0010	0.009 ± 0.0010

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/Km^2)	^{137}Cs (mCi/Km^2)
Chiba, CHIBA	32	99.4	0.002 ± 0.0007	0.008 ± 0.0007
Niigata, NIIGATA	31	73.8	0.002 ± 0.0006	0.006 ± 0.0006
Kanazawa, ISHIKAWA	31	132.0	0.002 ± 0.0006	0.003 ± 0.0005
Nagano, NAGANO	31	45.2	0.002 ± 0.0006	0.004 ± 0.0007
Osaka, OSAKA	31	141.9	0.002 ± 0.0006	0.005 ± 0.0007
Okayama, OKAYAMA	31	122.2	0.002 ± 0.0006	0.002 ± 0.0006
Yamaguchi, YAMAGUCHI	31	194.0	0.003 ± 0.0007	0.006 ± 0.0007
Kochi, KOCHI	32	323.5	0.005 ± 0.0007	0.007 ± 0.0007
Kagoshima, KAGOSHIMA	32	136.0	0.003 ± 0.0006	0.002 ± 0.0006
May, 1986				
Akita, AKITA	22	84.2	0.15 ± 0.003	8.4 ± 0.02
Chiba, CHIBA	21	139.4	0.040 ± 0.0017	3.8 ± 0.01
Niigata, NIIGATA	22	44.3	0.048 ± 0.0021	2.8 ± 0.01
Kanazawa, ISHIKAWA	23	175.0	0.067 ± 0.0020	8.6 ± 0.02
Nagano, NAGANO	22	81.9	0.027 ± 0.0014	1.3 ± 0.01
Osaka, OSAKA	23	214.6	0.016 ± 0.0012	1.3 ± 0.01
Okayama, OKAYAMA	22	194.4	0.023 ± 0.0013	2.8 ± 0.01
Yamaguchi, YAMAGUCHI	22	230.0	0.039 ± 0.0017	3.7 ± 0.01
Kochi, KOCHI	22	222.3	0.020 ± 0.0013	4.6 ± 0.02
Kagoshima, KAGOSHIMA	22	100.5	0.007 ± 0.0008	0.37 ± 0.004
June, 1986				
Akita, AKITA	41	87.3	0.037 ± 0.0016	2.5 ± 0.01
Chiba, CHIBA	41	123.2	0.003 ± 0.0007	0.44 ± 0.004
Niigata, NIIGATA	41	99.5	0.007 ± 0.0008	0.47 ± 0.005
Kanazawa, ISHIKAWA	40	235.0	0.007 ± 0.0008	0.40 ± 0.005
Nagano, NAGANO	41	84.3	0.004 ± 0.0007	0.13 ± 0.003
Osaka, OSAKA	40	234.5	0.003 ± 0.0006	0.12 ± 0.003
Okayama, OKAYAMA	41	169.9	0.003 ± 0.0006	0.14 ± 0.003
Yamaguchi, YAMAGUCHI	40	448.5	0.007 ± 0.0008	0.47 ± 0.005
Kagoshima, KAGOSHIMA	41	358.5	0.009 ± 0.0009	0.17 ± 0.003
JUly, 1986				
Akita, AKITA	32	189.9	0.002 ± 0.0006	0.14 ± 0.003
Chiba, CHIBA	35	64.8	0.001 ± 0.0006	0.043 ± 0.0018
Osaka, OSAKA	32	152.1	0.001 ± 0.0006	0.017 ± 0.0011

(2) Strontium-90 and Cesium-137 in Airborne Dust
(from Oct. 1985 to Jun. 1986)

-continued from NO. 74 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, 1985				
Ookuma-machi, FUKUSHIMA	10～12	11,270	0.03 ± 0.02	0.02 ± 0.01
Mito, IBARAGI	10～12	11,417	0.0 ± 0.02	0.0 ± 0.01
Niigata, NIIGATA	10～12	15,015	0.01 ± 0.02	0.02 ± 0.01
Hamaoka-machi, SHIZUOKA	10～12	11,682	0.02 ± 0.02	0.02 ± 0.01
Nagoya, AICHI	10～12	6,573	0.0 ± 0.03	0.1 ± 0.03
Kyoto, KYOTO	10～12	10,031	0.01 ± 0.03	0.04 ± 0.02
Tottori, TOTTORI	10～12	9,643	0.0 ± 0.03	0.0 ± 0.02
Hiroshima, HIROSHIMA	10～12	10,546	0.01 ± 0.03	0.05 ± 0.02
Nagasaki, NAGASAKI	10～12	12,024	0.01 ± 0.02	0.04 ± 0.01
January～March, 1986				
Ookuma-machi, FUKUSHIMA	1～3	9,587	0.01 ± 0.03	0.03 ± 0.02
Mito, IBARAGI	1～3	12,123	0.02 ± 0.02	0.0 ± 0.01
Niigata, NIIGATA	1～3	14,130	0.02 ± 0.02	0.02 ± 0.01
Fukui, FUKUI	1～3	18,609	0.03 ± 0.01	0.02 ± 0.01
Hamaoka-machi, SHIZUOKA	1～3	11,349	0.02 ± 0.02	0.03 ± 0.01
Nagoya, AICHI	1～3	10,405	0.01 ± 0.02	0.03 ± 0.02
Kyoto, KYOTO	1～3	8,455	0.04 ± 0.03	0.02 ± 0.02
Osaka, OSAKA	1～3	11,489	0.01 ± 0.02	0.01 ± 0.02
KOBE, HYOGO	1～3	10,095	0.0 ± 0.03	0.02 ± 0.02
Tottori, TOTTORI	1～3	9,735	0.0 ± 0.03	0.1 ± 0.02
Hiroshima, HIROSHIMA	1～3	11,036	0.03 ± 0.02	0.1 ± 0.01
Nagasaki, NAGASAKI	1～3	11,139	0.1 ± 0.02	0.04 ± 0.01
April～June, 1986				
Fukui, FUKUI	4～6	16,152	0.04 ± 0.01	1.0 ± 0.04
Hamaoka-machi, SHIZUOKA	4～6	11,347	0.2 ± 0.03	13. ± 0.1
Nagoya, AICHI	4～6	6,196	0.05 ± 0.04	1.8 ± 0.08
Kyoto, KYOTO	4～6	9,211	0.2 ± 0.03	8.3 ± 0.13
Osaka, OSAKA	4～6	14,635	0.3 ± 0.03	51. ± 0.3
KOBE, HYOGO	4～6	9,581	0.3 ± 0.03	17. ± 0.2
Tottori, TOTTORI	4～6	10,156	1.0 ± 0.06	140. ± 1.
Hiroshima, HIROSHIMA	4～6	11,261	0.3 ± 0.03	15. ± 0.2
Nagasaki, NAGASAKI	4～6	11,438	0.1 ± 0.02	3.5 ± 0.08

(3) Strontium-90 and Cesium-137 in Service Water
(from Dec. 1985 to Jul. 1986)

-continued from NO. 74 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)			
December, 1985			
Katsushika, TOKYO	6.9	0.06 ± 0.005	0.01 ± 0.002
Fukuoka, FUKUOKA	7.3	0.08 ± 0.005	0.002 ± 0.002
January, 1986			
Sapporo, HOKKAIDO	6.9	0.07 ± 0.005	0.07 ± 0.004
Kyoto, KYOTO	6.8	0.18 ± 0.007	0.01 ± 0.002
June, 1986			
Katsushika, TOKYO	7.1	0.05 ± 0.005	0.09 ± 0.006
Tsukui-machi, KANAGAWA	8.6	0.03 ± 0.003	0.04 ± 0.004
Nagano, NAGANO	7.1	0.04 ± 0.004	0.04 ± 0.004
Inuyama, AICHI	6.8	0.08 ± 0.006	0.07 ± 0.005
Moriguchi, OSAKA	7.1	0.16 ± 0.007	0.09 ± 0.006
Fukuoka, FUKUOKA	6.9	0.07 ± 0.005	0.16 ± 0.007
JUly, 1986			
Sapporo, HOKKAIDO	7.1	0.06 ± 0.005	0.05 ± 0.004
(Tap Water)			
December, 1985			
Katsushika, TOKYO	6.7	0.07 ± 0.005	0.01 ± 0.002
Matsue, SHIMANE	7.4	0.12 ± 0.006	0.002 ± 0.002
Fukuoka, FUKUOKA	7.0	0.08 ± 0.005	0.00 ± 0.002
Nagasaki, NAGASAKI	6.8	0.06 ± 0.005	0.004 ± 0.002
January, 1986			
Fukushima, FUKUSHIMA	7.0	0.14 ± 0.007	0.003 ± 0.002
Kyoto, KYOTO	6.5	0.17 ± 0.007	0.00 ± 0.002
Wakayama, WAKAYAMA	7.2	0.08 ± 0.005	0.001 ± 0.002
Hiroshima, HIROSHIMA	6.8	0.10 ± 0.006	0.001 ± 0.002
Naha, OKINAWA	7.3	0.14 ± 0.007	0.00 ± 0.002
May, 1986			
Hiroshima, HIROSHIMA	6.9	0.10 ± 0.006	0.03 ± 0.004
June, 1986			
Wakkanai, HOKKAIDO	6.8	0.05 ± 0.004	0.10 ± 0.006

Location	pH	^{90}Sr (pCi/l)	^{137}Cs (pCi/l)
Aomori, AOMORI	7.7	0.06 ± 0.005	0.02 ± 0.003
Yamagata, YAMAGATA	7.0	0.07 ± 0.005	0.04 ± 0.004
Mito, IBARAGI	7.7	0.05 ± 0.004	0.07 ± 0.005
Katsushika, TOKYO	6.9	0.08 ± 0.005	0.04 ± 0.004
Yokohama, KANAGAWA	6.7	0.02 ± 0.003	0.02 ± 0.003
Niigata, NIIGATA	7.0	0.11 ± 0.006	0.02 ± 0.003
Kanazawa, ISHIKAWA	7.3	0.09 ± 0.006	0.03 ± 0.004
Fukui, FUKUI	7.0	0.01 ± 0.003	0.01 ± 0.003
Nagano, NAGANO	7.0	0.04 ± 0.004	0.03 ± 0.004
Shizuoka, SHIZUOKA	7.3	0.05 ± 0.005	0.02 ± 0.003
Nagoya, AICHI	7.0	0.09 ± 0.006	0.08 ± 0.005
Osaka, OSAKA	6.8	0.12 ± 0.006	0.02 ± 0.003
KOBE, HYOGO	6.2	0.12 ± 0.006	0.05 ± 0.004
Wakayama, WAKAYAMA	7.2	0.07 ± 0.005	0.06 ± 0.005
Tottori, TOTTORI	7.5	0.07 ± 0.005	0.01 ± 0.002
Okayama, OKAYAMA	6.7	0.09 ± 0.006	0.03 ± 0.003
Ube, YAMAGUCHI	7.1	0.06 ± 0.005	0.01 ± 0.003
Matsuyama, EHIME	7.0	0.05 ± 0.005	0.02 ± 0.003
Kochi, KOCHI	7.2	0.06 ± 0.006	0.01 ± 0.003
Fukuoka, FUKUOKA	6.9	0.09 ± 0.006	0.07 ± 0.005
Saga, SAGA	7.1	0.07 ± 0.005	0.03 ± 0.003
Nagasaki, NAGASAKI	7.0	0.06 ± 0.005	0.06 ± 0.005
Kagoshima, KAGOSHIMA	7.3	0.04 ± 0.004	0.04 ± 0.004
JUly, 1986			
Sendai, MIYAGI	6.8	0.06 ± 0.004	0.08 ± 0.007
Akita, AKITA	6.8	0.12 ± 0.007	0.13 ± 0.007
Naha, OKINAWA	7.6	0.13 ± 0.007	0.05 ± 0.004

(4) **Strontium-90 and Cesium-137 in Freshwater (from May 1986 to Jul. 1986)**

-continued from NO. 74 of this publication-

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

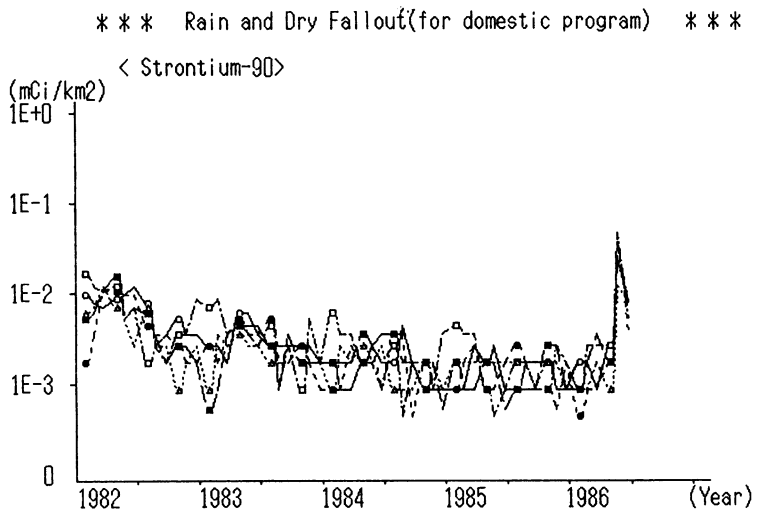
Location	pH	^{90}Sr (pCi/l)	^{137}Cs (pCi/l)
(Freshwater)			
May, 1986			
Kasumigaura, IBARAGI	8.1	0.15 ± 0.007	0.32 ± 0.010
JUly, 1986			
Barato-lake, HOKKAIDO	7.2	0.08 ± 0.005	0.10 ± 0.006

(5) Strontium-90 and Cesium-137 in Soil (from May 1986 to Jul. 1986)

-continued from NO. 74 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)
May, 1986					
Tokai-mura, IBARAGI	0～5	310± 9	10 ±0.3	2000±20	64 ±0.7
〃	5～20	260± 8	17 ±0.6	190± 7	13 ±0.5
Akabane-machi, AICHI	0～5	52± 4.5	3.1±0.27	320± 9	19 ±0.6
〃	5～20	52± 4.7	11 ±1.0	250± 8	54 ±1.7
June, 1986					
Naha, OKINAWA	0～5	39± 4.9	2.1±0.26	150± 6	7.7±0.34
〃	5～20	62± 5.3	12 ±1.1	88± 5.2	18 ±1.0
JUly, 1986					
Wakayama, WAKAYAMA	0～5	43± 4.4	1.5±0.16	140± 6	5.1±0.22
〃	5～20	95± 5.5	15 ±0.9	170± 7	27 ±1.1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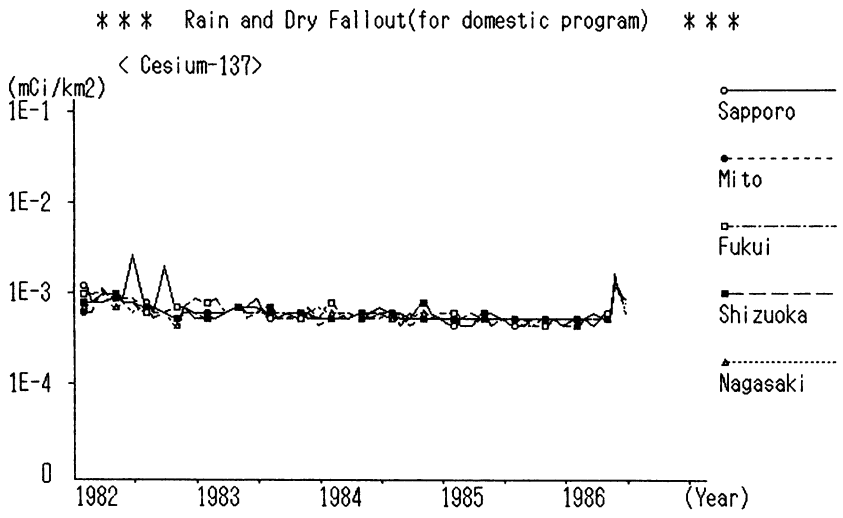
(mCi/km2)
1E+0
1E-1
1E-2
1E-3
0
1982
1983
1984
1985
1986
(Year)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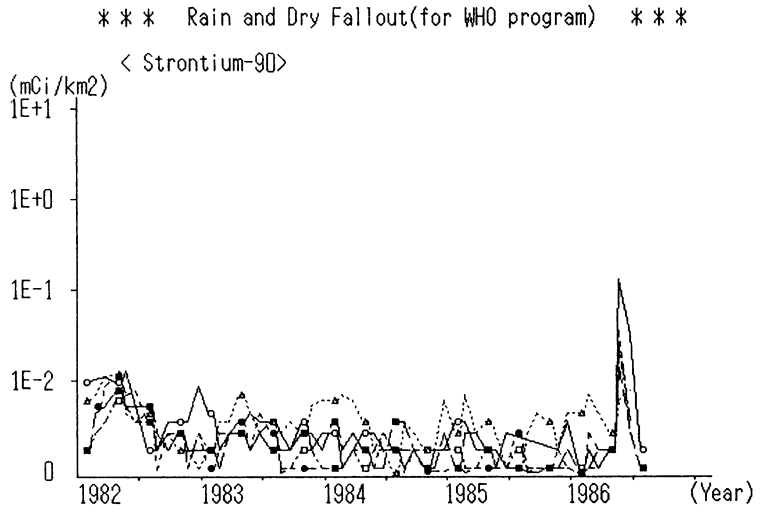
< Cesium-137>
(mCi/km2)
1E-1
1E-2
1E-3
1E-4
0
1982
1983
1984
1985
1986
(Year)
Sapporo
Mito
Fukui
Shizuoka
Nagasaki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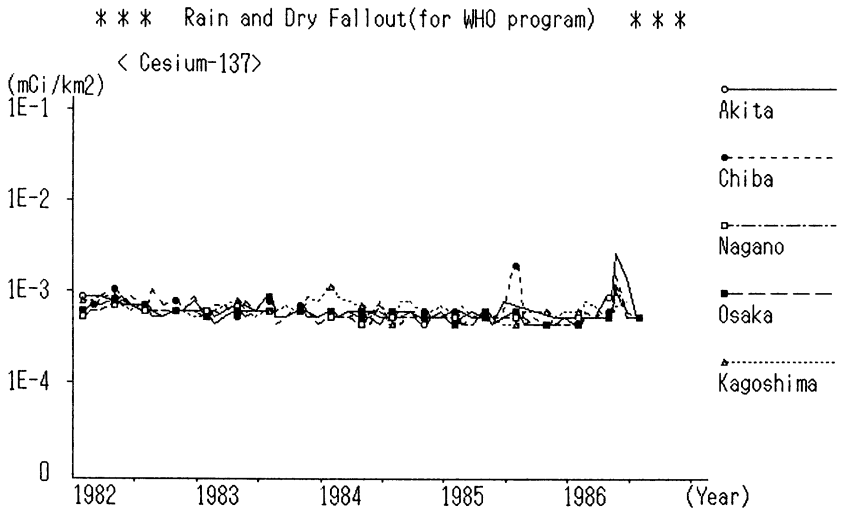
< Strontium-90>
(mCi/km2)
1E+1
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)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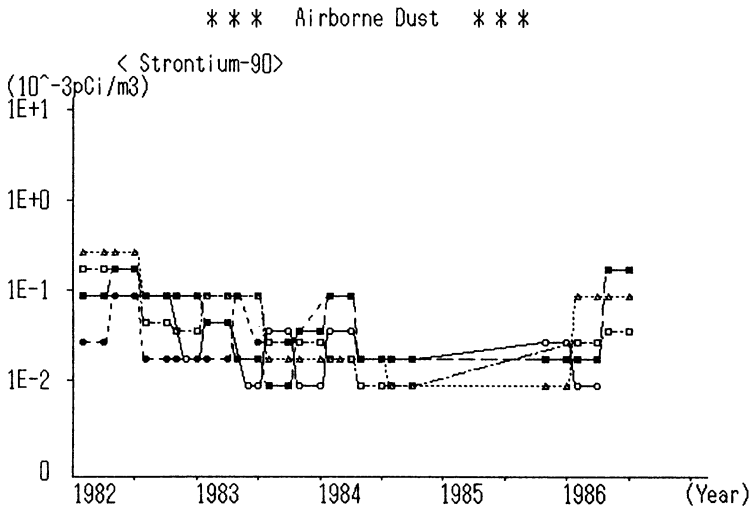
(mCi/km2)
1E-1
1E-2
1E-3
1E-4
0
1982
1983
1984
1985
1986
(Year)
Akita
Chiba
Nagano
Osaka
Kagoshima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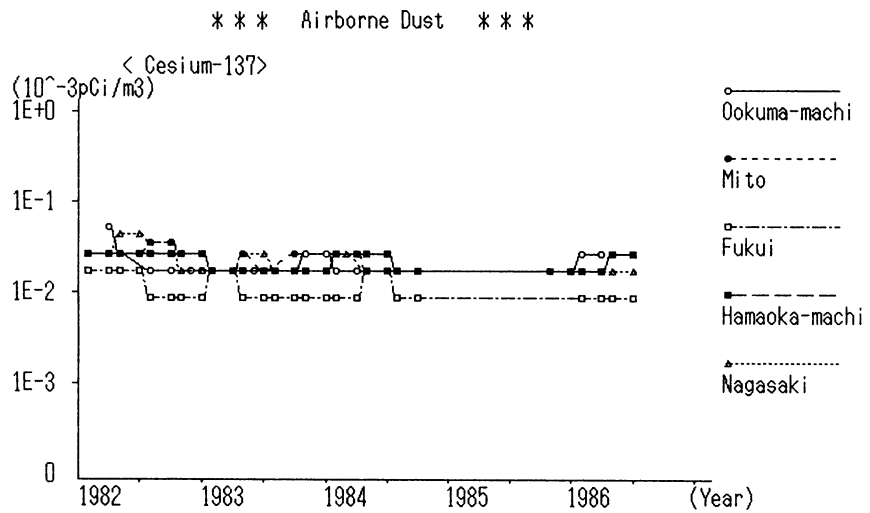
(10^-3pCi/m3)
1E+1
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)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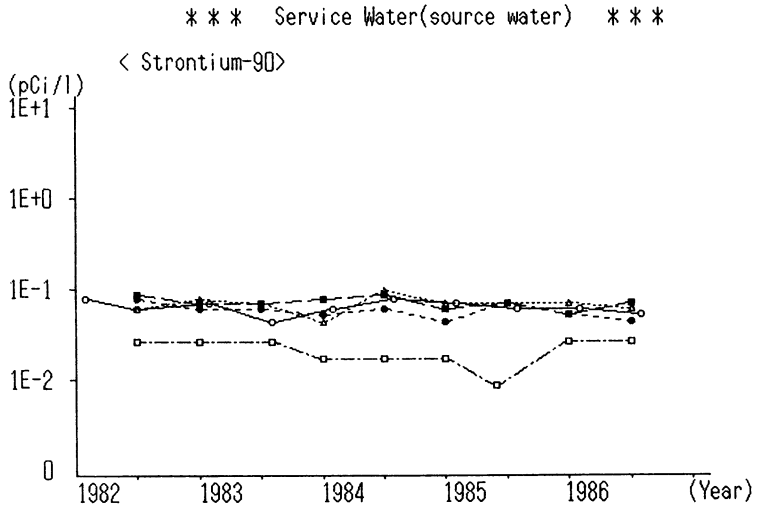
(10^-3pCi/m3)
1E+0
1E-1
1E-2
1E-3
0
1982
1983
1984
1985
1986
(Year)
Ookuma-machi
Mito
Fukui
Hamaoka-machi
Nagasaki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(pCi/l)
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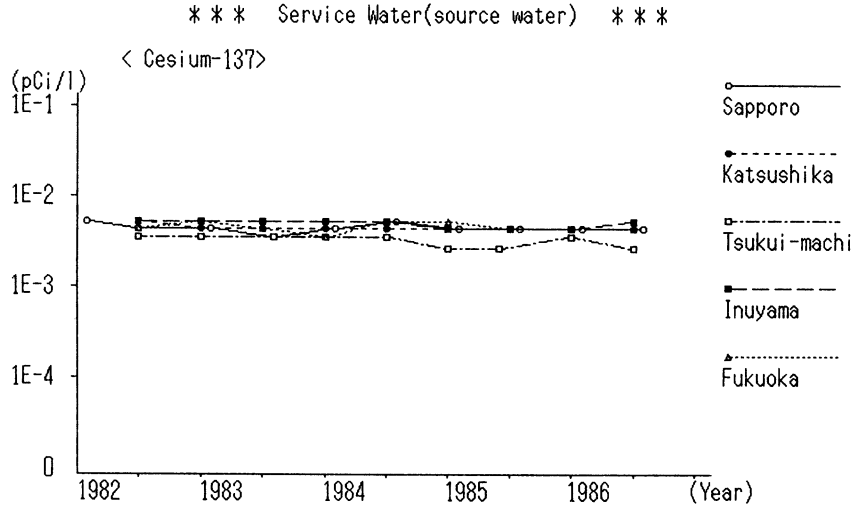
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)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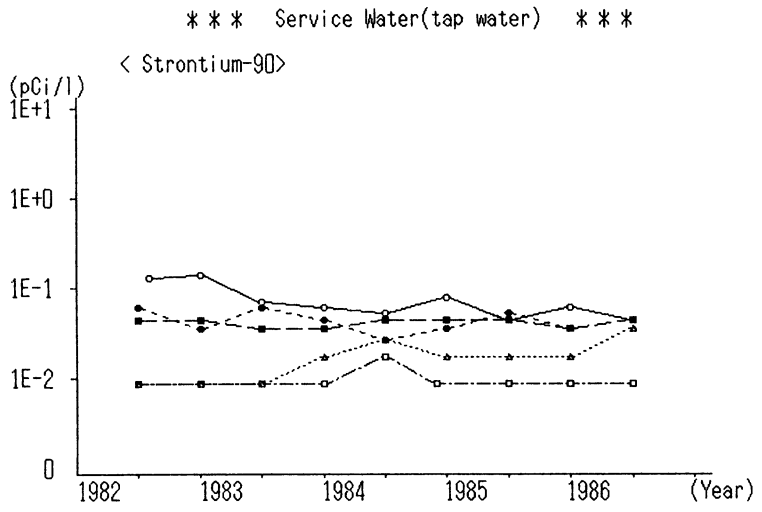
< Cesium-137>
(pCi/l)
1E-1
1E-2
1E-3
1E-4
0
1982
1983
1984
1985
1986
(Year)
Sapporo
Katsushika
Tsukui-machi
Inuyama
Fukuoka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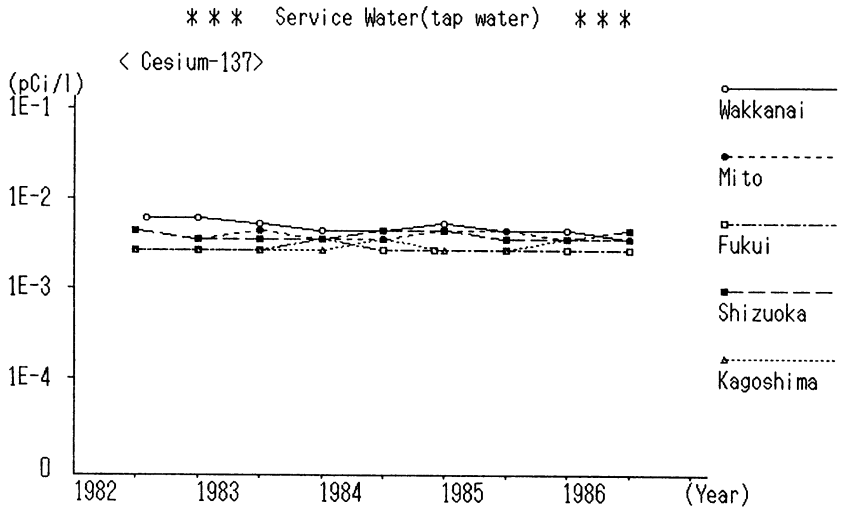
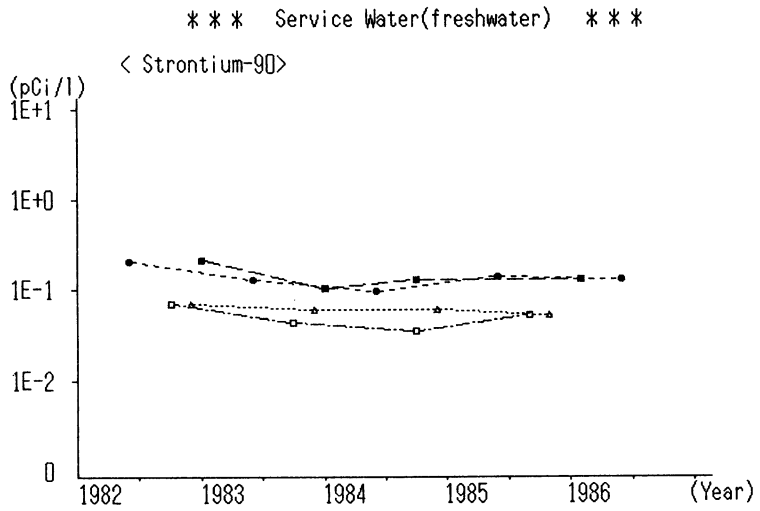
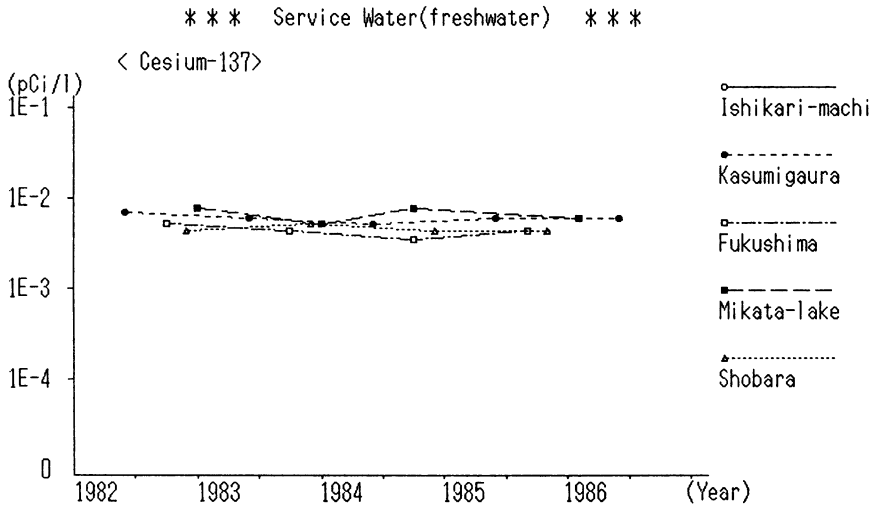
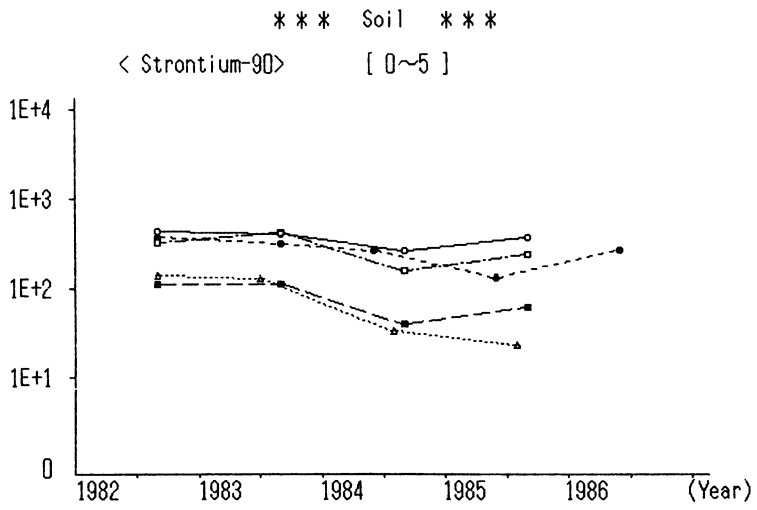
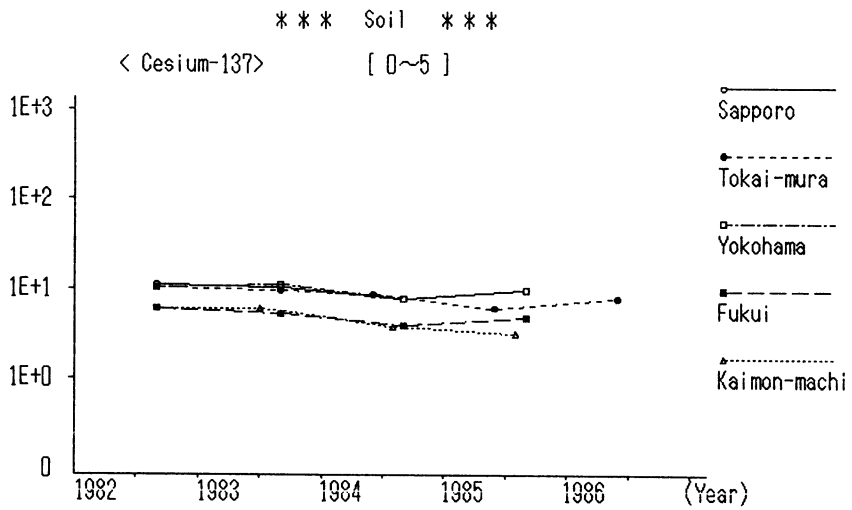
< Strontium-90>
(pCi/l)
1E+1
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)

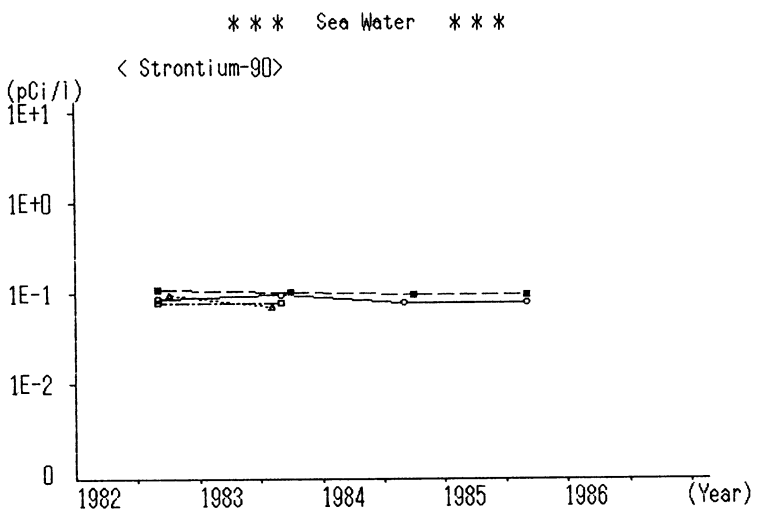

＊＊＊ Service Water(tap water) ＊＊＊
< Cesium-137>
(pCi/l)
1E-1
1E-2
1E-3
1E-4
0
1982
1983
1984
1985
1986
(Year)
Wakkanai
Mito
Fukui
Shizuoka
Kagoshima

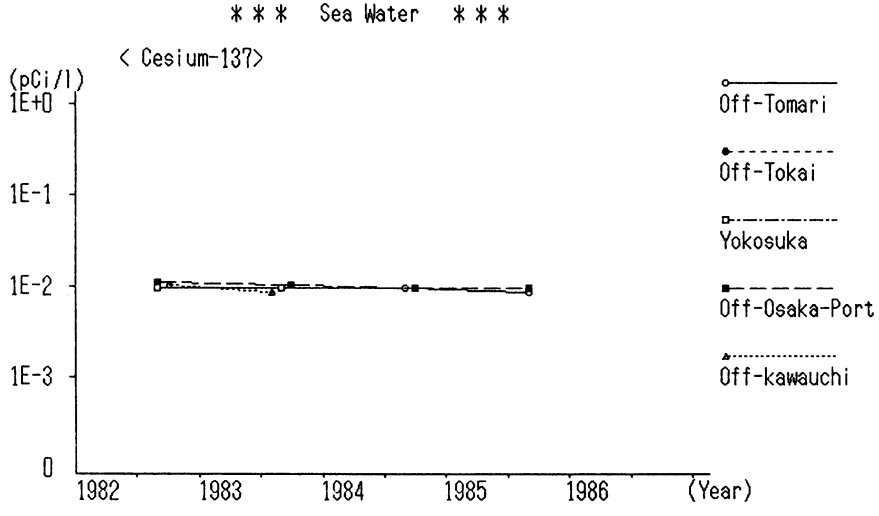

＊＊＊ Service Water(freshwater) ＊＊＊
< Strontium-90>
(pCi/l)
1E+1
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)

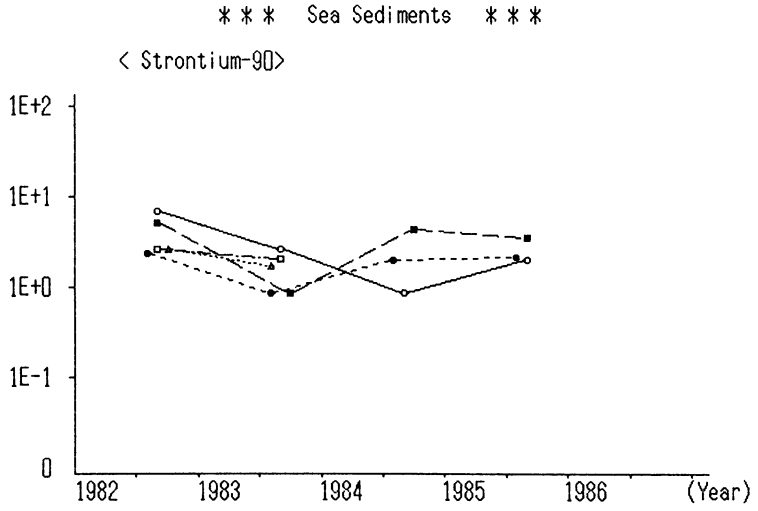

＊＊＊ Service Water(freshwater) ＊＊＊
< Cesium-137>
(pCi/l)
1E-1
1E-2
1E-3
1E-4
0
1982
1983
1984
1985
1986
(Year)
Ishikari-machi
Kasumigaura
Fukushima
Mikata-lake
Shobara


＊＊＊ Soil ＊＊＊
< Strontium-90> [0~5]
1E+4
1E+3
1E+2
1E+1
0
1982
1983
1984
1985
1986
(Year)


＊＊＊ Soil ＊＊＊
< Cesium-137> [0~5]
1E+3
1E+2
1E+1
1E+0
0
1982
1983
1984
1985
1986
(Year)
Sapporo
Tokai-mura
Yokohama
Fukui
Kaimon-machi


＊＊＊ Sea Water ＊＊＊
< Strontium-90>
(pCi/l)
1E+1
1E+0
1E-1
1E-2
0
1982
1983
1984
1985
1986
(Year)


＊＊＊ Sea Water ＊＊＊
< Cesium-137>
(pCi/l)
1E+0
1E-1
1E-2
1E-3
0
1982
1983
1984
1985
1986
(Year)
Off-Tomari
Off-Tokai
Yokosuka
Off-Osaka-Port
Off-kawauchi


＊＊＊ Sea Sediments ＊＊＊
< Strontium-90>
1E+2
1E+1
1E+0
1E-1
0
1982
1983
1984
1985
1986
(Year)

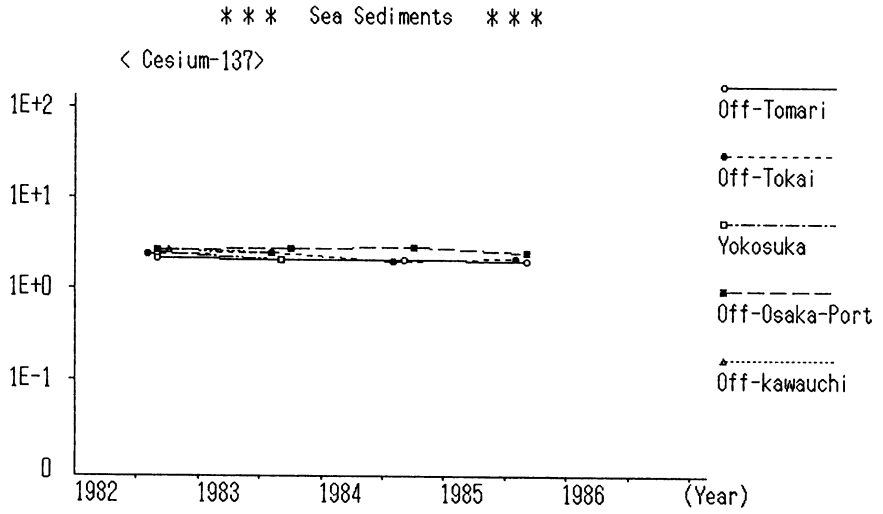
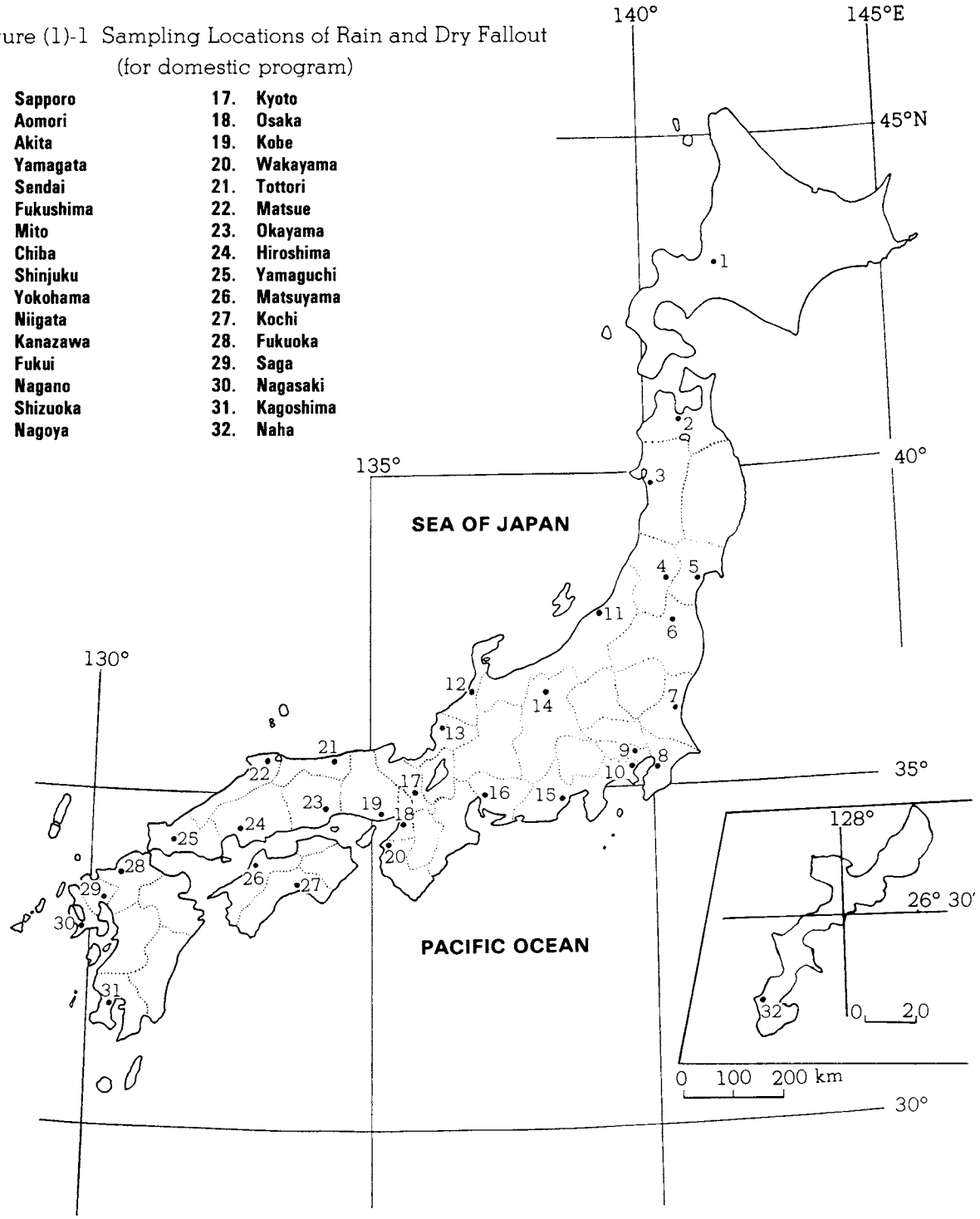

＊＊＊ Sea Sediments ＊＊＊
< Cesium-137>
1E+2
1E+1
1E+0
1E-1
0
1982
1983
1984
1985
1986
(Year)
Off-Tomari
Off-Tokai
Yokosuka
Off-Osaka-Port
Off-kawauchi

Figure (1)-1 Sampling Locations of Rain and Dry Fallout
(for domestic program)

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



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