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RADIOACTIVITY SURVEY DATA in Japan

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National Institute of Radiological Sciences
Chiba, Japan

Radioactivity Survey Data in Japan

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Contents

Environmental and Dietary Materials*

(Japan Chemical Analysis Center)

1. Collection and pretreatment of samples

(1) Rain and dry fallout

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

The sample was filtered after strontium and cesium carriers were added. The tray was washed with 5ℓ 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 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, 100ℓ each, was collected at an intake of the water-treatment plant and at the tap after water was left running for five minutes. Water, to which added carriers of strontium and cesium immediately after sampling, was vigorously stirred and filtered. 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 disturbance on the surface caused by duststorms, inflow and outflow due to precipitation, and so on. 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. In the course of air-drying, lumps were crushed by hand, and roots of plants and pebbles were removed. The soil was then passed through a 2 mm sieve to remove small gravels.

(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 large porcelain dish and dried in an electric oven at 105 to 110 °C to a constant weight.

(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 transferred to a porcelain dish and then ashed at 500°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 (sourse water)	semiyearly (June and December)	100 ℓ
2 Service water (tap water)	semiyearly (June and December)	100 ℓ
3 Freshwater	yearly (fishing season)	100 ℓ
(4) Soil		
1 0 ~ 5 cm	yearly (June or July)	4 kg
2 5 ~ 20 cm	yearly (June or July)	4 kg
(5) Sea water	yearly (July or August)	40 ℓ
(6) Sea sediments	yearly (July or August)	4 kg
= Dietary materials =		
(7) Total diet	semiyearly (June, November or December)	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 (harvesting 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

Air-dried soil was passed through a 20 mesh sieve. The sieved sample was heated, in the presence of strontium and cesium carriers, together with sodium hydroxide. The sample was then heated with hydrochloric acid and the insoluble part was filtered and washed. The combined solution of the filtrate and washings was used for radiochemical analysis.

(3) Sea sediments

After removal of pebbles, shells and other foreign matters, the sediment sample was dried in a hot-air oven and ground finely with a mortar. The sample was passed through a 20 mesh sieve. The further preparation of the sample was the same as that described in the section 2-(2).

(4) Rice

The ashed sample was pulverlized with a porcelain mortar and passed through a 42 mesh sieve. The sieved sample to which both strontium and cesium carriers were added, was digested with hydrochloric 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 part was filtered and washed. The filtrate and washings were combined for subsequent radiochemical analysis.

(5) Airborne dust, diet, milk, vegetable, 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-(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 calcium and strontium were precipitated as oxalates. The precipitate was dissolved in nitric acid and strontium was separated from calcium by successive fuming nitric acid separations. 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 the iron carrier was added. The solution was allowed to stand

for two weeks for strontium-90 and yttrium-90 to attain equilibrium. The 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 in the solution was acidified with hydrochloric acid. While stirring the solution, cesium was adsorbed on ammonium molybdophosphate.

After filtered off and washed with dilute nitric acid, the precipitate was dissolved in 2.5N sodium hydroxide solution. Ammonia was removed completely from the solution by boiling. The solution was adjusted to pH 8.2 with hydrochloric acid and allowed to cool. Molybdenum hydroxide which came out in the solution, was filtered off and washed with water. In such circumstance that ontamination by rubidium-87 was not negligible for the measurement of cesium-137, the following ion-exchange procedure was applied. A fixed amount of ferric chloride solution was added to the solution dissolved with 2.5N sodium hydroxide. Ammonia and molybdenum hydroxide were removed as described above. Ethylenediaminetetraaceticacid tetrasodium salt was added to the filtrate and washings. Cesium and rubidium were adsorbed on a cation exchange resin. Cesium was separated from rubidium by eluting with hydrochloric acid.

To this eluate or the filtrate and washings after removing molybdenum hydroxide, chloroplatinic acid solution was added to precipitate cesium. The precipitate was filtered onto a tared paper in a demountable filter and washed with water and then ethanol. After fixing the filter paper on a tared planchette and drying it, the chemical yield of cesium was determined by weighing the precipitate with the planchette. Radioactivity from cesium-137 was measured for this precipitate.

4. Determination of stable strontium, calcium and potassium

A weighed amount of soil or sea sediment was treated under heating with sodium hydroxide and then with hydrochloric acid for extraction. A weighed aliquot of ashed samples of total diet, vegetables, milk, fish, shellfish or seeweeds was digested using hydrochloric acid or nitric acid, hydrofluoric acid being used when necessary. 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 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 radio activity 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 Jan. 1983 to Jul. 1983)

– continued from No. 62 of this publication –

Table (1)-1: Strontium-90 and Cesium-137 Rain and dry fallout

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
January, 1983				
Sapporo, HOKKAIDO	36	68.5	0.0030 ± 0.0007	0.0040 ± 0.0007
Aomori, AOMORI	29	33.1	0.0030 ± 0.0007	0.0080 ± 0.0008
Ojika-gun, MIYAGI	35	18.3	0.0050 ± 0.0008	0.0030 ± 0.0006
Yamagata, YAMAGATA	29	48.1	0.0030 ± 0.0007	0.0040 ± 0.0007
Futaba-gun, FUKUSHIMA	37	20.0	0.0030 ± 0.0007	0.0020 ± 0.0006
Mito, IBARAGI	28	22.5	0.0030 ± 0.0007	0.0020 ± 0.0006
Shinjuku, TOKYO	33	29.0	0.0020 ± 0.0008	0.0030 ± 0.0007
Yokohama, KANAGAWA	29	45.2	0.0020 ± 0.0006	0.0020 ± 0.0006
Fukui, FUKUI	26	218.3	0.0080 ± 0.0009	0.0110 ± 0.0009
Shizuoka, SHIZUOKA	29	43.5	0.0000 ± 0.0006	0.0010 ± 0.0005
Nagoya, AICHI	28	23.0	0.0030 ± 0.0007	0.0010 ± 0.0005
Kyoto, KYOTO	28	39.9	0.0020 ± 0.0006	0.0000 ± 0.0004
Kobe, HYOGO	36	21.6	0.0020 ± 0.0006	0.0030 ± 0.0006
Tottori, TOTTORI	27	105.3	0.0090 ± 0.0009	0.0100 ± 0.0009
Matsue, SHIMANE	31	68.6	0.0040 ± 0.0007	0.0070 ± 0.0008
Hiroshima, HIROSHIMA	29	39.8	0.0040 ± 0.0007	0.0030 ± 0.0005
Matsuyama, EHIME	35	28.5	0.0040 ± 0.0007	0.0070 ± 0.0008
Dazaifu, FUKUOKA	28	40.6	0.0020 ± 0.0007	0.0030 ± 0.0006
Saga, SAGA	19	30.5	0.0010 ± 0.0007	0.0020 ± 0.0005
Nagasaki, NAGASAKI	29	29.0	0.0010 ± 0.0006	0.0030 ± 0.0006
Nakagami-gun, OKINAWA	30	141.5	0.0070 ± 0.0008	0.0040 ± 0.0007
February, 1983				
Sapporo, HOKKAIDO	29	128.0	0.0030 ± 0.0007	0.0030 ± 0.0007
Aomori, AOMORI	29	70.1	0.0070 ± 0.0009	0.0040 ± 0.0008
Ojika-gun, MIYAGI	29	119.9	0.0030 ± 0.0006	0.0030 ± 0.0006
Yamagata, YAMAGATA	29	87.7	0.0030 ± 0.0007	0.0050 ± 0.0007
Futaba-gun, FUKUSHIMA	29	79.0	0.0020 ± 0.0006	0.0030 ± 0.0006

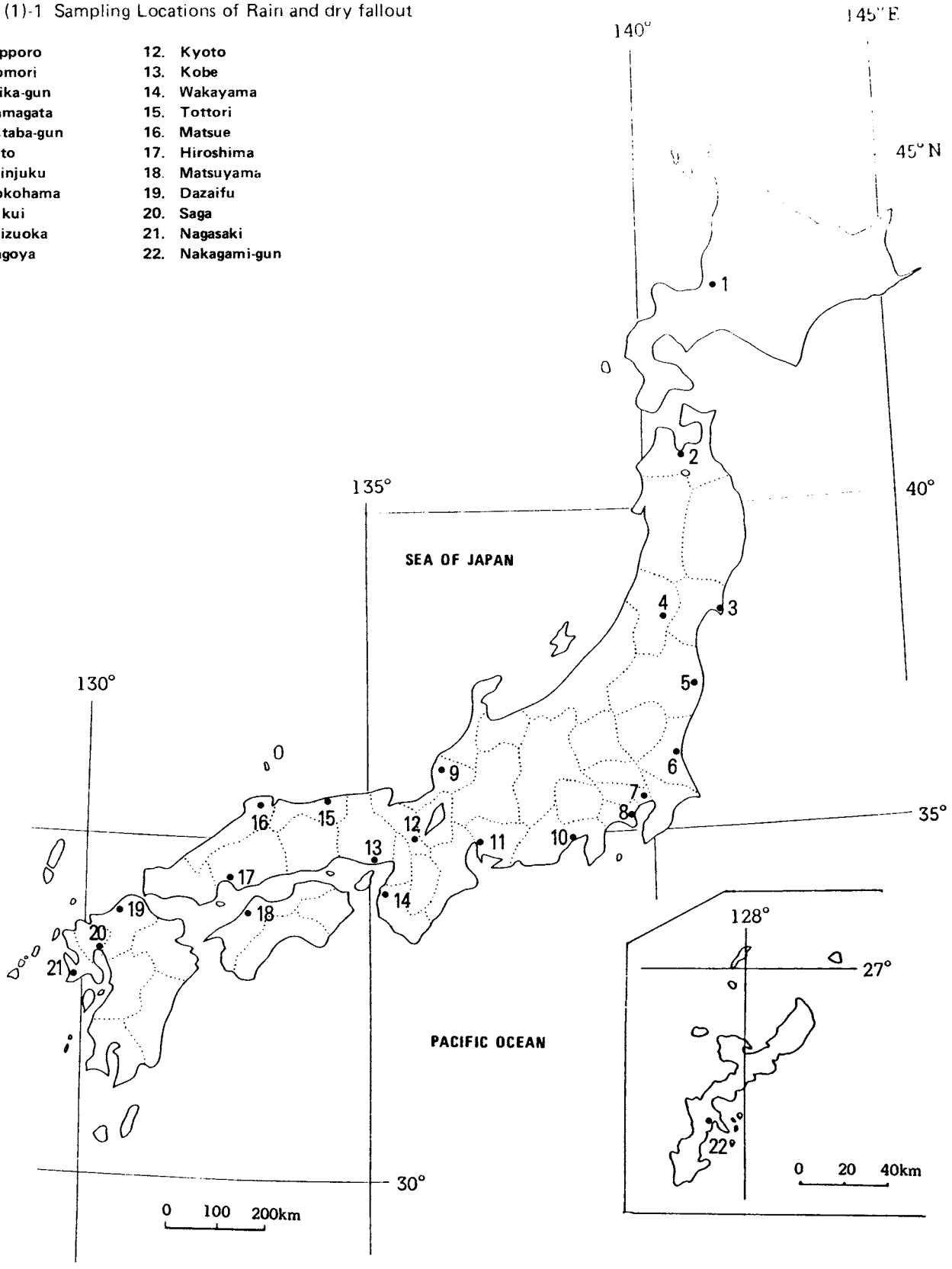
Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
Mito, IBARAGI	29	70.5	0.0020 ± 0.0007	0.0030 ± 0.0006
Shinjuku, TOKYO	29	68.0	0.0020 ± 0.0006	0.0030 ± 0.0006
Yokohama, KANAGAWA	28	75.9	0.0020 ± 0.0006	0.0020 ± 0.0006
Fukui, FUKUI	30	208.4	0.0100 ± 0.0010	0.0150 ± 0.0011
Shizuoka, SHIZUOKA	29	43.5	0.0010 ± 0.0006	0.0000 ± 0.0005
Nagoya, AICHI	29	40.0	0.0030 ± 0.0007	0.0030 ± 0.0006
Kyoto, KYOTO	29	35.9	0.0020 ± 0.0006	0.0010 ± 0.0005
Kobe, HYOGO	27	29.5	0.0020 ± 0.0006	0.0030 ± 0.0006
Wakayama, WAKAYAMA	30	43.5	0.0020 ± 0.0007	0.0010 ± 0.0005
Tottori, TOTTORI	29	144.2	0.0100 ± 0.0009	0.0140 ± 0.0011
Watsue, SHIMANE	31	88.7	0.0060 ± 0.0008	0.0120 ± 0.0009
Hiroshima, HIROSHIMA	29	49.3	0.0030 ± 0.0007	0.0030 ± 0.0006
Matsuyama, EHIME	30	55.0	0.0050 ± 0.0007	0.0080 ± 0.0008
Dazaifu, FUKUOKA	29	78.4	0.0040 ± 0.0007	0.0060 ± 0.0007
Saga, SAGA	27	97.3	0.0030 ± 0.0006	0.0050 ± 0.0007
Nagasaki, NAGASAKI	29	81.5	0.0040 ± 0.0007	0.0040 ± 0.0007
Nakagami-gun, OKINAWA	29	172.5	0.0060 ± 0.0008	0.0050 ± 0.0007
March, 1983				
Sapporo, HOKKAIDO	32	72.0	0.0020 ± 0.0007	0.0030 ± 0.0008
Aomori, AOMORI	32	80.0	0.0050 ± 0.0007	0.0040 ± 0.0008
Ojika-gun, MIYAGI	32	176.3	0.0070 ± 0.0008	0.0060 ± 0.0008
Yamagata, YAMAGATA	32	84.0	0.0030 ± 0.0008	0.0050 ± 0.0007
Futaba-gun, FUKUSHIMA	32	143.0	0.0050 ± 0.0007	0.0050 ± 0.0007
Mito, IBARAGI	32	118.0	0.0040 ± 0.0007	0.0060 ± 0.0007
Shinjuku, TOKYO	32	113.8	0.0030 ± 0.0006	0.0070 ± 0.0009
Yokohama, KANAGAWA	32	151.1	0.0050 ± 0.0007	0.0070 ± 0.0008
Fukui, FUKUI	32	130.1	0.0040 ± 0.0007	0.0080 ± 0.0008
Shizuoka, SHIZUOKA	32	241.0	0.0040 ± 0.0007	0.0080 ± 0.0009
Nagoya, AICHI	32	155.0	0.0040 ± 0.0007	0.0060 ± 0.0007
Kyoto, KYOTO	33	133.3	0.0040 ± 0.0007	0.0040 ± 0.0007
Kobe, HYOGO	34	102.2	0.0030 ± 0.0006	0.0040 ± 0.0007
Wakayama, WAKAYAMA	22	55.5	0.0040 ± 0.0007	0.0040 ± 0.0007
Tottori, TOTTORI	32	205.2	0.0060 ± 0.0008	0.0080 ± 0.0009
Matsue, SHIMANE	32	152.7	0.0060 ± 0.0008	0.0070 ± 0.0008
Hiroshima, HIROSHIMA	32	187.1	0.0060 ± 0.0008	0.0050 ± 0.0007
Matsuyama, EHIME	32	143.0	0.0030 ± 0.0007	0.0070 ± 0.0008
Dazaifu, FUKUOKA	33	176.1	0.0040 ± 0.0007	0.0050 ± 0.0008
Saga, SAGA	31	159.8	0.0030 ± 0.0007	0.0030 ± 0.0006
Nagasaki, NAGASAKI	32	172.5	0.0030 ± 0.0007	0.0050 ± 0.0007
Nakagami-gun, OKINAWA	31	412.0	0.0060 ± 0.0008	0.0100 ± 0.0009

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
April, 1983				
Sapporo, HOKKAIDO	32	24.5	0.0070 ± 0.0008	0.0170 ± 0.0011
Aomori, AOMORI	32	30.9	0.0070 ± 0.0008	0.0100 ± 0.0009
Ojika-gun, MIYAGI	31	107.1	0.0110 ± 0.0010	0.0060 ± 0.0008
Yamagata, YAMAGATA	31	70.1	0.0050 ± 0.0008	0.0050 ± 0.0008
Futaba-gun, FUKUSHIMA	28	136.0	0.0030 ± 0.0008	0.0050 ± 0.0008
Mito, IBARAGI	32	158.5	0.0060 ± 0.0008	0.0070 ± 0.0008
Shinjuku, TOKYO	31	123.6	0.0030 ± 0.0007	0.0070 ± 0.0008
Yokohama, KANAGAWA	31	171.9	0.0040 ± 0.0007	0.0050 ± 0.0007
Fukui, FUKUI	32	186.3	0.0050 ± 0.0008	0.0160 ± 0.0011
Shizuoka, SHIZUOKA	32	389.5	0.0050 ± 0.0008	0.0060 ± 0.0008
Nagoya, AICHI	34	165.0	0.0050 ± 0.0007	0.0080 ± 0.0008
Kyoto, KYOTO	31	188.9	0.0040 ± 0.0006	0.0040 ± 0.0007
Kobe, HYOGO	29	142.9	0.0040 ± 0.0007	0.0050 ± 0.0008
Wakayama, WAKAYAMA	34	164.9	0.0050 ± 0.0008	0.0060 ± 0.0009
Tottori, TOTTORI	32	147.3	0.0110 ± 0.0010	0.0090 ± 0.0009
Hiroshima, HIROSHIMA	31	164.3	0.0060 ± 0.0008	0.0070 ± 0.0008
Matsuyama, EHIME	32	145.5	0.0040 ± 0.0007	0.0050 ± 0.0007
Dazaifu, FUKUOKA	30	208.2	0.0060 ± 0.0008	0.0070 ± 0.0008
Saga, SAGA	37	355.4	0.0050 ± 0.0008	0.0090 ± 0.0009
Nagasaki, NAGASAKI	32	156.5	0.0040 ± 0.0008	0.0050 ± 0.0007
Nakagami-gun, OKINAWA	31	156.5	0.0050 ± 0.0007	0.0040 ± 0.0007
May, 1983				
Sapporo, HOKKAIDO	31	43.0	0.0070 ± 0.0008	0.0100 ± 0.0009
Aomori, AOMORI	31	90.9	0.0060 ± 0.0007	0.0070 ± 0.0008
Ojika-gun, MIYAGI	32	100.1	0.0080 ± 0.0008	0.0070 ± 0.0009
Yamagata, YAMAGATA	32	62.1	0.0040 ± 0.0008	0.0050 ± 0.0008
Futaba-gun, FUKUSHIMA	34	139.0	0.0030 ± 0.0007	0.0050 ± 0.0008
Mito, IBARAGI	31	98.5	0.0040 ± 0.0007	0.0040 ± 0.0007
Shinjuku, TOKYO	32	105.4	0.0040 ± 0.0007	0.0070 ± 0.0008
Yokohama, KANAGAWA	32	172.8	0.0050 ± 0.0007	0.0030 ± 0.0007
Fukui, FUKUI	33	124.9	0.0040 ± 0.0006	0.0060 ± 0.0008
Shizuoka, SHIZUOKA	30	269.5	0.0050 ± 0.0008	0.0060 ± 0.0008
Nagoya, AICHI	29	88.0	0.0010 ± 0.0006	0.0030 ± 0.0007
Kyoto, KYOTO	31	122.6	0.0020 ± 0.0006	0.0030 ± 0.0007
Kobe, HYOGO	33	126.7	0.0040 ± 0.0007	0.0060 ± 0.0008
Wakayama, WAKAYAMA	28	104.8	0.0040 ± 0.0007	0.0040 ± 0.0008
Tottori, TOTTORI	31	99.9	0.0090 ± 0.0009	0.0050 ± 0.0008
Hiroshima, HIROSHIMA	32	139.3	0.0050 ± 0.0008	0.0040 ± 0.0007
Matsuyama, EHIME	31	134.5	0.0030 ± 0.0006	0.0030 ± 0.0007

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
Dazaifu, FUKUOKA	33	178.7	0.0030 ± 0.0006	0.0040 ± 0.0007
Saga, SAGA	29	95.6	0.0040 ± 0.0007	0.0030 ± 0.0007
Nagasaki, NAGASAKI	31	262.5	0.0030 ± 0.0007	0.0040 ± 0.0007
Nakagami-gun, OKINAWA	36	221.5	0.0030 ± 0.0007	0.0040 ± 0.0007
June, 1983				
Sapporo, HOKKAIDO	31	59.0	0.0040 ± 0.0010	0.0060 ± 0.0007
Aomori, AOMORI	31	108.4	0.0090 ± 0.0012	0.0060 ± 0.0007
Ojika-gun, MIYAGI	31	184.3	0.0100 ± 0.0009	0.0110 ± 0.0009
Yamagata, YAMAGATA	31	56.6	0.0050 ± 0.0008	0.0070 ± 0.0008
Futaba-gun, FUKUSHIMA	32	143.0	0.0060 ± 0.0008	0.0080 ± 0.0008
Mito, IBARAGI	31	190.5	0.0040 ± 0.0007	0.0050 ± 0.0008
Shinjuku, TOKYO	31	172.2	0.0040 ± 0.0007	0.0060 ± 0.0007
Yokohama, KANAGAWA	32	225.1	0.0060 ± 0.0008	0.0090 ± 0.0009
Fukui, FUKUI	28	95.2	0.0030 ± 0.0007	0.0050 ± 0.0007
Nagoya, AICHI	31	259.0	0.0040 ± 0.0007	0.0050 ± 0.0008
Kobe, HYOGO	30	182.3	0.0040 ± 0.0008	0.0040 ± 0.0007
Wakayama, WAKAYAMA	31	155.6	0.0030 ± 0.0007	0.0020 ± 0.0007
Tottori, TOTTORI	31	143.8	0.0070 ± 0.0009	0.0050 ± 0.0008
Hiroshima, HIROSHIMA	31	197.2	0.0070 ± 0.0008	0.0050 ± 0.0007
Matsuyama, EHIME	31	143.5	0.0010 ± 0.0007	0.0020 ± 0.0005
Dazaifu, FUKUOKA	31	165.1	0.0030 ± 0.0007	0.0020 ± 0.0005
Nagasaki, NAGASAKI	30	279.5	0.0030 ± 0.0007	0.0030 ± 0.0007
Nakagami-gun, OKINAWA	25	122.5	0.0020 ± 0.0007	0.0020 ± 0.0005
July, 1983				
Yamagata, YAMAGATA	32	162.1	0.0030 ± 0.0006	0.0030 ± 0.0006
Futaba-gun, FUKUSHIMA	32	251.5	0.0040 ± 0.0007	0.0070 ± 0.0008
Kobe, HYOGO	32	170.5	0.0000 ± 0.0009	0.0020 ± 0.0005
Hiroshima, HIROSHIMA	32	242.4	0.0040 ± 0.0008	0.0010 ± 0.0005

Figure (1)-1 Sampling Locations of Rain and dry fallout

1. Sapporo
2. Aomori
3. Ojika-gun
4. Yamagata
5. Futaba-gun
6. Mito
7. Shinjuku
8. Yokohama
9. Fukui
10. Shizuoka
11. Nagoya
12. Kyoto
13. Kobe
14. Wakayama
15. Tottori
16. Matsue
17. Hiroshima
18. Matsuyama
19. Dazaifu
20. Saga
21. Nagasaki
22. Nakagami-gun



(1)-2 Strontium-90 and Cesium-137 in Rain and dry Fallout (for WHO program) (from Jan. 1983 to Jul. 1983)

– continued from No. 62 of this publication –

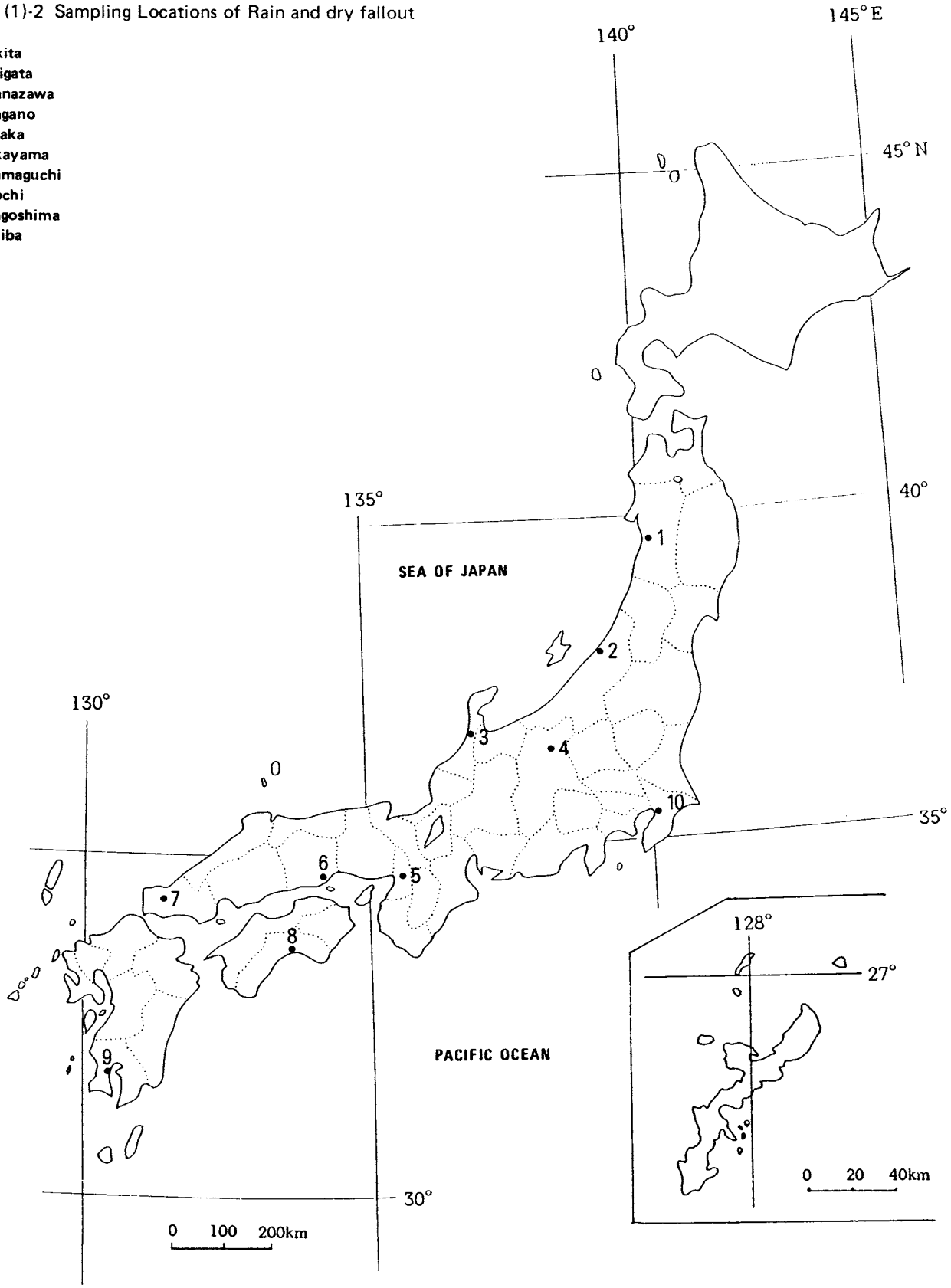
Table (1)-2: Strontium-90 and Cesium-137 in Rain and dry fallout

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
January, 1983				
Akita, AKITA	29	79.4	0.0050 ± 0.0007	0.0080 ± 0.0008
Niigata, NIIGATA	28	102.6	0.0050 ± 0.0008	0.0120 ± 0.0010
Kanazawa, ISHIKAWA	29	240.0	0.0090 ± 0.0009	0.0110 ± 0.0010
Nagano, NAGANO	29	32.0	0.0020 ± 0.0007	0.0010 ± 0.0005
Osaka, OSAKA	33	42.2	0.0020 ± 0.0006	0.0020 ± 0.0005
Okayama, OKAYAMA	29	27.0	0.0020 ± 0.0006	0.0010 ± 0.0005
Yamaguchi, YAMAGUCHI	27	70.0	0.0070 ± 0.0008	0.0030 ± 0.0006
Kochi, KOCHI	28	22.5	0.0030 ± 0.0006	0.0000 ± 0.0005
Kagoshima, KAGOSHIMA	28	44.7	0.0020 ± 0.0006	0.0020 ± 0.0005
Chiba, CHIBA	28	35.8	0.0010 ± 0.0006	0.0040 ± 0.0007
Feburary, 1983				
Akita, AKITA	29	72.6	0.0020 ± 0.0006	0.0050 ± 0.0007
Niigata, NIIGATA	29	167.9	0.0060 ± 0.0008	0.0120 ± 0.0010
Kanazawa, ISHIKAWA	30	215.0	0.0100 ± 0.0010	0.0170 ± 0.0011
Nagano, NAGANO	29	27.0	0.0030 ± 0.0007	0.0030 ± 0.0006
Osaka, OSAKA	29	33.7	0.0010 ± 0.0005	0.0030 ± 0.0006
Okayama, OKAYAMA	29	31.2	0.0020 ± 0.0006	0.0020 ± 0.0005
Yamaguchi, YAMAGUCHI	30	43.5	0.0090 ± 0.0009	0.0060 ± 0.0007
Kochi, KOCHI	29	63.6	0.0040 ± 0.0007	0.0030 ± 0.0006
Kagoshima, KAGOSHIMA	29	97.5	0.0040 ± 0.0007	0.0060 ± 0.0007
Chiba, CHIBA	29	87.1	0.0020 ± 0.0008	0.0030 ± 0.0005
March, 1983				
Akita, AKITA	32	97.9	0.0030 ± 0.0007	0.0050 ± 0.0007
Niigata, NIIGATA	32	72.2	0.0050 ± 0.0008	0.0070 ± 0.0008
Kanazawa, ISHIKAWA	31	166.0	0.0060 ± 0.0008	0.0090 ± 0.0009
Nagano, NAGANO	32	73.5	0.0030 ± 0.0006	0.0030 ± 0.0007
Osaka, OSAKA	31	121.3	0.0030 ± 0.0006	0.0030 ± 0.0005
Okayama, OKAYAMA	32	121.2	0.0030 ± 0.0007	0.0050 ± 0.0007
Yamaguchi, YAMAGUCHI	31	271.0	0.0060 ± 0.0008	0.0060 ± 0.0008
Kochi, KOCHI	32	261.7	0.0080 ± 0.0009	0.0070 ± 0.0008
Kagoshima, KAGOSHIMA	32	307.0	0.0040 ± 0.0008	0.0040 ± 0.0007
Chiba, CHIBA	32	136.1	0.0030 ± 0.0008	0.0050 ± 0.0007

Location	Duration (days)	Precipitation (mm)	^{90}Sr (mCi/km^2)	^{137}Cs (mCi/km^2)
April, 1983				
Akita, AKITA	32	112.9	0.0040 ± 0.0008	0.0110 ± 0.0010
Niigata, NIIGATA	32	97.4	0.0090 ± 0.0009	0.0130 ± 0.0010
Kanazawa, ISHIKAWA	32	187.5	0.0090 ± 0.0009	0.0110 ± 0.0009
Nagano, NAGANO	32	79.0	0.0030 ± 0.0007	0.0030 ± 0.0007
Osaka, OSAKA	33	148.4	0.0030 ± 0.0007	0.0060 ± 0.0008
Okayama, OKAYAMA	32	120.1	0.0030 ± 0.0007	0.0050 ± 0.0008
Yamaguchi, YAMAGUCHI	31	220.0	0.0090 ± 0.0009	0.0090 ± 0.0009
Kochi, KOCHI	31	338.0	0.0100 ± 0.0009	0.0100 ± 0.0009
Kagoshima, KAGOSHIMA	32	554.1	0.0080 ± 0.0009	0.0090 ± 0.0009
Chiba, CHIBA	34	133.2	0.0040 ± 0.0006	0.0080 ± 0.0007
May, 1983				
Akita, AKITA	31	103.1	0.0050 ± 0.0008	0.0050 ± 0.0008
Niigata, NIIGATA	31	67.3	0.0030 ± 0.0006	0.0070 ± 0.0008
Kanazawa, ISHIKAWA	31	104.5	0.0020 ± 0.0006	0.0030 ± 0.0007
Nagano, NAGANO	31	85.6	0.0020 ± 0.0006	0.0030 ± 0.0007
Osaka, OSAKA	31	120.4	0.0020 ± 0.0007	0.0020 ± 0.0006
Okayama, OKAYAMA	31	93.2	0.0020 ± 0.0007	0.0030 ± 0.0007
Yamaguchi, YAMAGUCHI	32	130.5	0.0060 ± 0.0007	0.0050 ± 0.0008
Kochi, KOCHI	32	199.4	0.0060 ± 0.0007	0.0040 ± 0.0007
Kagoshima, KAGOSHIMA	31	347.5	0.0050 ± 0.0007	0.0060 ± 0.0008
Chiba, CHIBA	29	77.0	0.0020 ± 0.0009	0.0040 ± 0.0006
June, 1983				
Akita, AKITA	31	189.2	0.0040 ± 0.0007	0.0070 ± 0.0008
Niigata, NIIGATA	31	54.0	0.0040 ± 0.0007	0.0040 ± 0.0007
Kanazawa, ISHIKAWA	30	87.0	0.0040 ± 0.0008	0.0040 ± 0.0007
Nagano, NAGANO	31	80.5	0.0030 ± 0.0007	0.0030 ± 0.0007
Osaka, OSAKA	31	173.4	0.0030 ± 0.0007	0.0030 ± 0.0007
Okayama, OKAYAMA	31	126.3	0.0030 ± 0.0007	0.0030 ± 0.0006
Yamaguchi, YAMAGUCHI	31	281.5	0.0070 ± 0.0009	0.0030 ± 0.0006
Kochi, KOCHI	30	228.4	0.0070 ± 0.0011	0.0030 ± 0.0007
Kagoshima, KAGOSHIMA	31	603.0	0.0030 ± 0.0006	0.0050 ± 0.0008
Chiba, CHIBA	31	228.5	0.0050 ± 0.0007	0.0070 ± 0.0007
July, 1983				
Akita, AKITA	32	167.4	0.0040 ± 0.0007	0.0060 ± 0.0007
Kanazawa, ISHIKAWA	31	495.5	0.0040 ± 0.0007	0.0050 ± 0.0006
Osaka, OSAKA	32	193.7	0.0020 ± 0.0010	0.0020 ± 0.0005
Okayama, OKAYAMA	32	143.1	0.0030 ± 0.0007	0.0010 ± 0.0005
Chiba, CHIBA	32	204.7	0.0030 ± 0.0009	0.0060 ± 0.0006

Figure (1)-2 Sampling Locations of Rain and dry fallout

1. Akita
2. Niigata
3. Kanazawa
4. Nagano
5. Osaka
6. Okayama
7. Yamaguchi
8. Kochi
9. Kagoshima
10. Chiba



(2) Strontium-90 and Cesium-137 in Airborne dust (from Oct. 1982 to Jun. 1983)

– continued from No. 62 of this publication –

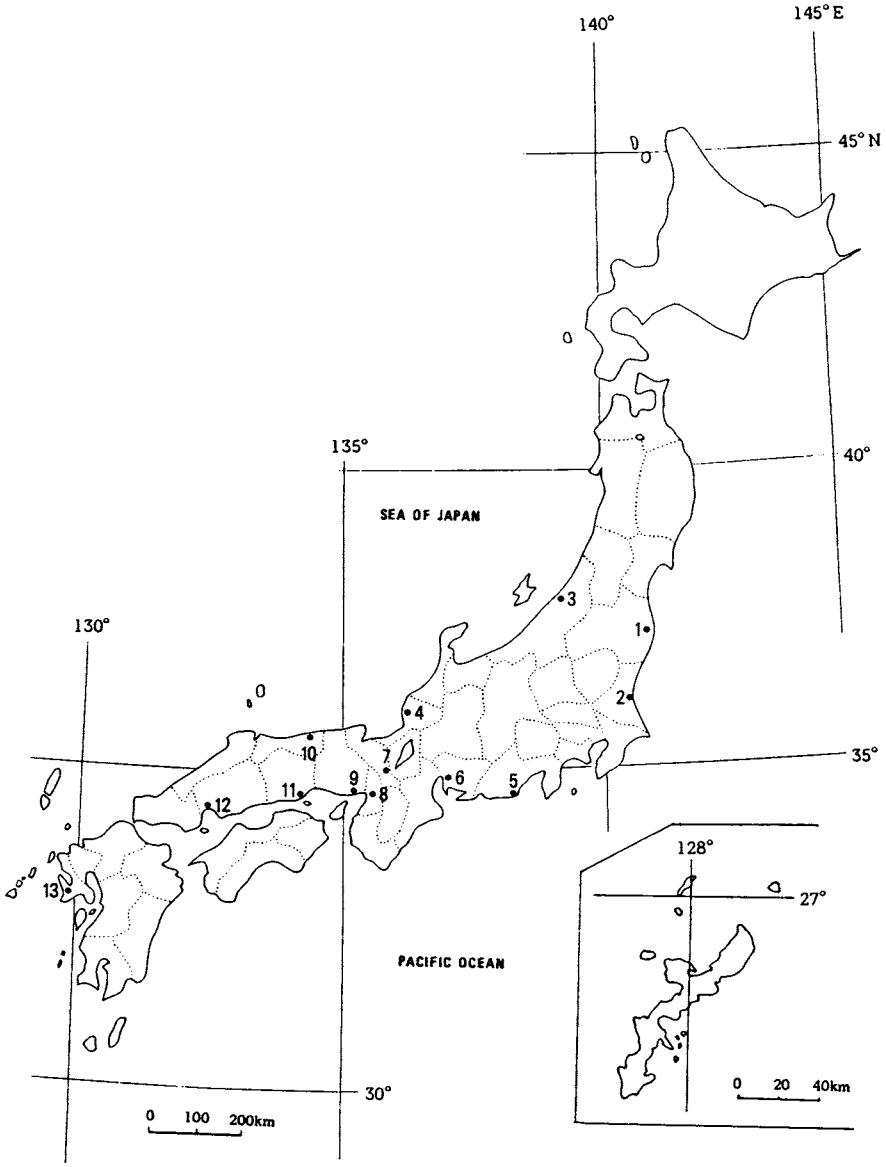
Table (2): Strontium-90 and Cesium-137 in Airborne dust

Location	Sampling period	Absorption volume (m^3)	^{90}Sr (10^{-3} pCi/m^3)	^{137}Cs (10^{-3} pCi/m^3)
October ~ December, 1982				
Mito, IBARAGI	10 ~ 12	10,368	0.02 ± 0.03	0.01 ± 0.01
Niigata, NIIGATA	10 ~ 12	14,520	0.10 ± 0.02	0.10 ± 0.01
Fukui, FUKUI	10 ~ 12	24,616	0.04 ± 0.01	0.10 ± 0.01
Ogasa-gun, SHIZUOKA	10 ~ 12	11,246	0.10 ± 0.03	0.10 ± 0.02
Nagoya, AICHI	10 ~ 12	10,103	0.04 ± 0.03	0.04 ± 0.03
Kyoto, KYOTO	10 ~ 12	9,867	0.02 ± 0.03	0.10 ± 0.02
Osaka, OSAKA	10 ~ 12	7,776	0.10 ± 0.04	0.10 ± 0.02
Kobe, HYOGO	10 ~ 12	9,724	0.05 ± 0.03	0.10 ± 0.02
Tottori, TOTTORI	10 ~ 12	12,058	0.00 ± 0.02	0.05 ± 0.01
Okayama, OKAYAMA	10 ~ 12	10,176	0.10 ± 0.03	0.10 ± 0.02
Hiroshima, HIROSHIMA	10 ~ 12	10,800	0.04 ± 0.03	0.10 ± 0.02
Nagasaki, NAGASAKI	10 ~ 12	12,953	0.10 ± 0.02	0.10 ± 0.02
November ~ December, 1982				
Futaba-gun, FUKUSHIMA	11 ~ 12	13,843	0.00 ± 0.02	0.02 ± 0.01
January ~ March, 1983				
Futaba-gun, FUKUSHIMA	1 ~ 3	15,899	0.05 ± 0.02	0.10 ± 0.01
Mito, IBARAGI	1 ~ 3	10,368	0.00 ± 0.02	0.02 ± 0.01
Niigata, NIIGATA	1 ~ 3	14,497	0.02 ± 0.02	0.10 ± 0.02
Fukui, FUKUI	1 ~ 3	21,074	0.10 ± 0.02	0.10 ± 0.01
Ogasa-gun, SHIZUOKA	1 ~ 3	11,813	0.05 ± 0.02	0.10 ± 0.02
Nagoya, AICHI	1 ~ 3	10,214	0.10 ± 0.03	0.05 ± 0.02
Kyoto, KYOTO	1 ~ 3	10,340	0.03 ± 0.02	0.10 ± 0.02
Osaka, OSAKA	1 ~ 3	7,776	0.10 ± 0.03	0.05 ± 0.02
Kobe, HYOGO	1 ~ 3	9,964	0.10 ± 0.03	0.10 ± 0.02
Tottori, TOTTORI	1 ~ 3	12,246	0.04 ± 0.02	0.03 ± 0.01
Okayama, OKAYAMA	1 ~ 3	11,328	0.10 ± 0.03	0.10 ± 0.02
Hiroshima, HIROSHIMA	1 ~ 3	10,800	0.04 ± 0.03	0.10 ± 0.02
Nagasaki, NAGASAKI	1 ~ 3	14,451	0.10 ± 0.02	0.10 ± 0.02
April ~ June, 1983				
Niigata, NIIGATA	4 ~ 6	14,032	0.10 ± 0.02	0.10 ± 0.02
Fukui, FUKUI	4 ~ 6	22,278	0.10 ± 0.01	0.10 ± 0.01

Location	Sampling period	Absorption volume (m^3)	^{90}Sr (10^{-3} pCi/m^3)	^{137}Cs (10^{-3} pCi/m^3)
Nagoya, AICHI	4 ~ 6	9,635	0.10 ± 0.03	0.10 ± 0.02
Kyoto, KYTOTO	4 ~ 6	10,751	0.10 ± 0.03	0.10 ± 0.02
Osaka, OSAKA	4 ~ 6	7,582	0.10 ± 0.04	0.10 ± 0.03
Kobe, HYOGO	4 ~ 6	9,948	0.20 ± 0.04	0.30 ± 0.03
Tottori, TOTTORI	4 ~ 6	13,863	0.10 ± 0.02	0.10 ± 0.02
Hiroshima, HIROSHIMA	4 ~ 6	10,040	0.10 ± 0.04	0.20 ± 0.03
Nagasaki, NAGASAKI	4 ~ 6	11,968	0.10 ± 0.03	0.20 ± 0.02

Figure (2) Sampling Location of Airborne dust

1. Futaba-gun
2. Mito
3. Niigata
4. Fukui
5. Ogasa-gun
6. Nagoya
7. Kyoto
8. Osaka
9. Kobe
10. Tottori
11. Okayama
12. Hiroshima
13. Nagasaki



(3) Strontium-90 and Cesium-137 in Service water (from Dec. 1982 to Jul. 1983)

– continued from No. 62 of this publication –

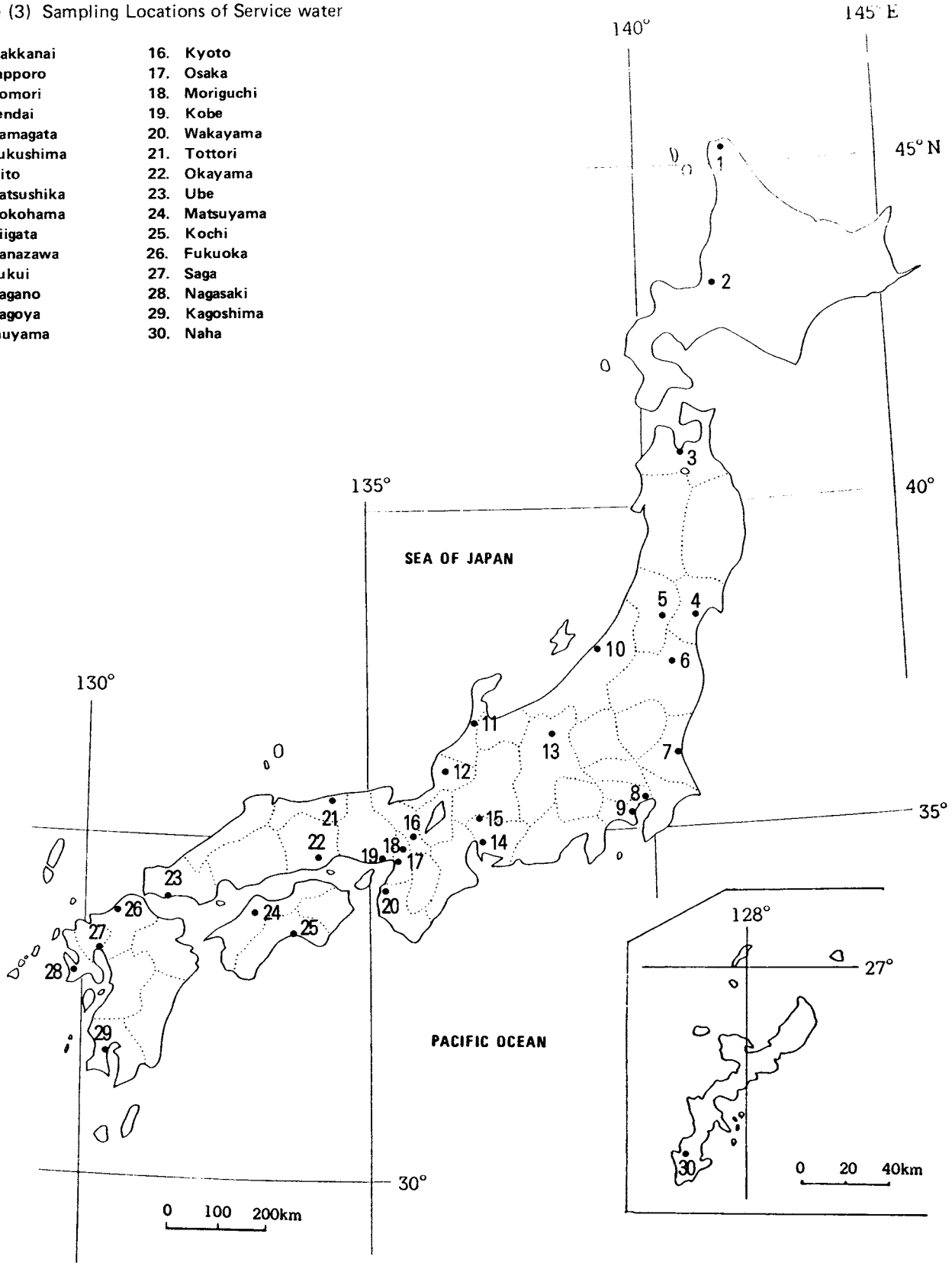
Table (3): Strontium-90 and Cesium-137 in Service water

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
(Source Water)			
December, 1982			
Katsushika, TOKYO	6.9	0.070 ± 0.005	0.003 ± 0.002
Moriguchi, OSAKA	7.2	0.170 ± 0.007	0.010 ± 0.002
Fukuoka, FUKUOKA	7.0	0.090 ± 0.006	0.010 ± 0.002
January, 1983			
Sapproro, HOKKAIDO	7.0	0.080 ± 0.005	0.001 ± 0.002
Kyoto, KYOTO	6.6	0.210 ± 0.008	0.010 ± 0.003
June, 1983			
Katsushika, TOKYO	6.7	0.070 ± 0.005	0.020 ± 0.004
Inuyama, AICHI	7.1	0.080 ± 0.006	0.010 ± 0.003
Moriguchi, OSAKA	7.0	0.190 ± 0.007	0.020 ± 0.003
Fukuoka, FUKUOKA	6.5	0.080 ± 0.005	0.003 ± 0.003
July, 1983			
Sapporo, HOKKAIDO	7.0	0.050 ± 0.004	0.005 ± 0.003
(Tap Water)			
December, 1982			
Wakkanai, HOKKAIDO	6.8	0.160 ± 0.007	0.000 ± 0.002
Aomori, AOMORI	7.3	0.050 ± 0.005	0.010 ± 0.003
Fukushima, FUKUSHIMA	–	0.140 ± 0.007	0.005 ± 0.002
Katsushika, TOKYO	6.7	0.070 ± 0.005	0.010 ± 0.002
Niigata, NIIGATA	7.0	0.140 ± 0.007	0.010 ± 0.002
Kanazawa, ISHIKAWA	7.0	0.120 ± 0.006	0.010 ± 0.002
Osaka, OSAKA	6.8	0.150 ± 0.007	0.000 ± 0.002
Okayama, OKAYAMA	6.8	0.080 ± 0.006	0.000 ± 0.002
Matsuyama, EHIME	7.4	0.060 ± 0.005	0.000 ± 0.002
Fukuoka, FUKUOKA	7.0	0.100 ± 0.006	0.003 ± 0.003
Nagasaki, NAGASAKI	7.0	0.100 ± 0.006	0.001 ± 0.003
January, 1983			
Kyoto, KYOTO	6.7	0.210 ± 0.008	0.010 ± 0.003
Saga, SAGA	7.5	0.050 ± 0.005	0.005 ± 0.003
Naha, OKINAWA	7.5	0.180 ± 0.008	0.010 ± 0.003

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
Feburary, 1983			
Wakayama, WAKAYAMA	6.9	0.080 ± 0.006	0.002 ± 0.002
June, 1983			
Wakkanai, HOKKAIDO	6.8	0.080 ± 0.006	0.004 ± 0.003
Aomori, AOMORI	7.6	0.060 ± 0.005	0.010 ± 0.003
Yamagata, YAMAGATA	7.1	0.100 ± 0.006	0.010 ± 0.003
Mito, IBARAGI	6.8	0.070 ± 0.005	0.001 ± 0.003
Katsushika, TOKYO	6.7	0.070 ± 0.005	0.010 ± 0.003
Yokohama, KANAGAWA	6.8	0.030 ± 0.004	0.001 ± 0.003
Niigata, NIIGATA	6.8	0.140 ± 0.007	0.010 ± 0.003
Kanazawa, ISHIKAWA	6.7	0.100 ± 0.007	0.002 ± 0.003
Fukui, FUKUI	7.1	0.010 ± 0.003	0.000 ± 0.003
Nagano, NAGANO	7.3	0.050 ± 0.005	0.004 ± 0.003
Nagoya, AICHI	6.6	0.090 ± 0.006	0.002 ± 0.003
Osaka, OSAKA	6.6	0.150 ± 0.007	0.010 ± 0.003
Kobe, HYOGO	7.2	0.130 ± 0.007	0.005 ± 0.003
Wakayama, WAKAYAMA	7.5	0.080 ± 0.005	0.002 ± 0.003
Tottori, TOTTORI	7.5	0.090 ± 0.006	0.010 ± 0.003
Okayama, OKAYAMA	6.9	0.090 ± 0.005	0.002 ± 0.003
Ube, YAMAGUCHI	7.1	0.090 ± 0.006	0.004 ± 0.003
Kochi, KOCHI	7.3	0.050 ± 0.004	0.000 ± 0.003
Fukuoka, FUKUOKA	6.7	0.100 ± 0.006	0.010 ± 0.003
Saga, SAGA	7.4	0.050 ± 0.005	0.001 ± 0.003
Nagasaki, NAGASAKI	7.2	0.050 ± 0.004	0.003 ± 0.003
Kagoshima, KAGOSHIMA	7.0	0.010 ± 0.003	0.010 ± 0.003
July, 1983			
Sendai, MIYAGI	6.8	0.080 ± 0.005	0.005 ± 0.003
Fukushima, FUKUSHIMA	6.8	0.120 ± 0.006	0.010 ± 0.003
Matsuyama, EHIME	7.2	0.050 ± 0.004	0.001 ± 0.003
Naha, OKINAWA	7.4	0.080 ± 0.006	0.010 ± 0.003

Figure (3) Sampling Locations of Service water

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



(4) Strontium-90 and Cesium-137 in Freshwater (from Dec. 1982 to Jul. 1983)

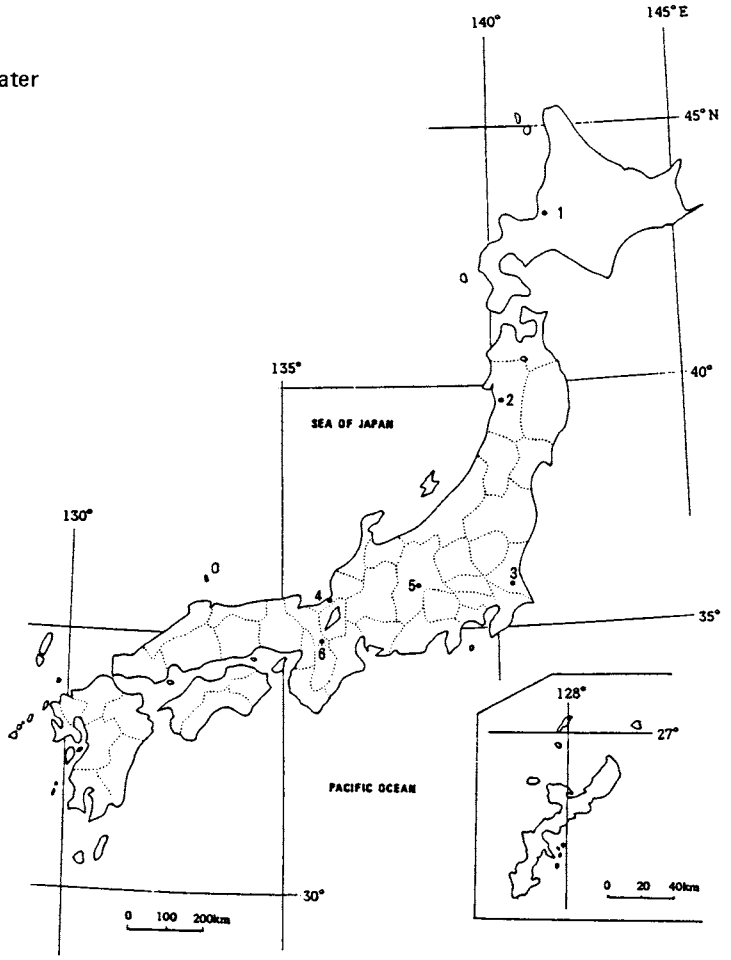
– continued from No. 62 of this publication –

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

Location	pH	^{90}Sr (pCi/ℓ)	^{137}Cs (pCi/ℓ)
December, 1982			
Mikata-gun, FUKUI	7.0	0.250 ± 0.009	0.070 ± 0.005
Suwa-lake, NAGANO	7.9	0.050 ± 0.005	0.010 ± 0.003
Uji, KYOTO	6.3	0.010 ± 0.003	0.002 ± 0.002
May, 1983			
Kasumigaura-lake, IBARAGI	8.7	0.150 ± 0.007	0.030 ± 0.004
July, 1983			
Ishikari, HOKKAIDO	7.3	0.100 ± 0.006	0.020 ± 0.004
Akita, AKITA	7.3	0.140 ± 0.007	0.010 ± 0.003

Figure (4) Sampling Locations of Freshwater

1. **Ishikari**
2. **Akita**
3. **Kasumigaura-lake**
4. **Mikata-gun**
5. **Suwa-lake**
6. **Uji**



(5) Strontium-90 and Cesium-137 in Soil (from May. 1983 to Jul. 1983)

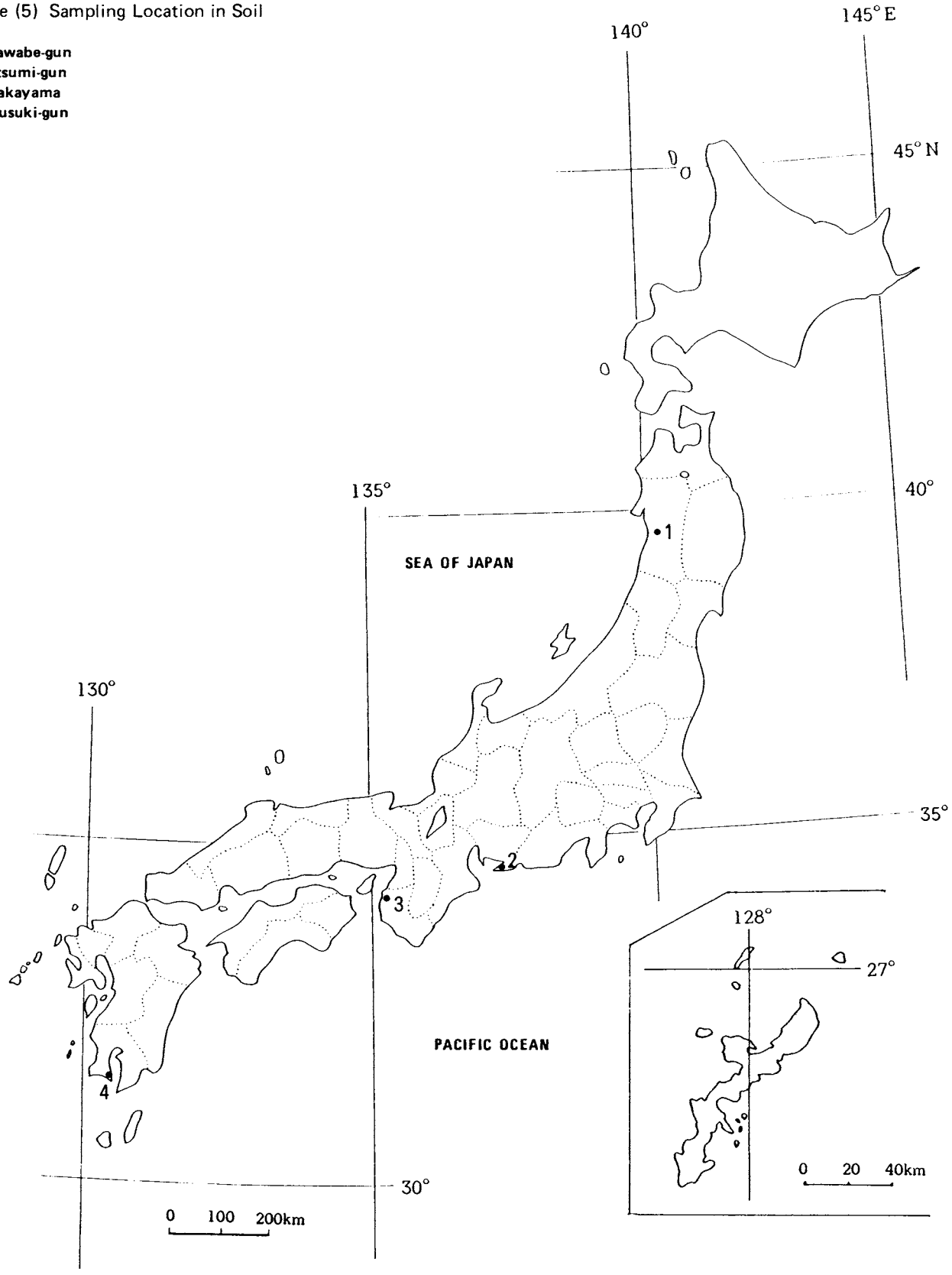
– continued from No. 62 of this publication –

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

Location	Sampling Depth (cm)	^{90}Sr		^{137}Cs	
		(pCi/kg)	(mCi/km^2)	(pCi/kg)	(mCi/km^2)
May, 1983					
Atsumi-gun, AICHI	0 ~ 5	43.0 ± 4.5	2.00 ± 0.20	750.0 ± 16.0	34.00 ± 0.70
〃	5 ~ 20	57.0 ± 4.8	8.40 ± 0.71	370.0 ± 11.0	55.00 ± 1.60
June, 1983					
Kawabe-gun, AKITA	0 ~ 5	530.0 ± 12.0	8.40 ± 0.20	1100.0 ± 20.0	17.00 ± 0.30
〃	5 ~ 20	690.0 ± 14.0	77.00 ± 1.60	1300.0 ± 20.0	150.00 ± 2.00
Ibusuki-gun, KAGOSHIMA	0 ~ 5	150.0 ± 7.0	7.80 ± 0.37	710.0 ± 15.0	37.00 ± 0.80
〃	5 ~ 20	260.0 ± 9.0	30.00 ± 1.00	340.0 ± 10.0	39.00 ± 1.20
July, 1983					
Wakayama, WAKAYAMA	0 ~ 5	160.0 ± 7.0	15.00 ± 0.70	570.0 ± 14.0	52.00 ± 1.20
〃	5 ~ 20	130.0 ± 7.0	19.00 ± 1.00	410.0 ± 11.0	60.00 ± 1.70

Figure (5) Sampling Location in Soil

1. Kawabe-gun
2. Atsumi-gun
3. Wakayama
4. Ibusuki-gun



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