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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Lakewood, Colorado 80225

RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT,
AMCHITKA ISLAND, ALASKA, MAY 1974

(Amchitka-45)
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ABSTRACT

During May 1974, the U.S. Geological Survey collected water samples from Amchitka Island, Alaska. Tritium determinations were made on 99 water samples, and dissolved gross alpha and gross beta/gamma determinations were made on 34 water samples. No appreciable differences were found between the data obtained in May 1974 and the data obtained before the Cannikin nuclear explosion.

INTRODUCTION

Amchitka Island, Alaska, was the site for three underground nuclear detonations. The Long Shot event was conducted on October 29, 1965, the Milrow event on October 2, 1969, and the Cannikin event on November 6, 1971.

The U.S. Geological Survey, on behalf of the U.S. Energy Research and Development Administration (formerly the U.S. Atomic Energy Commission), started water sampling of wells, streams, and springs on Amchitka Island in 1965 in order to establish pre-nuclear explosion background levels of radioactivity. A long-term water-sampling network was developed in 1967 in order to observe possible effects of nuclear testing on the island. This network was expanded in September 1971 to include the drainage area surrounding the final nuclear explosion, the Cannikin event, and

to include offshore stations. The water-sampling network was sampled by both Teledyne Isotopes and the U.S. Geological Survey from 1967 through September 1971. The Geological Survey has done the water sampling since September 1971.

The network stations were sampled in 1971 in September, November, and December; in 1972 in January, April, and October; in 1973 in August; and in 1974 in May and August. Future sampling will probably be once each year in August.

The techniques and procedures used by the U.S. Geological Survey for collecting, identifying, and analyzing water samples are described in previous reports (Beetem and others, 1971a, 1971b; Schroder, 1971).

Radiochemical and chemical data, obtained by the U.S. Geological Survey from 1965 through 1973, were presented in previous reports (Beetem and others, 1971a, 1971b; Schroder and Ballance, 1972a, 1972b, 1973a, 1973b, 1973c; Ballance, 1974). This report presents the radiochemical data from water samples collected in May 1974.

WATER SAMPLING NETWORK

Water samples were collected from wells, streams, lakes, springs, and seeps. Seawater samples were collected both at the shoreline and offshore. At each offshore sampling station, water samples were collected from near the ocean bottom, two-thirds of the distance from the surface to the bottom, one-third of the distance from the surface to the bottom, and surface.

Figures 1, 2, and 3 show the locations of the sample collection sites. The sampling sites in figures 1, 2, and 3 have reference numbers that are identified in tables 1, 2, and 3. Table 1 presents the radiochemical-sampling stations and types of radiochemical analyses performed on the freshwater samples and

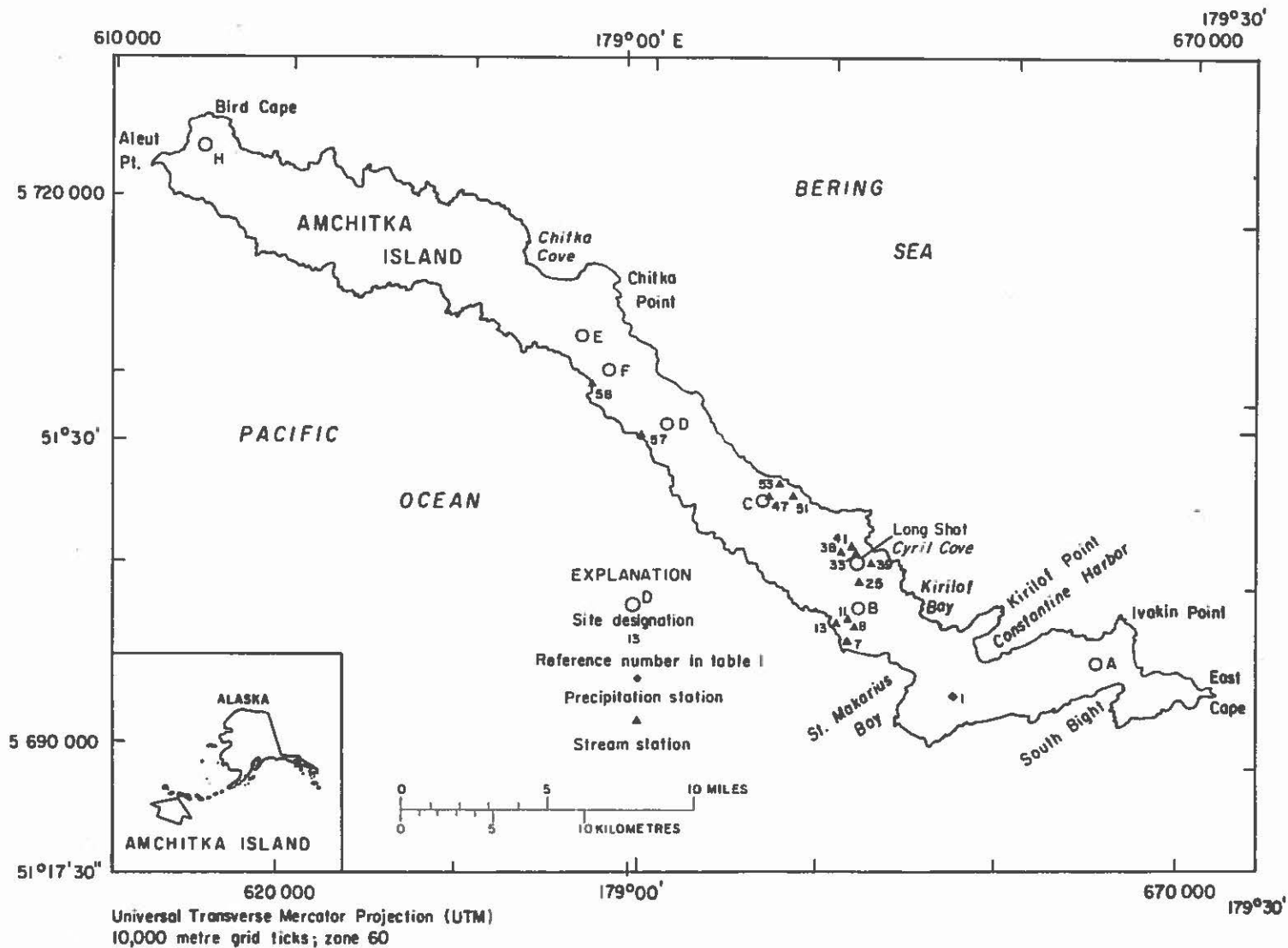


Figure 1.--Precipitation- and stream-sampling stations for radiochemical monitoring, Amchitka Island, Alaska.

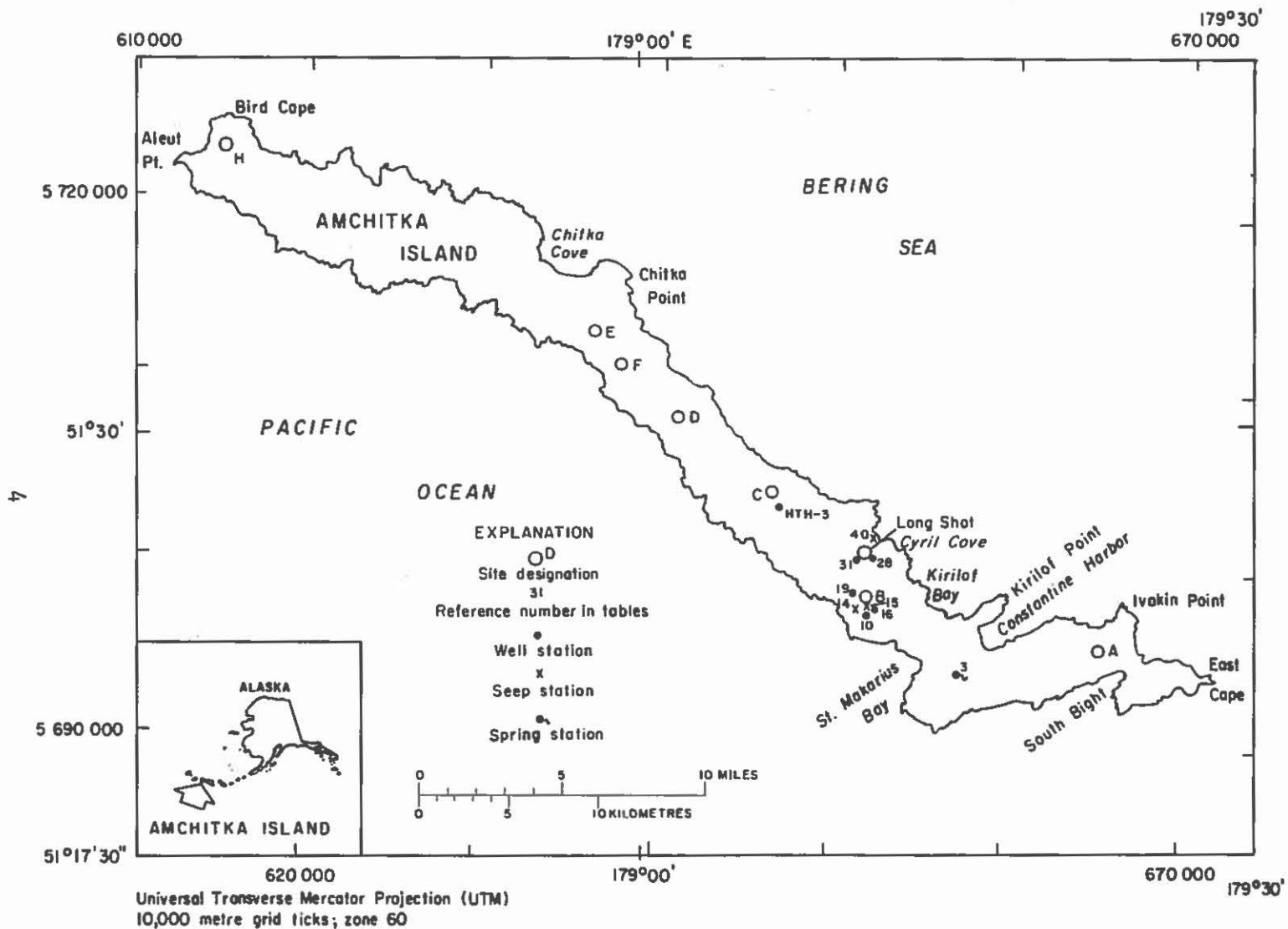


Figure 2.--Well-, spring-, and seep-sampling stations for radiochemical monitoring, Amchitka Island, Alaska.

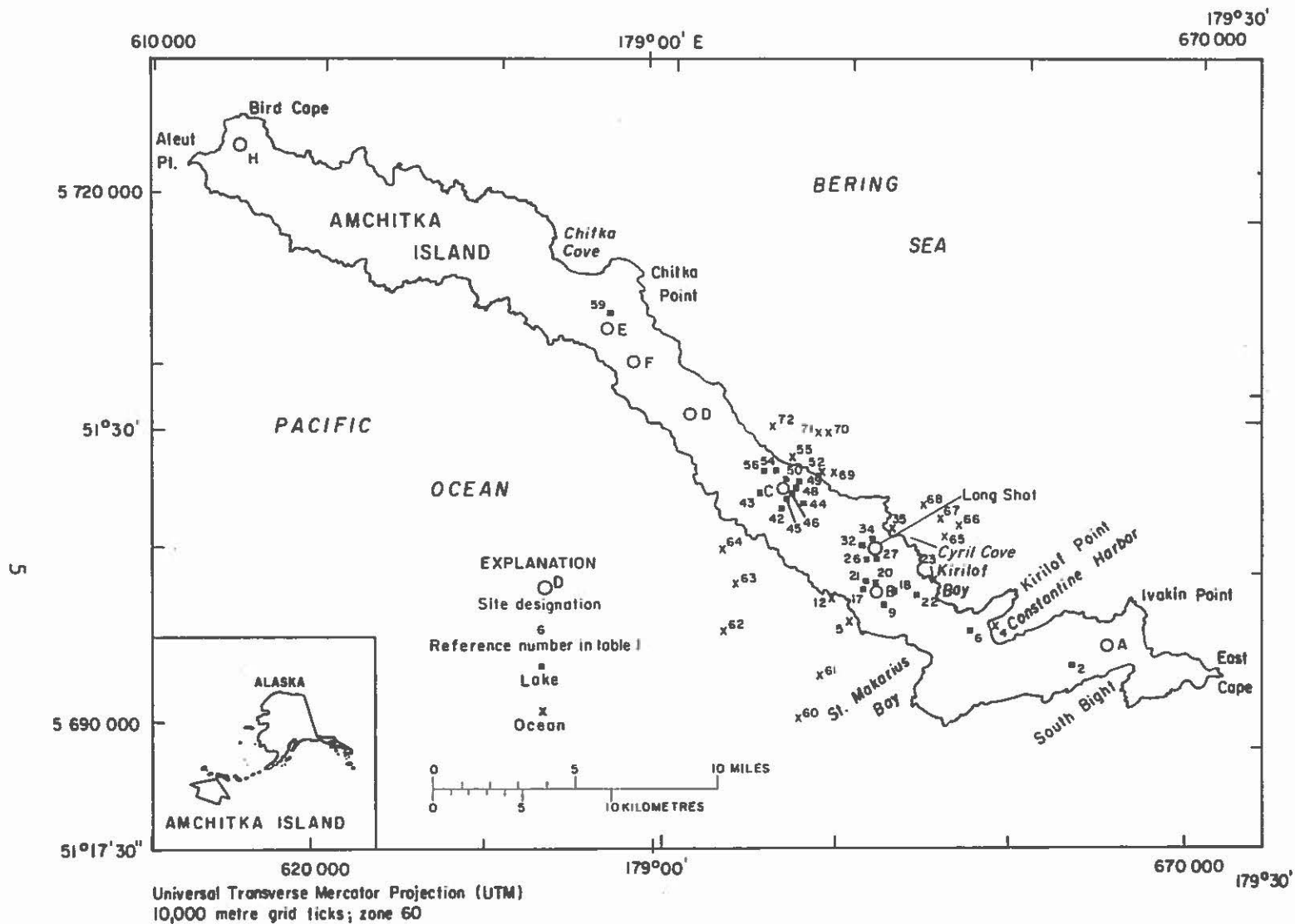


Figure 3.--Lake- and sea-sampling stations for radiochemical monitoring, Amchitka Island, Alaska.

Table 1.--Radiochemical-sampling stations, Amchitka Island,
Alaska

(A, analyzed for gross alpha, gross beta/gamma, and tritium;
T, analyzed for tritium only; N, not collected)

Ident. no.	Ref. no.	Other identifying name	May 1974 sampling and type of analyses
PR93-57	1	Precipitation at South Hanger	N
LK94-62	2	Lake 145	A
SP94-56	3	Constantine Spring	A
OB96-58	4	Bering Sea	T
OP96-51	5	Pacific Ocean	T
LK96-57	6	Jones Lake	A
ST96-51	7	Clevenger Creek at road	A
ST97-51	8	Clevenger Creek at gage	A
LK97-52	9	Lake B-1	A
WE97-51	10	Well W-13	A
ST97-51A	11	Stream B-6	T
OP97-50	12	Pacific Ocean	T
ST97-50	13	Midden Creek	A
SE98-51	14	Seep B-13	T
SE98-51A	15	Seep B-18	T
WE98-51C	16	Well W-17	A
LK98-51B	17	Lake B-3	A
LK98-52A	18	Lake B-4	A
WE98-51K	19	Well W-11	A
LK98-51	20	Lake B-2	A
LK98-51A	21	Lake B-2A	A
LK98-53	22	Silver Salmon Lake	A
OB99-54	23	Bering Sea	T
ST00-51	25	Stream A-7	A
LK00-51B	26	Lake A-6	A
LK00-51A	27	Lake	N
WE00-51E	28	Well No. 10C	T
WE00-51F	31	Well No. 8A	T
LK00-51	32	Lake	N
ST00-51B	33	Long Shot drainage ditch, A-2	A

Table 1.--Radiochemical-sampling stations, Amchitka Island,
Alaska--Continued

(A, analyzed for gross alpha, gross beta/gamma, and tritium;
T, analyzed for tritium only; N, not collected)

Ident. no.	Ref. no.	Other identifying name	May 1974 sampling and type of analyses
LK00-51D	34	Long Shot mudpit, A-3	A
OB01-52A	35	Bering Sea (F-11)	T
ST01-51	38	Stream at weir 2	A
ST01-52	39	Stream at weir 1	A
SE01-52	40	Seep 3	N
ST01-51A	41	Bridge Creek at gage	A
LK02-46	42	Lake C-2	A
LK03-45	43	Lake	A
LK03-47	44	Lake	A
LK04-46C	45	Lake	A
LK04-46D	46	Lake	N
ST04-47A	47	White Alice Creek	N
LK04-46B	48	Lake	N
LK04-46F	49	Lake	N
LK04-46E	50	Lake	A
ST04-47	51	White Alice Creek at gage	A
OB05-47	52	Bering Sea at outlet of White Alice Creek	T
ST05-47	53	Stream	A
LK05-46	54	Lake	A
OB05-46	55	Bering Sea north of UA-1-HTH-1	T
LK05-45	56	Lake	A
ST07-40	57	Falls Creek at gage	A
ST09-36	58	Limpet Creek at gage	A
LK14-36	59	Lake E-2	A
WE03-46		HTH-3	T

Table 2.--Radiochemical analyses of water samples collected on Amchitka Island, Alaska, May 1974

(Gross beta/gamma as cesium-137 reported in picocuries per litre, gross alpha as natural uranium equivalent in micrograms per litre, and tritium in picocuries per litre; <, less than)

Ident. no.	Ref. no.	Latitude N.			Longitude E.			Date			Time	Gross beta/gamma	Gross alpha	Tritium
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Day	Yr.				
$\frac{1}{1}$ /LK94-62	2	51	22	37	179	20	25	05	21	74	1945	9.2	4.9	<480
$\frac{1}{1}$ /SP94-56	3	51	22	43	179	14	59	05	21	74	1900	6.2	<2.5	<480
$\frac{1}{1}$ /OB96-58	4	51	24	08	179	16	32	05	21	74	1925	--	--	<480
$\frac{1}{1}$ /OP96-51	5	51	24	09	179	10	17	05	23	74	0755	--	--	<480
$\frac{1}{1}$ /LK96-57	6	51	24	11	179	16	09	05	21	74	1915	5.9	4.1	<480
$\frac{1}{1}$ /ST96-51	7	51	24	16	179	10	19	05	23	74	0745	7.9	13	<480
$\frac{1}{1}$ /ST97-51	8	51	24	35	179	11	00	05	23	74	1920	5.4	18	<480
$\frac{1}{1}$ /LK97-52	9	51	24	43	179	11	15	05	23	74	1010	5.2	<1.5	<480
WE97-51	10	51	24	50	179	10	58	05	24	74	1020	5.5	8.6	<480
ST97-51A	11	51	24	51	179	10	55	05	24	74	1920	--	--	<480
$\frac{1}{1}$ /OP97-50	12	51	24	52	179	09	44	05	23	74	0730	--	--	<480
$\frac{1}{1}$ /ST97-50	13	51	24	53	179	09	49	05	23	74	0725	6.1	2.7	<480
SE98-51	14	51	24	56	179	10	58	05	24	74	1200	--	--	<480
SE98-51A	15	51	24	56	179	10	56	05	24	74	1015	--	--	<480
WE98-51C	16	51	24	57	179	11	03.5	05	24	74	1030	5.1	2.7	<480
$\frac{1}{1}$ /LK98-51B	17	51	25	01	179	10	51	05	23	74	0940	9.2	3.7	<480
$\frac{1}{1}$ /LK98-52A	18	51	25	03	179	11	36	05	23	74	1000	6.0	2.0	<480
WE98-51K	19	51	25	04.5	179	10	55	05	23	74	0945	9.0	3.8	<480
$\frac{1}{1}$ /LK98-51	20	51	25	08	179	10	59	05	23	74	0935	5.9	1.9	<480
LK98-51A	21	51	25	12	179	10	59	05	23	74	0925	5.0	2.0	<480
$\frac{1}{1}$ /LK98-53	22	51	25	17	179	12	48	05	23	74	1400	8.0	<1.6	<480
OB99-54	23	51	25	31	179	13	28	05	23	74	1350	--	--	<480
ST00-51	25	51	26	11	179	11	11	05	23	74	0920	4.3	<1.1	<480
LK00-51B	26	51	26	12	179	10	47	05	23	74	0905	7.0	1.5	<480
WE00-51E	28	51	26	15	179	10	59	05	23	74	0900	--	--	1.2x10 ⁵

Table 2.--Radiochemical analyses of water samples collected on Amchitka Island, Alaska, May 1974--Continued

(Gross beta/gamma as cesium-137 reported in picocuries per litre, gross alpha as natural uranium equivalent in micrograms per litre, and tritium in picocuries per litre; <, less than)

Ident. no.	Ref. no.	Latitude N.			Longitude E.			Date			Time	Gross beta/gamma	Gross alpha	Tritium
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	No.	Day	Yr.				
WEC0-51F	31	51	26	17	179	10	58	05	23	74	0815	--	--	1.1x10 ⁴
ST00-51B	33	51	26	18	179	11	04	05	22	74	1705	6.4	7.4	1.3x10 ³
LK00-51D	34	51	26	18	179	11	01	05	22	74	1700	3.8	<1.8	4.8x10 ³
OBO1-52A	35	51	26	22	179	11	59	05	22	74	1645	--	--	<490
¹ /ST01-51	38	51	26	37	179	10	47	05	22	74	1605	5.1	<1.1	<480
¹ /ST01-52	39	51	26	45	179	11	32	05	22	74	1630	3.8	<1.6	<480
¹ /ST01-51A	41	51	26	54	179	10	57	05	22	74	0750	6.6	2.2	<480
LK02-46	42	51	27	37	179	06	32	05	22	74	1050	5.7	<.8	<480
¹ /LK03-45	43	51	28	05	179	05	26	05	22	74	1015	4.6	<.8	<480
LK03-47	44	51	28	03	179	07	12	05	22	74	0900	8.8	2.8	<480
LK04-46C	45	51	28	12	179	06	42	05	22	74	0830	4.7	5.7	<480
LK04-46E	50	51	28	36	179	06	50	05	22	74	0945	8.9	1.9	<480
¹ /ST04-47	51	51	28	41	179	07	34	05	23	74	1510	4.4	4.1	<480
OBO5-47	52	51	28	47	179	07	35	05	23	74	1500	--	--	<480
¹ /ST05-47	53	51	28	47	179	07	16	05	22	74	0950	4.0	4.5	<480
LK05-46	54	51	28	57	179	06	23	05	22	74	1035	6.6	<1.1	<480
OBO5-46	55	51	29	00	179	06	47	05	23	74	1530	--	--	<480
LK05-45	56	51	29	01	179	05	55	05	22	74	1030	5.3	<1.3	<480
¹ /ST07-40	57	51	30	04	179	01	01	05	23	74	1440	4.3	<1.5	<480
¹ /ST09-36	58	51	31	32	178	58	24	05	23	74	1320	5.1	2.0	<480
LK14-36	59	51	33	58	178	58	23	05	22	74	1335	5.0	<.8	<480
WE03-46	HTII-3	51	28	08	179	06	45	05	23	74	0945	--	--	<480

¹/ Stations sampled for gross beta/gamma and gross alpha in May 1974 and prior to Cannikin event (Beetem and others, 1971a).

Table 3.--Tritium analyses of seawater samples collected near
Amchitka Island, Alaska, May 1974

Ref. no.	Ident. no.	Sta- tion no.1/	Latitude N.			Longitude E.			Date			Depth (metres)	Tritium (pico- curies per litre)
			Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.		
68	OB03-54	2	51	27	36	179	13	00	05	27	74	0	58
68	OB03-54	2	51	27	36	179	13	00	05	27	74	22	48
68	OB03-54	2	51	27	36	179	13	00	05	27	74	44	61
68	OB03-54	2	51	27	36	179	13	00	05	27	74	66	51
65	OB01-55	3	51	26	36	179	14	18	05	27	74	0	32
65	OB01-55	3	51	26	36	179	14	18	05	27	74	5	16
65	OB01-55	3	51	26	36	179	14	18	05	27	74	10	16
65	OB01-55	3	51	26	36	179	14	18	05	27	74	17	120
67	OB02-55	4	51	27	06	179	14	09	05	27	74	0	48
67	OB02-55	4	51	27	06	179	14	09	05	27	74	15	42
67	OB02-55	4	51	27	06	179	14	09	05	27	74	30	96
67	OB02-55	4	51	27	06	179	14	09	05	27	74	46	54
66	OB02-56	5	51	27	00	179	15	18	05	27	74	0	51
66	OB02-56	5	51	27	00	179	15	18	05	27	74	29	45
66	OB02-56	5	51	27	00	179	15	18	05	27	74	58	120
66	OB02-56	5	51	27	00	179	15	18	05	27	74	86	61
69	OB05-48	10	51	29	15	179	08	32	05	27	74	0	22
69	OB05-48	10	51	29	15	179	08	32	05	27	74	7	32
69	OB05-48	10	51	29	15	179	08	32	05	27	74	14	45
69	OB05-48	10	51	29	15	179	08	32	05	27	74	21	38
72	OB07-46	11	51	30	00	179	06	30	05	27	74	0	150
72	OB07-46	11	51	30	00	179	06	30	05	27	74	8	83
72	OB07-46	11	51	30	00	179	06	30	05	27	74	16	130
72	OB07-46	11	51	30	00	179	06	30	05	27	74	24	180
71	OB06-47	14	51	29	30	179	08	30	05	27	74	0	74
71	OB06-47	14	51	29	30	179	08	30	05	27	74	26	83
71	OB06-47	14	51	29	30	179	08	30	05	27	74	52	16
71	OB06-47	14	51	29	30	179	08	30	05	27	74	78	29
70	OB05-48	15	51	29	15	179	08	45	05	27	74	0	22
70	OB05-48	15	51	29	15	179	08	45	05	27	74	14	32
70	OB05-48	15	51	29	15	179	08	45	05	27	74	28	32
70	OB05-48	15	51	29	15	179	08	45	05	27	74	52	32

Table 3.--Tritium analyses of seawater samples collected near
Amchitka Island, Alaska, May 1974--Continued

Ref. no.	Ident. no.	Sta- tion no. ^{1/}	Latitude N.			Longitude E.			Date			Depth (metres)	Tritium (pico- curies per litre)
			Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.		
61	OP94-49	6	51	23	06	179	08	30	05	26	74	0	64
61	OP94-49	6	51	23	06	179	08	30	05	26	74	11	54
61	OP94-49	6	51	23	06	179	08	30	05	26	74	22	77
61	OP94-49	6	51	23	06	179	08	30	05	26	74	33	67
60	OP93-47	7	51	22	42	179	06	54	05	26	74	0	58
60	OP93-47	7	51	22	42	179	06	54	05	26	74	18	64
60	OP93-47	7	51	22	42	179	06	54	05	26	74	36	67
60	OP93-47	7	51	22	42	179	06	54	05	26	74	51	35
63	OP98-44	8	51	25	12	179	04	18	05	26	74	0	38
63	OP98-44	8	51	25	12	179	04	18	05	26	74	10	35
63	OP98-44	8	51	25	12	179	04	18	05	26	74	20	130
63	OP98-44	8	51	25	12	179	04	18	05	26	74	30	190
62	OP94-42	9	51	24	00	179	03	00	05	26	74	0	58
62	OP94-42	9	51	24	00	179	03	00	05	26	74	26	19
62	OP94-42	9	51	24	00	179	03	00	05	26	74	52	22
62	OP94-42	9	51	24	00	179	03	00	05	26	74	77	16
64	OP00-42	16	51	26	30	179	03	00	05	26	74	0	180
64	OP00-42	16	51	26	30	179	03	00	05	26	74	10	74
64	OP00-42	16	51	26	30	179	03	00	05	26	74	20	83
64	OP00-42	16	51	26	30	179	03	00	05	26	74	30	77

^{1/} Station numbers were originally assigned by the Laboratory of Radiation Ecology, College of Fisheries, University of Washington during the Amchitka Pacific Apollo Cruise, August 5 to 11, 1971.

the shoreline seawater samples. Table 2 presents the results of radiochemical analyses, and table 3 presents the tritium data obtained from offshore seawater sampling stations.

RESULTS

The data obtained from analyses of freshwater samples collected on the island and seawater samples collected at the shoreline are presented in table 2. In 34 freshwater samples, the dissolved gross alpha activity reported as natural uranium equivalent in micrograms per litre ($\mu\text{g}/\text{l}$) ranged from less than 0.8 to 18 $\mu\text{g}/\text{l}$. Before the Cannikin explosion, a range of less than 0.4 to 70 $\mu\text{g}/\text{l}$ was found in samples from 54 freshwater stations on Amchitka (Beetem and others, 1971a). Nineteen of the freshwater stations sampled in May 1974 were also sampled prior to the Cannikin event. The May 1974 samples from these 19 stations ranged from less than 0.8 to 18 $\mu\text{g}/\text{l}$. Before the Cannikin explosion, 19 samples from the same stations ranged from less than 0.6 to 21 $\mu\text{g}/\text{l}$ in dissolved gross alpha activity (Beetem and others, 1971a).

The dissolved gross beta/gamma activity that is reported as Cs-137 equivalent in picocuries per litre (pCi/l) ranged from 3.8 to 9.2 pCi/l for the 34 freshwater samples from the May 1974 sampling (table 2). Before the Cannikin explosion, a range of less than 1.0 to 36 pCi/l was found in samples from 54 freshwater stations on Amchitka (Beetem and others, 1971a). The May 1974 samples from 19 freshwater stations ranged from 3.8 to 9.2 pCi/l . Before the Cannikin event, samples from the same 19 stations ranged from 1.2 to 22 pCi/l in dissolved gross beta/gamma activity (Beetem and others, 1971a).

Tritium analyses of freshwater and shoreline seawater samples (table 2) were made using the liquid scintillation counting technique. The minimum tritium-detection level using

this method is 480 pCi/l. Offshore seawater samples (table 3) were analyzed using electrolytic enrichment coupled with liquid scintillation counting techniques. The minimum detection level using this method is about 16 pCi/l.

Freshwater samples having detectable (greater than 480 pCi/l) tritium activity were those collected at the Long Shot site (reference numbers 28, 31, 33, and 34 in table 2). The tritium activity found in water at the Long Shot site is consistent with the activity found after the Long Shot event and prior to the Cannikin event. The greatest tritium values at the Long Shot site prior to the Cannikin event ranged from 7,400 pCi/l, February 1970, in a mudpit at the site to 300,000 pCi/l, August 1970, in a drill hole at the site (Beetem and others, 1971a). Tritium values determined for water samples from these locations in May 1974 were 4,800 and 120,000 pCi/l, respectively.

Sampling and analyses of seawater around Amchitka (fig. 3) are intended to detect contaminated ground water that may have been discharged into the ocean. Tritium activity in seawater samples prior to the Cannikin explosion ranged from 45 ± 3 pCi/l to 350 ± 9 pCi/l (Schroder and Ballance, 1973b). The tritium activity determined from resampling of these seawater stations in May 1974 after the Cannikin explosion ranged from 16 to 190 pCi/l.

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