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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, AUGUST 1973

(Amchitka-42)
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Amchitka-42
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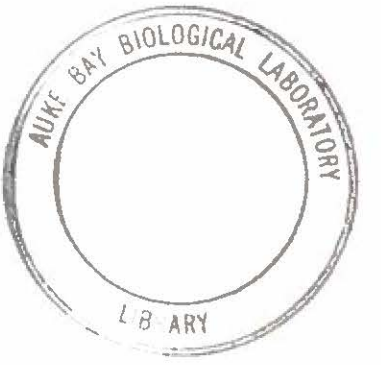
By

Wilbur C. Ballance



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RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT AMCHITKA ISLAND, ALASKA, AUGUST 1973

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ABSTRACT

Radiochemical data from the Amchitka Island study area were obtained from water samples collected by the U.S. Geological Survey during August 1973. Tritium determinations were made on 86 samples collected and gross alpha and gross beta/gamma determinations were made on 38 samples. The range of data for these samples was equal or less than the range of values obtained before the Cannikin event.

INTRODUCTION

Amchitka Island, Alaska, has been the site for three underground nuclear detonations. Water sampling and analyses begun in 1965 has established natural levels of radioactivity of different sources of water. Results of radiochemical analyses of postevent water samples are compared with natural levels of radioactivity to detect the presence or absence of significant quantities of explosion-produced radioactivity in environmental water. This work is being accomplished by the U.S. Geological Survey on behalf of the U.S. Atomic Energy Commission.

A long-term monitoring program was established in 1967 to observe possible effects of nuclear testing on Amchitka Island by the U.S. Atomic Energy Commission. A water-sampling network was established

in 1967 and revised in September 1971 to aid in evaluating the effects of the Cannikin event (November 6, 1971) on the hydrologic environment. The water-sampling network was sampled jointly by Teledyne Isotopes and the U.S. Geological Survey from 1967 through September 1971. The Geological Survey has conducted the water sampling since September 1971.

The network stations were sampled in September, November, and December 1971, January, April, and October 1972, and August 1973. Future sampling will be once each year, probably in August, and continue for an indefinite time.

The techniques and procedures used for sample collection, identification, and analysis as well as radiochemical data obtained from samples analyzed by the U.S. Geological Survey through November 1970 are reported in Beetem, Washington, Janzer, and Schroder (1971). Radiochemical data obtained from samples analyzed by the U.S. Geological Survey from September 1971 through October 1972 are reported in Schroder and Ballance (1972a, 1972b, 1973a, 1973b, 1973c). This report presents the radiochemical data from samples collected during August 1973.

WATER SAMPLING NETWORK

Fresh-water samples were collected from shallow wells, streams, lakes, springs, seeps, and precipitation. Sea-water samples were collected at the shoreline and offshore. At each offshore sampling

station, water samples were usually collected from the ocean bottom, two-thirds distance from surface to bottom, one-third distance from surface to bottom, and at the surface.

Figures 1, 2, and 3 show the locations of the sampling points in the water sampling network. Table 1 presents the radiochemical sampling stations and types of analyses performed for the fresh-water and shoreline sea-water samples. Table 2 presents the offshore sea-water sampling stations.

RESULTS

Table 3 presents the data obtained from analyses of fresh-water samples collected on the island and sea-water samples collected at the shoreline. The gross alpha activity, as natural uranium equivalent, ranged from less than 0.4 to less than 4.4 ~~pCi/l~~ µg/l micrograms (~~picocuries~~ per liter) for the August 1973 sampling. This compares with a range from less than ~~0.1 to 23 pCi/l~~ 0.4 To 70 µg/l in water observed on Amchitka prior to detonation of Cannikin as reported by Schroder and Ballance, 1973b. Schroder and Ballance (1972a, 1972b, 1973a, 1973c) reported a range of less than ~~0.1 to 3.0 pCi/l~~ 0.4 To 8.9 µg/l for samples before and after the Cannikin event.

The gross beta activity in fresh water as Cs-137 equivalent in the August 1973 samples ranged from 1.4 to 6.4 pCi/l (table 3). Beetem, Washington, Janzer, and Schroder (1971) reported a range of less than 1.0 to 36 pCi/l observed in fresh waters prior to the Cannikin event.

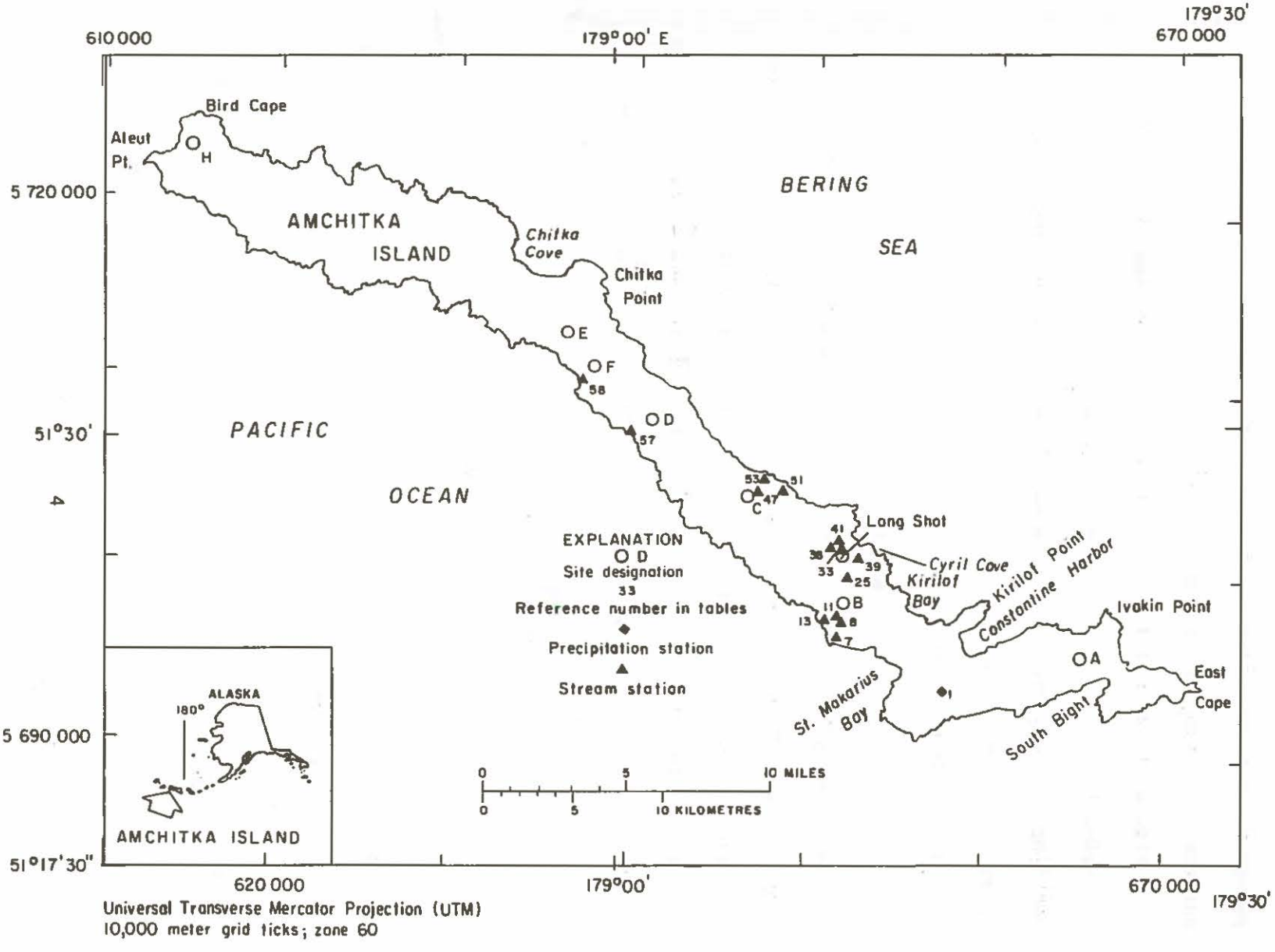

Figure 1.-- Precipitation-and stream-sampling stations for radiochemical monitoring, Amchitka Island, Alaska

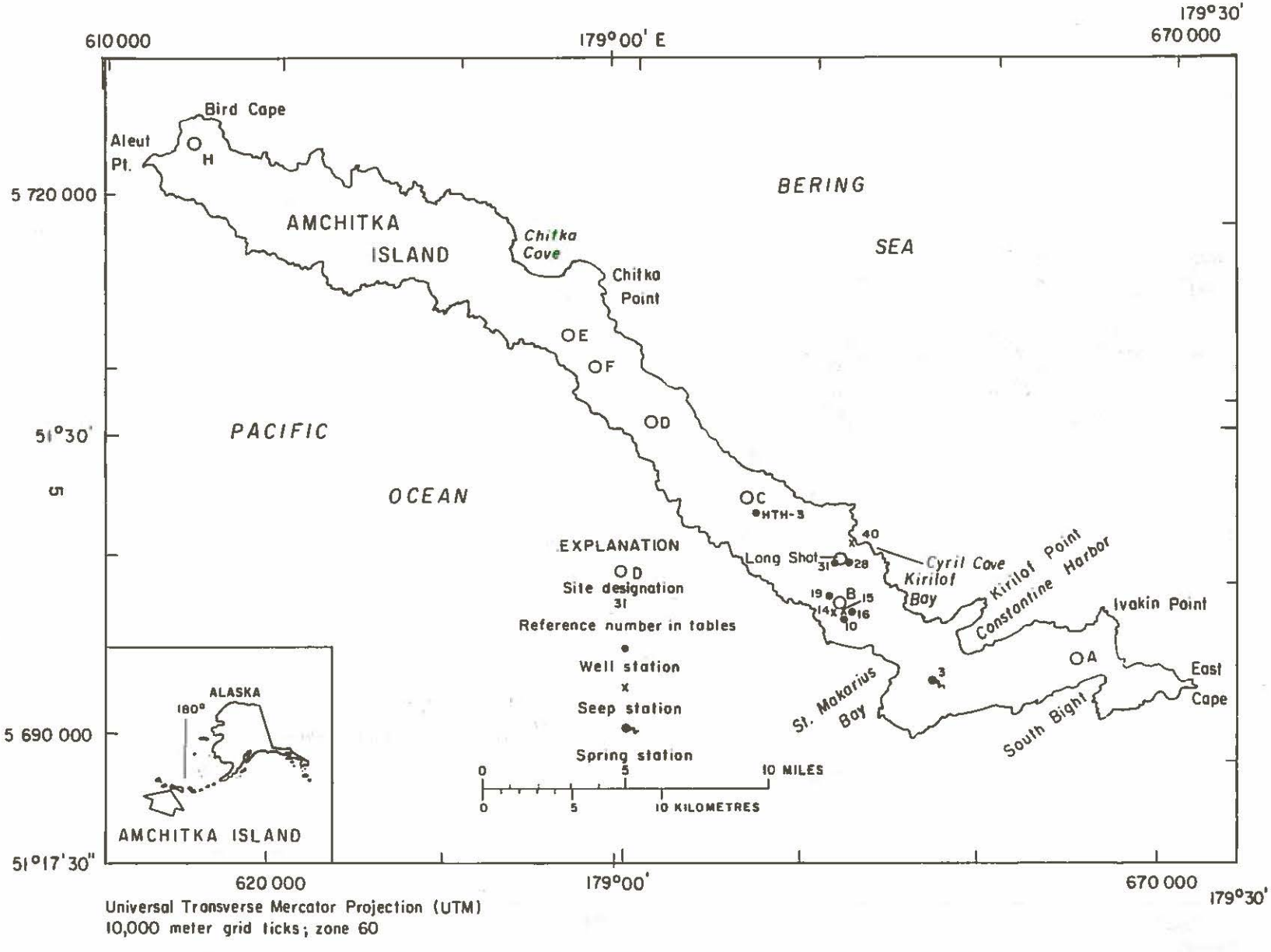

Figure 2.-- Well, spring, and seep-sampling stations for radiochemical monitoring, Amchitka Island, Alaska.

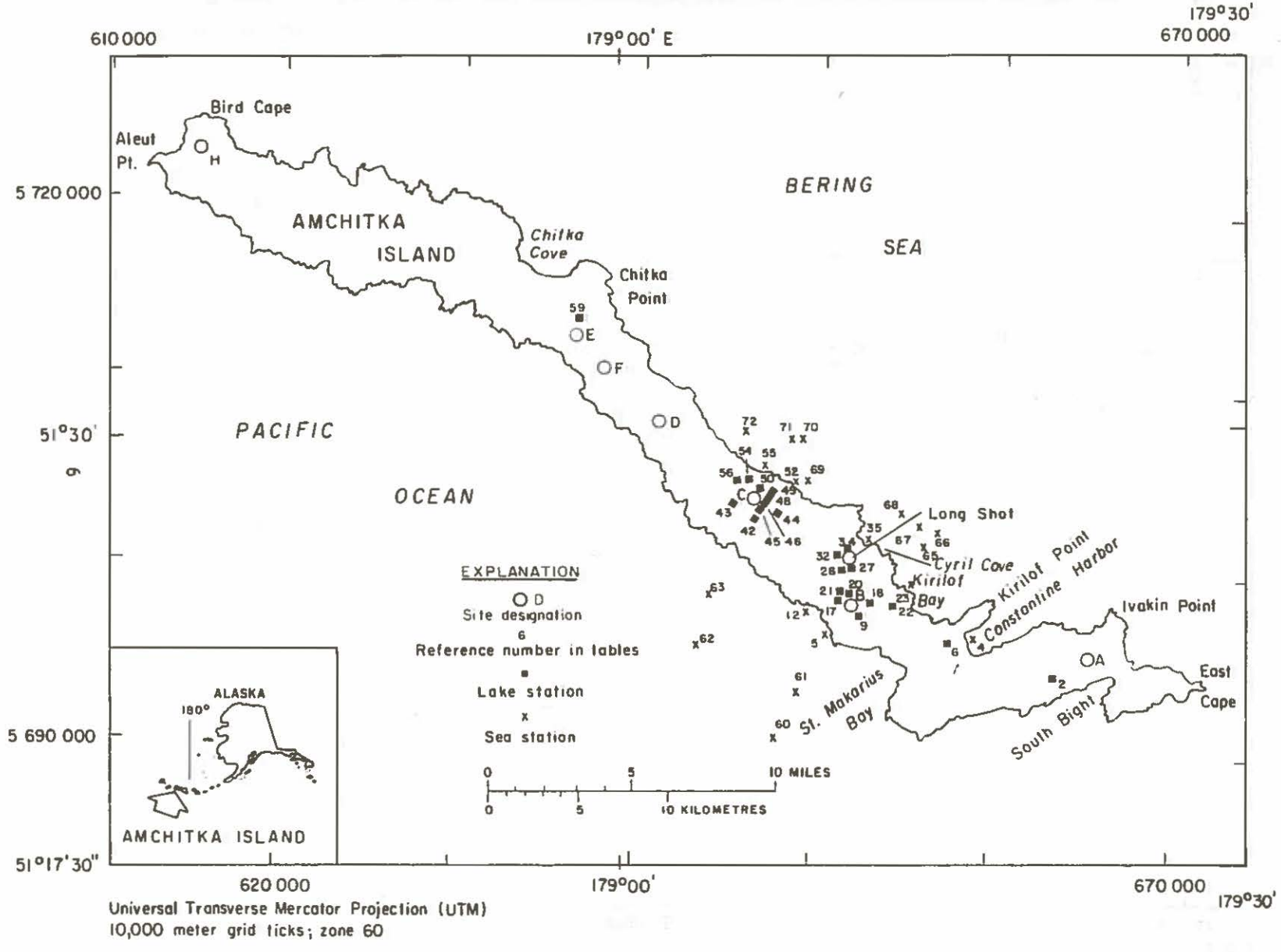

Figure 3--Lake-and sea-sampling stations for radiochemical monitoring, Amchitka Island, Alaska

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; D, destroyed in shipment)

Ident. no.	Ref. no. 1/	Other identifying name	August 1973 sampling and type of analyses
PR93-57	1	Precipitation at South Hanger	T
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 2/
ST97-51	8	Clevenger Creek at gage	T 2/
LK97-52	9	Lake B-1	A 3/
WE97-51	10	Well W-13	A 3/
ST97-51A	11	Stream B-6	A
OP97-50	12	Pacific Ocean	D
ST97-50	13	Midden Creek	A
SE98-51	14	Seep B-13	A
SE98-51A	15	Seep B-18	A
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	N
LK00-51A	27	Lake	A 2/
WE00-51E	28	Well No. 10C	T 2/
WE00-51F	31	Well No. 8A	T 2/
LK00-51	32	Lake	A 3/
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; D, destroyed in shipment)

Ident. no.	Ref. no. 1/	Other identifying name	August 1973 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	A
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	A

1/ Reference numbers used for locations on figures 1, 2, and 3.

2/ Gross alpha, gross beta/gamma water sample lost in shipment.

3/ Tritium sample destroyed in shipment.

Table 2.--Offshore tritium sampling stations near Amchitka Island, Alaska

(T, analyzed for tritium; N, not collected or destroyed in shipment)

Ident. no.	Station no.	Ref. no. 1/	August 1973 sampling and type of analyses
OP93-47	7	60	T
OP94-49	6	61	T
OP94-42	9	62	T
OP98-44	8	63	T
OP00-42	16	64	N
OB01-55	3	65	T
OB02-56	5	66	T
OB02-55	4	67	T
OB03-54	2	68	T
OP05-48	10	69	T
OB05-48	15	70	T
OB06-47	14	71	T
OB07-46	11	72	T

1/ Reference numbers used for locations on figures 1, 2, and 3.

Table 3.--Radiochemical analyses of water samples collected on Amchitka Island, Alaska, August 1973

reported in picocuries per ~~liter~~ litre, gross alpha as natural

~~(Gross beta as cesium-137, gross alpha as U equivalent, and tritium reported in picocuries per liter; <, less than)~~

uranium equivalent in micrograms per litre, and Tritium in Picocuries per litre; <less than)

Ident. no.	Ref. no. 1/	Latitude N.			Longitude E.			Date			Time	Gross beta	Gross alpha	Tritium
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.				
PR93-57	1	51	22	25	-179	15	48	08	23	73	1200	--	--	<480
LK94-62	2	51	22	37	-179	20	25	08	24	73	1918	4.4	1.6	<480
SP94-56	3	51	22	43	-179	14	59	08	21	73	1615	6.4	<2.3	<480
OB96-58	4	51	24	08	-179	16	32	08	21	73	1640	--	--	<480
OP96-51	5	51	24	09	-179	10	17	08	22	73	0810	--	--	<480
LK96-57	6	51	24	11	-179	16	09	08	21	73	1625	5.7	<2.1	<480
ST96-51	7	51	24	16	-179	10	19	08	22	73	0800	5.5	<3.2	<480
ST97-51	8	51	24	35	-179	11	00	08	24	73	1630	--	--	<480
LK97-52	9	51	24	43	-179	11	15	08	24	73	1510	4.3	<1.3	<480
WE97-51	10	51	24	50	-179	10	58	08	24	73	1630	4.0	<2.2	--
ST97-51A	11	51	24	51	-179	10	55	08	24	73	1520	4.6	<3.1	<480
ST97-50	13	51	24	53	-179	09	49	08	22	73	0815	5.5	<1.2	<480
SE98-51	14	51	24	56	-179	10	58	08	25	73	0900	1.4	<1.6	<480
SE98-51A	15	51	24	56	-179	10	56	08	24	73	1645	4.9	<2.0	<480
WE98-51C	16	51	24	57	-179	11	03.5	08	24	73	1615	2.5	<1.3	<480
LK98-51B	17	51	25	01	-179	10	51	08	22	73	0840	3.7	<1.1	<480
LK98-52A	18	51	25	03	-179	11	36	08	22	73	0850	5.3	<1.4	<480
WE98-51K	19	51	25	04.5	-179	10	55	08	24	73	1700	5.2	2.1	<480
LK98-51	20	51	25	08	-179	10	59	08	22	73	0830	3.5	<1.0	<480
LK98-51A	21	51	25	12	-179	10	59	08	22	73	0845	4.4	<.8	<480
LK98-53	22	51	25	17	-179	12	48	08	24	73	1345	4.5	<1.5	<480
OB99-54	23	51	25	31	-179	13	28	08	24	73	1410	--	--	<480
ST00-51	25	51	26	11	-179	11	11	08	25	73	0815	5.0	<1.0	<480
LK00-51A	27	51	26	14	-179	11	00	08	25	73	0805	5.3	<1.0	<480
WE00-51E	28	51	26	15	-179	10	59	08	23	73	1645	--	--	1.3×10^5

Table 3.--Radiochemical analyses of water samples collected on Amchitka Island, Alaska, August 1973--Continued

(Gross beta as cesium-137, gross alpha as U equivalent, and tritium reported in picocuries per liter; <, less than)

Ident. no.	Ref. no. 1/	Latitude N.			Longitude E.			Date			Time	Gross beta	Gross alpha	Tritium
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.				
WE00-51F	31	51	26	17	-179	10	58	08	23	73	1445	--	--	$1.1x10^4$
LK00-51	32	51	26	17	-179	10	45	08	25	73	0845	3.7	<0.6	--
ST00-51B	33	51	26	18	-179	11	04	08	23	73	1630	3.3	<2.1	<480
LK00-51D	34	51	26	18	-179	11	01	08	23	73	1635	3.1	<2.2	$5.0x10^3$
OB01-52A	35	51	26	22	-179	11	59	08	22	73	1025	--	--	<480
ST01-51	38	51	26	37	-179	10	47	08	23	73	1030	4.5	<.8	<480
ST01-52	39	51	26	45	-179	11	32	08	22	73	1010	3.6	<1.5	<480
ST01-51A	41	51	26	54	-179	10	57	08	23	73	1025	5.1	<1.2	<480
LK02-46	42	51	27	37	-179	06	32	08	23	73	1015	3.7	<.4	<480
LK03-45	43	51	28	05	-179	05	26	08	23	73	1000	2.7	<.6	<480
LK03-47	44	51	28	08	-179	07	12	08	24	73	1030	4.4	1.8	<480
LK04-46C	45	51	28	12	-179	06	42	08	23	73	1700	4.6	<2.9	<480
ST04-47A	47	51	28	21	-179	06	59	08	24	73	1015	4.7	<4.4	<480
LK04-46E	50	51	28	36	-179	06	50	08	24	73	0830	4.3	<.8	<480
ST04-47	51	51	28	41	-179	07	34	08	24	73	0920	4.8	<3.3	<480
OB05-47	52	51	28	47	-179	07	35	08	24	73	0900	--	--	<480
ST05-47	53	51	28	47	-179	07	16	08	24	73	0815	3.3	<1.2	<480
LK05-46	54	51	28	57	-179	06	23	08	23	73	0915	3.7	<1.2	<480
OB05-46	55	51	29	00	-179	06	47	08	23	73	0925	--	--	<480
LK05-45	56	51	29	01	-179	05	55	08	23	73	0900	3.9	<1.0	<480
ST07-40	57	51	30	04	-179	01	01	08	23	73	1530	3.6	<1.4	<480
ST09-36	58	51	31	32	-179	58	24	08	23	73	1330	3.5	<1.0	<480
LK14-36	59	51	33	58	-179	58	23	08	23	73	0820	2.4	<1.0	<480
WE03-46	HTH-3	51	28	08	-179	06	45	08	22	73	0940	--	--	<480

1/ Reference numbers used for locations on figures 1,2, and 3.

Tritium analyses of fresh-water and shoreline sea-water samples (table 3) were made using the liquid scintillation counting technique, the high-level detection method. The tritium-detection level using this method is 480 pCi/l. Offshore sea samples (table 4) were analyzed using electrolytic enrichment and liquid scintillation counting techniques, the low-level detection method. The tritium-detection level using this method is 50 pCi/l.

Water samples having detectable (greater than 480 pCi/l) tritium activity were those collected at the Long Shot site (table 3). The tritium values found in water at the Long Shot site are consistent with the values obtained prior to the Cannikin event. The tritium values in the more active areas at the Long Shot site prior to the Cannikin event (Beetem, and others, 1971) 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. Tritium values determined for water samples from these locations in August 1973 were 5,000 and 130,000 pCi/l, respectively.

Sampling and analyses of sea water around Amchitka (fig. 3) are intended to observe if any release of contaminated ground water were to discharge into the ocean. Tritium values determined from sea water samples prior to the Cannikin event ranged from 56±3 pCi/l to 350±9 pCi/l (Schroder and Ballance, 1973b). The values determined from ocean samples in August 1973 ranged from 54 to 202 pCi/l.

Table 4.--Tritium analyses of seawater samples collected near Amchitka Island, Alaska, August 1973

Ident. no.	Station no.	Latitude N.			Longitude E.			Date			Depth (meters)	Tritium (picocuries per liter)
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.		
OB03-54	2	51	27	36	-179	13	00	08	27	73	0	70
OB03-54	2	51	27	36	-179	13	00	08	27	73	6.7	77
OB03-54	2	51	27	36	-179	13	00	08	27	73	13.4	122
OB03-54	2	51	27	36	-179	13	00	08	27	73	20.0	70
OB01-55	3	51	26	36	-179	14	18	08	27	73	0	64
OB01-55	3	51	26	36	-179	14	18	08	27	73	4.3	67
OB01-55	3	51	26	36	-179	14	18	08	27	73	8.6	96
OB01-55	3	51	26	36	-179	14	18	08	27	73	12.8	86
OB02-55	4	51	27	06	-179	14	09	08	27	73	0	67
OB02-55	4	51	27	06	-179	14	09	08	27	73	5.5	106
OB02-55	4	51	27	06	-179	14	09	08	27	73	11.0	86
OB02-55	4	51	27	06	-179	14	09	08	27	73	16.5	102
OB02-56	5	51	27	00	-179	15	18	08	27	73	0	115
OB02-56	5	51	27	00	-179	15	18	08	27	73	9.1	64
OB02-56	5	51	27	00	-179	15	18	08	27	73	18.3	64
OB02-56	5	51	27	00	-179	15	18	08	27	73	22.9	61
OP05-48	10	51	28	12	-179	08	30	08	27	73	0	118
OP05-48	10	51	28	12	-179	08	30	08	27	73	5.5	112
OP05-48	10	51	28	12	-179	08	30	08	27	73	11.0	106
OP05-48	10	51	28	12	-179	08	30	08	27	73	16.5	106
OB07-46	11	51	30	00	-179	06	30	08	27	73	0	58
OB07-46	11	51	30	00	-179	06	30	08	27	73	6.7	125
OB07-46	11	51	30	00	-179	06	30	08	27	73	13.4	96
OB07-46	11	51	30	00	-179	06	30	08	27	73	20.1	99
OB06-47	14	51	29	30	-179	08	30	08	27	73	0	54
OB06-47	14	51	29	30	-179	08	30	08	27	73	7.9	131
OB06-47	14	51	29	30	-179	08	30	08	27	73	15.8	80
OB06-47	14	51	29	30	-179	08	30	08	27	73	23.8	134
OB05-48	15	51	29	15	-179	08	45	08	27	73	0	115
OB05-48	15	51	29	15	-179	08	45	08	27	73	4.3	118
OB05-48	15	51	29	15	-179	08	45	08	27	73	8.5	118
OB05-48	15	51	29	15	-179	08	45	08	27	73	12.8	93

Table 4.--Tritium analyses of seawater samples collected near Amchitka Island, Alaska, August 1973--Continued

Ident. no.	Station no.	Latitude N.			Longitude E.			Date			Depth (meters)	Tritium (picocuries per liter)
		Deg.	Min.	Sec.	Deg.	Min.	Sec.	Mo.	Da.	Yr.		
OP94-49	6	51	23	06	-179	08	30	08	30	73	0	99
OP93-47	7	51	22	42	-179	06	54	08	30	73	0	102
OP98-44	8	51	25	12	-179	04	18	08	30	73	0	202
OP94-42	9	51	24	00	-179	03	00	08	30	73	0	131
OP94-42	9	51	24	00	-179	03	00	08	30	73	23.8	90
OP94-42	9	51	24	00	-179	03	00	08	30	73	45.7	99
OP94-42	9	51	24	00	-179	03	00	08	30	73	73.2	67

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Distribution

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