EML-579

Worldwide Deposition of Strontium-90 through 1990

Matthew A. Monetti

Environmental Measurements Laboratory
U.S. Department of Energy
New York, NY 10014-3621

March 1996

Abstract

Strontium-90 results from the Environmental Measurements Laboratory's (EML) Global Fallout Program (GFP) are presented for the years 1987 through 1990. Quarterly ^{90}Sr deposition results for the 66 sampling locations of EML's GFP were generally low, indicating that there was no significant release of fission products into the atmosphere during this period. The global ^{90}Sr deposition during these 4 years was lower than it has been for any similar period since this program began in 1958. Since there was no major atmospheric source of ^{90}Sr during this period, the global cumulative deposit of ^{90}Sr continued to decrease by radioactive decay to a 27 year low of 311.4 Pbq.

Table of Contents

Page No.

Introduction 1

Methods 2

Data Quality and Validation 3

Results 5

Discussion 6

Acknowledgements 8

References 9

Tables 1-18 . . . . . 12 - 53

Figure 1-3 . . . . . 54 - 56

Introduction

As a result of increased atmospheric testing of nuclear weapons, concerns over the fate of radioactivity released from these detonations and related implications to national security during the "arms race", the Environmental Measurements Laboratory (EML) initiated a program known as the Global Fallout Program (GFP) in 1958. This program has been operated via one of the largest global sampling networks ever assembled in the world. The GFP had over 140 sampling stations during the 1960s (Hardy, 1977). From 1987 to 1990, the network consisted of the 66 sites shown in Figure 1, and listed in Table 1 along with other site characteristics. The intent of the GFP was to obtain radionuclide deposition information which could be used to address factors related to the global transport and fate of radionuclides following an atmospheric release. Around the same time that this program was being developed several other global studies on fission-produced radioactivity were being pursued. These studies included investi-gations of atmospheric transport and residence times in both the stratosphere and the troposphere, soil burdens, and the subsequent assimilation into food and the human body. An essentially complete understanding of the processes affecting the fate of released radioactivity resulted, which helped to identify the significance of this material to human health.

Since it is considered important to maintain a record of the global deposition, distribution and inventory of fallout radioactivity, the GFP has remained an active program. Initially, GFP data included several of the radionuclides produced during weapons testing. Strontium-90 was chosen as the primary radionuclide of interest due to its unique properties. To begin with, ^{90}Sr is produced with a relatively high fission yield (3.7 PBq MCi per Megaton) during the detonation of nuclear weapons. Strontium-90 is also an beta-emitting radionuclide with a fairly long half-life (28 years). Finally, ^{90}Sr is readily incorporated into the biosphere as a result of chemical properties it shares with calcium, an essential element for most organisms including human. Together these properties have important implications on the effect that nuclear weapons fallout ^{90}Sr can have on human health. Strontium-90 was considered the most important radionuclide released during the atmospheric weapons testing based on worldwide health hazards (UNSCEAR, 1982). EML's ^{90}Sr deposition database is the most extensive of its kind in the world.

This report has been prepared to present additional new data that has been added to EML's database. Numerous documents similar to this one have been published regularly since the GFP began to provide the scientific community, policy-makers and the general public with information on radioactive fallout. Three compilation reports have been published to date (Hardy 1977; Larsen, 1984a; Larsen, 1985). The database now serves as a direct source of fallout records for contemporary investigations addressing radiological concerns. These records have also proven extremely useful for studies in several other fields that have utilized the unique and well-defined source of radioactivity as tracers of different processes.

Methods

There have been very few changes in the procedures for the operation of the GFP since the years when the ^{90}Sr database was first generated. The same sampling devices are being used since the beginning of the program. These include two different open containers, a stainless-steel pot and a polyethylene bucket, and an ion-exchange unit (see Table 1). The open containers are simple devices that collect all the material which is deposited in them. The ion-exchange sampling unit performs a first-order extraction of the bulk deposition at the sampling site. It consist of a funnel connected in series to a column packed with Dowex-50 ion-exchange resin. The ion-exchange column removes the ^{90}Sr from the precipitation as it passes through the column. The sampling devices are exposed to collect a sample each calendar month, except for at the Australian stations where the samplers are exposed for a 3-month (quarterly) period. The area exposed to bulk deposition ranges from 640 to 760 cm^2 depending on which device is used. The samplers and their operation are described in more detail in EML's Procedure Manual, Section 2 (Chieco *et al.*, 1992).

The samples are sent to EML and prepared for analysis. The samples collected in pots and buckets are passed through ion-exchange columns in the laboratory. One column is used for each 3-month quarter of samples. The samples collected with the ion-exchange units are composted into quarterly samples by combining three months of samples. The ^{90}Sr analyses are then performed on quarterly samples (prior to 1976 the monthly samples were analyzed) by either EML or contractor laboratories. The radiochemical methods used to process, separate and count the samples for ^{90}Sr analysis are similar to those described in

EML's Procedures Manual, Section 4 (Chieco *et al.*, 1992). Blind quality control blanks and spiked reference samples are included with each set of samples and represent about 10% of the total samples analyzed. The contractors are required to meet specified criteria regarding agreement with quality control samples and counting errors for all samples.

Once the data is obtained it is evaluated for adherence to the contract specifications, converted to obtain values of ^{90}Sr deposition per unit area (Bq m^{-2}), and added to the ^{90}Sr deposition database. The database is then used to update estimates of the total annual deposition and global burden of ^{90}Sr. The method used to determine these values has been described by Volchok (1965). Representative ^{90}Sr deposition values (Bq m^{-2}) are derived for each 10-degree latitude band based on the site data averages. Deposition values are obtained for the unsampled regions (north of 70^0N and south of 70^0S) by extrapolating to a deposition of zero at the poles. The total ^{90}Sr deposition (TBq) is calculated for each latitude band and then summed for a global total.

Data Quality and Validation

As already mentioned, the contractors must meet established criteria to ensure that EML's database represents the best quality possible. Table 2 shows the results of blank samples submitted to four laboratories that performed analysis of samples collected from 1987 through 1990. The laboratories are identified by letters to maintain anonymity. The number of results reported in Table 2 is proportional to the total number of samples analyzed by that particular laboratory. The mean blank values for each of the laboratories was below the established criteria set at 17 Bq. One result reported by laboratory A and two results reported by laboratory C were above this limit, but the remainder of the results were generally well below this value. The blank result of 48.3 ± 10.8 Bq was obtained due to difficulties encountered in processing a batch of samples. There is no apparent explanation for the other two high blank values.

Results of spiked reference samples are shown in Table 3. The contract specifies that the reported values must be within 20% of the known quantity added to the sample as suggested by Harley (1961) and Hardy (1973). All four of the laboratories had mean percent recovery values within this range, but again

some individual analyses did not meet this criteria. Three, nine and three of the reported values analyzed by laboratory A, C and D, respectively, were outside the contract limit. One of the values reported by laboratory C was in the same problem batch mentioned above. The apparent difficulty encountered with the analyses of four samples by laboratory C and the three by laboratory D involved ashing of the samples prior to transfer to the contractor. There is no obvious explanation for the remaining seven results that did not meet the established criteria.

Another set of criteria that was established to help ensure the high quality of ^{90}Sr data was limits for relative counting errors. The relative counting error limits set in the analytical contracts are as follows: 30% for results greater than 17 up through 34 Bq; 15% for results greater than 34 up through 83 Bq; 8% for results greater than 83 up through 167 Bq; and 4% for results greater than 167 Bq. No limit is defined for reported results of 17 Bq and lower since these values are anticipated to be at or below the detection limits. The superscript letters following the data in Table 4 indicate the relative counting errors. Few of the reported results exceeded the limits described above.

In addition to the criteria established to ensure the quality of the data, the database has been evaluated by direct comparisons with other programs. The United Kingdom Atomic Energy Authority (UKAEA) also had a global program to investigate the deposition of radioactivity. This program was also based on a global network similar in size to EML's GFP. The primary radionuclide of interest in the UKAEA program was ^{137}Cs, but estimates of ^{90}Sr deposition were typically estimated by using a mean ^{137}Cs to ^{90}Sr ratio. Table 5 presents the UKAEA global ^{90}Sr deposition data from 1958 through 1990 (Playford *et al.*, 1993), along with EML's GFP data. The largest difference between the annual ^{90}Sr deposition databases is 58% in 1970, but overall the data are in good agreement. EML's annual ^{90}Sr deposition values are generally higher than the UKAEA values during the early period (1958 through 1992) of these programs, and the opposite is true during the later years. This comparison also indicates that EML's methodology is more sensitive than the UKAEA's for determining the global ^{90}Sr deposition since the UKAEA program could only report upper limit values from 1982 through 1990. The cumulative ^{90}Sr deposit data shows even better agreement than the annual deposition. The largest coefficient of variation in the cumulative ^{90}Sr deposit is 6%. It is likely that the differences between the two annual ^{90}Sr deposition databases can be accounted for as a result of varying meteorological conditions at the sampling locations between the networks (Hardy *et al.*, 1968). Both programs calculate global averages values based on a few individual

locations. Such an approach, although theoretically practical (Volchok, 1965), is certain to have some unknown error associated with it. The comparison between these two independent programs would indicate that this error is not great.

Since the release of radionuclides during atmospheric weapons testing was well studied, other data is also available for comparison. Feely (1977) matched the GFP-derived estimates of ^{90}Sr deposition with ^{90}Sr deposition expected as a result of the net loss of ^{90}Sr in the stratosphere during 1974 to 1976. The GFP estimate was 18% higher than the stratospheric loss. This is a good agreement since both estimates are subject to uncertainties. Larsen (1984b) made a similar comparison with stratospheric ^{90}Sr data from 1976 through 1982. Again, the results indicate that there is good agreement between the loss of ^{90}Sr from the stratosphere and the global deposition values estimated by the GFP. These results indicate that the overall uncertainty of the annual estimates of global ^{90}Sr deposition may be as high as 20%. This level of uncertainty would not significantly affect the interpretation or use of the GFP data.

Results

Quarterly ^{90}Sr deposition (Bq m^{-2}) and precipitation (cm) data from 1987 through 1990 are reported for the individual sampling locations shown in Table 4. The sites are listed in order of increasing distance from 90°N latitude. Annual totals of the quarterly results are provided in the last column of Table 4.

Tables 6 to 9 list the average ^{90}Sr deposited (Bq m^{-2}) in each 10-degree latitude band and the entire world for the years 1987, 1988, 1989 and 1990, respectively. Averages are provided for each quarter along with an annual average. The number of sites used to calculate the average deposition are given next to the values. The letter "E" indicates that no results were available to determine an average for the latitude band, so the average was calculated by extrapolation as mentioned in the Methods Section. The average deposition data is used to calculate the total ^{90}Sr deposits (TBq) in the latitude bands and the world shown in Tables 10 to 13 for the years 1987, 1988, 1989 and 1990, respectively. These tables present total deposition values for each quarter and a summation for the year. In Tables to 17, the total annual ^{90}Sr deposition is added to the previous global data to obtain the cumulative (decayed) burden of ^{90}Sr (PBq) in

each latitude band and the world for the years 1987, 1988, 1989 and 1990, respectively. The data shows the cumulative deposit at the end of each quarter. Figure 2 is a histogram showing the latitudinal distribution of the global ^{90}Sr burden at the end of 1990. The percent of the total global burden present in each 10-degree latitude band is also provided in this figure.

The total annual ^{90}Sr deposition (PBq) and fission yields of atmospheric weapons testing (MT) for the Northern and Southern Hemispheres are reported in Table 18. This table lists data from the inception of the GFP (1958) to the end of 1990. Figure 3 also displays some of the historical data available in the GFP. Figure 3A is a plot of the annual global ^{90}Sr deposition (PBq) from 1958 to 1990. A graph of the annual fission yields from atmospheric weapons testing from 1945 to 1990 is shown in Figure 3B, and a graph of the cumulative global deposit of ^{90}Sr (PBq) from 1958 to 1990 is shown in Figure 3C. The value (85.1 PBq) indicated in Figure 3C as the pre-1958 ^{90}Sr deposit was estimated from the fission yields of tests conducted prior to 1957 by assuming that each Megaton of nuclear explosive power generates 3.7 PBq of ^{90}Sr.

Discussion

The bulk of the data in the GFP database has already been presented and interpreted in numerous reports over the years (e.g., Monetti and Larsen, 1991). As more data becomes available it is compared and appended to the historic database.

The site specific ^{90}Sr deposition data in Table 4 shows that the majority of the 1987 through 1990 values were low and indicate that there was no significant atmospheric source of ^{90}Sr on a global scale. This is in agreement with the fact that there were no announced atmospheric detonations or large-scale nuclear accidents. Also the presence of fission products in the surface air samples collected around the world was generally below the detection limit as noted in EML's Surface Air Sampling Program (Larsen and Sanderson, 1991). Thirty-seven percent of the quarterly ^{90}Sr deposition results reported in Table 4 had a value of zero, and another 37% of the data had a value below 0.1 Bq m^{-2}. The remaining 26% of the

results generally were low values with high uncertainties. The ^{90}Sr deposition reported at these locations may simply have been due to the resuspension of previously deposited material. Some of the higher results are more interesting and require other explanations. Although the highest quarterly ^{90}Sr deposition, 7.4 Bq m^{-2}, was observed in the sample collected in Peru during the third quarter of 1989, this data is subject to high errors due to analytical difficulties. The next few locations in a series of decreasing quarterly ^{90}Sr deposition are all in Australia (Darwin during the fourth quarter of 1987, Townsville during the third quarter of 1989 and Perth during the fourth quarter of 1987, with 6.2, 2.1 and 1.8 Bq m^{-2}, respectively). The counting errors for these results were all low, but there were some unresolved problems with the quality control samples analyzed with several of the Australian samples. If there has been any atmospheric source of ^{90}Sr other than resuspension at any of the sampling stations during this period it would have been of limited quantity and extent. More detailed studies would be necessary to verify and identify potential radionuclide sources at specific locations of concern.

The averaged ^{90}Sr deposition data reported in Tables 6 through 9 reflect the individual site data. The few elevated values resulted from the increased deposition at the individual locations noted above. There is no apparent temporal or spatial pattern to suggest that any event resulted in a global atmospheric release of radioactivity. The total ^{90}Sr deposited (Tables 10 to 13) during this period of time was insignificant relative to the burden of ^{90}Sr present at the time (Tables 14 to 17). The quantity of ^{90}Sr deposited from 1987 to 1990 was the lowest it is has been over any other 4-year period since the GFP began. Since the total ^{90}Sr deposition was less than the decay of the ^{90}Sr burden, the cumulative ^{90}Sr deposit decreased from 1987 to 1990. At the end of 1990, the global burden of ^{90}Sr (311.4 PBq) was lower than it has been in 27 years.

The bimodal latitudinal distribution of the global ^{90}Sr burden shown in Figure 2 is a result of factors controlling the transport of radioactivity released into the atmosphere. Atmospheric weapons tests injected most of the radioactivity into the stratosphere (Bennett, 1978). This material tended to remain in the stratosphere until the spring of the following year when it passed through the disruptions in the tropopause at midlatitudes in the Northern and Southern Hemispheres (UNSCEAR, 1982). Once in the troposphere, the material was carried around the world within Hadley cells. The fallout radionuclides were then deposited onto the earth's surface by both wet and dry deposition. This circulation pattern maintained latitudinal bands of peak radioactivity at the midlatitudes.

Nuclear weapons testing began in 1945, but the total fission yields produced were low until the early 1950's (Figure 2B). Over 90% of the weapons testing occurred in the Northern Hemisphere since 1958, but only 76% of the ^{90}Sr was deposited in the Northern Hemisphere (Table 18). Most of the ^{90}Sr deposited in the Southern Hemisphere was from Northern Hemisphere tests and was transported across the equator while it was in the stratosphere (Juzdan, 1988). Additionally, many of the tests conducted in the Northern Hemisphere were performed near the equator (Carter and Moghissi, 1977). The peak of weapons testing in 1962 resulted in the peak annual ^{90}Sr deposition in 1963 (Figure 2A). Another minor peak in the annual ^{90}Sr deposition database during 1959 followed the increased testing the year before. The cumulative ^{90}Sr deposit increased sharply during the early 1960s because of the extensive testing conducted during this period. A moratorium on atmospheric weapons testing was observed since 1963 by all the countries involved except for China. Since this time, the fission yields have been low compared to the earlier testing yields. The annual global ^{90}Sr deposition sharply decreased as a result of the 1963 moratorium. The cumulative global ^{90}Sr deposit reached a maximum value (451.4 PBq) in 1966 and was maintained at this level for 6 years. Since 1972 the cumulative ^{90}Sr deposit has been decreasing since the radioactive decay of the global ^{90}Sr burden has been greater than the amount released into the atmosphere. The last atmospheric weapons test was performed by China at the Lop Nor test site on October 16, 1980. Most of the ^{90}Sr associated with this test was deposited in 1981. The ^{90}Sr deposited during 1986 was due to the Chernobyl accident in the Ukraine Republic of the former Soviet Union. Strontium-90 was distributed throughout the Northern Hemisphere, but the event was primarily of regional importance with greatest effects in Europe. The GFP was able to provide some interesting information on the transport and fate of this release (Monetti and Larsen, 1991). There was no significant global ^{90}Sr deposit from 1987 through 1990, and the cumulative deposit continued to decrease.

Acknowledgments

EML is extremely grateful for the support of the site operators who maintain the deposition sampling stations around the world. Their efforts are greatly appreciated but often not formally recognized. We would also like to thank all of those who aided us in establishing and maintaining the network. This includes those individuals or groups who served as contacts to ensure that supplies and information was

relayed to the appropriate locations. This program could not have been accomplished without the assistance of all these people.

References

Bennett, B. G.
"Environmental Aspects of Americium"
USERDA Report EML-348, December (1978)

Carter, M. and A. Moghissi
"Three Decades of Nuclear Testing"
Health Physics, 33, 55-71, July (1977)

Chieco, N. A., D. C. Bogen and E. O. Knutson
"EML Procedures Manual"
HASL-300, 27th Edition, Vol. 1, November (1992)

Feely, H. W.
"Worldwide Deposition of ^{90}Sr through 1976"
USERDA Report HASL-328, pp. 1-85-I-103, October (1977)

Hardy, E. P., Jr.
"Analysis of Quality Control Samples at HASL and a Contractor Laboratory - during 1972"
USERDA Report HASL-268, January (1973)

Hardy, E. P., Jr.
"Final Tabulation of Monthly ^{90}Sr Fallout Data, 1954-1976"
USERDA Report HASL-329, October (1977)

Hardy, E. P., Jr., M. W. Meyer, J. S. Allen and L. T. Alexander
"90-Sr on the Earth's Surface"
Nature, 219, 584-587 (1968)

Harley, J. H.
"Errors in Measurement"
USAEC Report HASL-105, January (1961)

Juzdan, Z. R.
"Worldwide Deposition of ^{90}Sr through 1985"
USDOE Report EML-515, July (1988)

Larsen, R. J.
"Graphic Presentation of Quarterly ^{90}Sr Fallout Data, 1954-1982"
USDOE Report EML-424, January (1984a)

Larsen, R. J.
"Worldwide Deposition of ^{90}Sr through 1982"
USDOE Report EML-430, June (1984b)

Larsen, R. J.
"Worldwide Deposition of ^{90}Sr through 1983"
USDOE Report EML-444, July (1985)

Larsen, R. J. and C. G. Sanderson
"EML Surface Air Sampling Program, 1989 Data"
USDOE Report EML-541, August (1991)

Monetti, M. A. and R. J. Larsen
"Worldwide Deposition of ^{90}Sr through 1986"
USDOE Report EML-533, April (1991)

Playford, K., J. Toole and I. Adsley
"Radioactive Fallout in Air and Rain: Results to the end of 1991"
U. K. Atomic Energy Authority Report AEA-EE-0498, May (1993)

UNSCEAR
"U.N. Scientific Committee on the Effects of Atomic Radiation - 1982 Report to the General Assembly, with Annexes. Ionizing Radiation: Sources and Biological Effects"
United Nations, New York (1982)

Volchok, H. L.
"Worldwide Deposition of ^{90}Sr through 1964"
USAEC Report HASL-245, pp. 268-284, July (1965)

TABLE 1

SAMPLING LOCATIONS OF THE GFP FROM 1987 TO 1990

Sampling Site	Latitude	Longitude	Elevation (m)	Sampling Unit
Faibanks, Alaska	64:49°N	147:52°W	143	Ion-Column Exchange
Nome, Alaska	64:30°N	165:30°W	7	„
Keflavik, Iceland	63:58°N	22:36°W	56	„
Anchorage, Alaska	61:10°N	149:59°W	27	„
Cold Bay, Alaska	55:12°N	162:43°W	31	„
Moosonee, Canada	51:16°N	80:89°W	10	„
Vienna, Austria	48:15°N	16:22°E	203	„
Munich, Germany	48:08°N	11:35°E	1000	„
Klagenfurt, Austria	46:39°N	14:20°E	448	„
Vermillion, South Dakota	42:47°N	96:56°W	372	Open Pot
Argonne, Illinois	41:42°N	88:00°W	192	Open Bucket
Chester, New Jersey	40:48°N	74:40°W	268	„
Wooster, Ohio	40:47°N	81:50°W	367	Open Pot
New York, New York	40:40°N	74:00°W	56	Open Bucket
Lajes Field, Azores	38:44°N	27:04°W	112	Ion-Exchange Column
Seoul, Korea	37:30°N	127:00°E	50	„
Hiroshima, Japan	34:23°N	132:27°E	23	Open Pot
West Los Angeles, California	34:04°N	118:27°W	125	„
Birmingham, Alabama	33:30°N	86:55°W	183	„
Nagasaki, Japan	32:45°N	129:52°E	61	„
Kindley AFB, Bermuda	32:22°N	64:31°W	8	Ion-Exchange Column
Houston, Texas	29:45°N	95:17°W	22	„
Miami, Florida	25:49°N	80:17°W	4	„
Taipei, Taiwan	25:05°N	121:31°E	50	Open Pot
Lihue, Hawaii	21:59°N	159:21°W	35	Ion-Exchange Column
Mauna Loa, Hawaii	19:32°N	155:31°W	3401	Open Pot
Wake Island	19:17°N	166:39°E	3	Ion-Exchange Column
San Juan, Puerto Rico	18:26°N	66:00°W	10	„
Johnston Island	16:45°N	169:32°W	0	„
Clark AFB, Philippines	15:11°N	120:33°E	10	„
Bangkok, Thailand	13:44°N	100:30°E	23	Open Pot
Anderson AFB, Guam	13:35°N	144:55°E	185	Ion-Exchange Column
Yap Island	9:31°N	138:08°E	18	„
Panama Canal Zone	8:55°N	79:36°W	10	„
Truk Island	7:28°N	151:51°E	2	„
Koror Island	7:21°N	134:31°E	31	„

TABLE 1 (Cont'd)

SAMPLING LOCATIONS OF THE GFP FROM 1987 TO 1990

Sampling Site	Latitude	Longitude	Elevation (m)	Sampling Unit
Majoro Island	07:05°N	171:23°E	3	Ion- Exchange Column
Ponape Island	06:58°N	158:13°E	38	”
Karawa, Zaire	03:14°N	020:17°E	750	”
Mbandaka, Zaire	00:03°N	018:28°E	350	”
Kikuyu, Kenya	01:13°S	036:38°E	2074	Open Pot
Belem, Brazil	01:27°S	048:29°E	8	Ion-Exchange Column
Guayaquil, Ecuador	02:10°S	079:52°E	7	”
Lima, Peru	12:01°S	077:07°E	30	”
Darwin, Australia	12:28°S	130:51°E	30	”
Tutuila, American Samoa	14:16°S	170:43°W	77	Open Bucket
Chacaltaya, Bolivia	16:21°S	068:08°W	5222	Ion-Exchange Column
Harare, Zimbabwe	17:48°S	031:03°E	1495	Open Pot
Suva, Fiji	18:09°S	178:25°W	11	Ion-Exchange Column
Townsville, Australia	19:18°S	146:48°E	4	”
Rio de Janeiro, Brazil	22:54°S	043:13°W	9	Open Pot
Antofagasta, Chile	23:37°S	070:25°W	30	Ion-Exchange Column
Pretoria, South Africa	25:45°S	028:14°E	1369	Open Pot
Easter Island, Chile	27:10°S	109:26°W	41	Ion-Exchange Column
Brisbane, Australia	27:28°S	153:02°W	42	”
Durban, South Africa	29:52°S	030:59°E	156	Open Pot
Perth, Australia	31:57°S	115:51°E	64	Ion-Exchange Column
Santiago, Chile	33:27°S	070:42°W	520	”
Sydney, Australia	33:52°S	151:12°E	42	”
Buenos Aires, Argentina	34:37°S	058:26°W	20	”
Adelaide, Australia	34:56°S	138:35°E	43	”
Melbourne, Australia	37:49°S	144:58°E	47	”
Wellington, New Zealand	41:17°S	174:46°E	34	”
Puerto Montt, Chile	41:26°S	073:07°W	110	”
Hobart, Australia	42:53°S	147:20°E	54	”
Punta Arenas, Chile	53:00°S	070:50°W	74	”
Antarticia, Chile	62:56°S	060:36°W	16	”

TABLE 2

RESULTS OF QUALITY CONTROL BLANK SAMPLES SUBMITTED WITH SAMPLES COLLECTED FROM 1987 TO 1990
(mBq ^{90}Sr per Sample ± Standard Deviation)

Laboratory A[a]	Laboratory B[b]	Laboratory C[c]	Laboratory D[d]
0.0 ± 1.7	2.2 ± 6.0	0.0 ± 6.7	0.0 ± 1.7
0.0 ± 1.7	8.7 ± 2.8	16.7 ± 3.3	3.3 ± 3.3
0.0 ± 1.7	3.7 ± 3.0	1.7 ± 8.3	0.0 ± 1.7
0.0 ± 3.3	7.8 ± 2.9	1.7 ±16.7	0.0 ± 1.7
3.3 ± 1.7		5.0 ± 4.2	1.7 ± 1.7
143.3 ± 1.7		0.0 ± 5.8	0.0 ± 1.7
3.3 ± 1.7		0.0 ± 5.0	1.7 ± 1.7
6.7 ± 1.7		0.3 ± 4.2	0.0 ± 1.7
11.7 ± 1.7		0.0 ± 3.3	0.0 ± 1.7
0.0 ± 1.7		3.3 ± 2.5	1.7 ± 3.3
0.0 ± 1.7		6.7 ± 3.3	6.7 ± 3.3
0.0 ± 1.7		0.0 ± 9.2	
		10.0 ± 3.3	
		8.3 ± 3.3	
		16.7 ± 2.5	
		0.0 ± 5.8	
		1.7 ± 1.7	
		0.0 ± 4.2	
		0.0 ± 7.5	
		0.0 ±10.8	
		0.0 ± 2.5	
		0.0 ± 1.7	
		5.0 ± 1.7	
		1.7 ± 5.8	
		0.0 ± 6.7	
		48.3 ±10.8	
		3.3 ± 1.7	
		3.3 ± 8.3	
		1.7 ± 3.3	
		1.7 ± 5.0	
		5.0 ± 1.7	
		1.7 ± 1.7	
		0.0 ± 5.8	
		25.0 ± 2.5	
		0.0 ± 0.8	

[a] Mean Blank Value = 12.5 ± 40.7
[b] Mean Blank Value = 5.6 ± 3.1
[c] Mean Blank Value = 4.9 ± 9.4
[d] Mean Blank Value = 1.3 ± 2.0

TABLE 3

RESULTS OF QUALITY CONTROL REFERENCE SAMPLES SUBMITED WITH SAMPLES COLLECTED FROM 1987 TO 1990
(mBq ^{90}Sr per Sample ± Standard Deviation)

Added	Reported	% Recovered	Added	Reported	% Recovered
Laboratory - A					
55.0	53.3 ± 1.7	95	106.7	88.3 ± 1.7	84
60.0	56.7 ± 5.0	95	108.3	161.7 ± 1.7	149
53.3	43.3 ± 5.0	81	80.0	193.3 ± 1.7	242
98.3	75.0 ± 1.7	76			
Mean % Recovery = 117 ± 60					
Laboratory - B					
60.5	55.0 ± 5.0	91	85.7	76.5 ± 3.9	89
82.7	78.3 ± 5.4	95	58.5	54.2 ± 3.7	93
Mean % Recovery = 92 ± 3					
Laboratory - C					
41.7	45.0 ± 12.5	108	25.0	23.3 ± 5.0	93
75.0	80 0 ± 5.0	107	46.7	45.0 ± 5.0	96
46.7	45.0 ± 5.0	90	60.0	51.7 ± 2.5	86
68.3	65.0 ± 6.7	91	78.3	78.3 ± 4.2	100
51.7	61.7 ± 5.0	116	35.0	45.0 ± 5.0	129
20.0	23.3 ± 5.0	116	53.3	63.3 ± 5.8	119
83.3	88.3 ± 8.3	106	75.0	73.3 ± 10.0	98
33.3	36.7 ± 5.0	110	23.3	45.0 ± 12.5	197
70.0	61.7 ± 4.2	88	70.0	76.7 ± 5.0	110
60.0	63.3 ± 8.3	106	43.3	50.0 ± 3.3	115
61.7	76.7 ± 5.8	124	21.7	30.0 ± 3.3	138
23.3	30.0 ± 4.2	129	66.7	56.7 ± 3.3	85
120.0	131.7 ± 12.5	110	25.0	20.0 ± 6.7	80
61.7	60.0 ± 4.2	97	28.3	11.7 ± 1.7	41
51.7	58.3 ± 5.8	113	41.7	13.3 ± 3.3	32
90.0	81.7 ± 3.3	91	51.7	21.7 ± 1.7	42
25.0	20.0 ± 4.2	80	55.0	23.3 ± 1.7	42
Mean % Recovery = 100 ± 31					

TABLE 3 (Cont'd.)

Added	Reported	% Recovered	Added	Reported	% Recovered
Laboratory - D					
70.0	60.0 ± 3.3	86	30.0	31.7 ± 1.7	113
40.0	36.7 ± 3.3	92	43.3	40.0 ± 3.3	93
40.0	28.3 ± 3.3	73	58.3	60.0 ± 3.3	101
41.7	26.7 ± 3.3	63	76.7	71.7 ± 3.3	94
51.7	51.7 ± 6.7	100	120.0	126.7 ± 5.0	107
103.3	95.0 ±10.0	91	45.0	35.0 ± 3.3	75
75.0	65.0 ± 6.7	87			
Mean % Recovery = 90 ± 14					

TABLE 5

COMPARISON OF ESTIMATES OF ^{90}Sr DEPOSITION MADE BY EML AND UKAEA

Year	Annual Deposition (PBq ^{90}Sr)		Cumulative Deposit (PBq ^{90}Sr)	
	EML	UKAEA	EML	UKAEA
1958	32.6	31	115	110
1959	45.9	54	159	158
1960	15.9	15	170	170
1961	19.2	21	185	190
1962	63.3	75	244	260
1963	108.4	107	344	360
1964	77.0	81	411	430
1965	41.8	38	444	460
1966	20.0	19	451	460
1967	10.4	10	451	460
1968	11.1	11	448	460
1969	10.7	10	451	460
1970	12.6	8	451	460
1971	12.6	9	451	460
1972	6.7	6	448	450
1973	2.3	5	440	440
1974	5.9	6	433	440
1975	3.4	6	426	430
1976	1.8	2.5	418	430
1977	3.8	4	411	420
1978	4.4	4.5	407	410
1979	1.5	2.5	400	400
1980	0.9	2	392	400
1981	1.9	~3	381	390
1982	0.7	<2.5	374	380
1983	0.5	<3	366	370
1984	0.4	<2	357	360
1985	0.2	<2	349	350
1986	1.7	<3	343	340
1987	0.3	<2	336	335
1988	0.2	<2	326	325
1989	0.2	<2	319	319
1990	0.1	<2	311	312

TABLE 7

AVERAGE ^{90}Sr DEPOSITS IN 10^{o} LATITUDE BANDS DURING 1988 (Bq m^{-2})

Latitude Band	First Quarter		Second Quarter		Third Quarter		Fourth Quarter		1988 Annual Average
	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	
80-90°N	0.0	E	0.0	E	0.0	E	0.0	E	0.0
70-80°N	0.1	E	0.0	E	0.1	E	0.0	E	0.1
60-70°N	0.2	3	0.0	3	0.1	3	0.0	3	0.1
50-60°N	0.1	2	0.1	2	0.1	2	0.1	2	0.1
40-50°N	0.2	8	0.1	8	0.1	8	0.1	8	0.1
30-40°N	0.1	7	0.0	6	0.1	6	0.1	6	0.1
20-30°N	0.1	5	0.0	5	0.0	5	0.1	5	0.1
10-20°N	0.0	7	0.0	7	0.0	7	0.1	7	0.0
0-10°N	0.0	6	0.1	6	0.0	6	0.1	6	0.1
0-10°S	0.0	3	0.1	3	0.1	3	0.2	3	0.1
10-20°S	0.3	7	0.2	7	0.1	4	0.1	4	0.2
20-30°S	0.2	6	0.2	6	0.1	4	0.1	4	0.1
30-40°S	0.2	5	0.1	6	0.1	2	0.3	2	0.2
40-50°S	0.2	3	0.1	3	0.3	2	0.1	2	0.2
50-60°S	0.0	1	0.1	1	0.1	1	0.1	1	0.1
60-70°S	0.0	1	0.1	1	0.1	1	0.1	1	0.1
70-80°S	0.0	E	0.0	E	0.0	E	0.1	E	0.0
80-90°S	0.0	E	0.0	E	0.0	E	0.0	E	0.0
Global Average	0.1		0.1		0.1		0.1		0.1

*E indicates that no sampling sites are in the latitude band, and the data was obtained by extrapolating the results to a value of zero at the poles.

TABLE 8

AVERAGE ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1989 (Bq m^{-2})

Latitude Band	First Quarter		Second Quarter		Third Quarter		Fourth Quarter		1989 Annual Average
	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	
80-90°N	0.0	E	0.0	E	0.0	E	0.0	E	0.0
70-80°N	0.1	E	0.0	E	0.1	E	0.0	E	0.0
60-70°N	0.1	2	0.0	3	0.1	3	0.0	3	0.1
50-60°N	0.1	2	0.0	2	0.2	2	0.0	2	0.1
40-50°N	0.1	7	0.1	7	0.1	7	0.1	7	0.1
30-40°N	0.1	6	0.0	7	0.0	6	0.0	6	0.0
20-30°N	0.1	5	0.0	5	0.0	4	0.1	4	0.1
10-20°N	0.0	6	0.0	6	0.2	6	0.0	7	0.1
0-10°N	0.0	7	0.1	7	0.1	7	0.0	8	0.1
0-10°S	0.0	3	0.0	3	0.0	3	0.3	2	0.1
10-20°S	0.0	5	0.0	7	1.4	7	0.2	6	0.4
20-30°S	0.0	5	0.0	5	0.0	6	0.0	6	0.0
30-40°S	0.0	2	0.0	2	0.1	6	0.0	6	0.1
40-50°S	0.0	2	0.0	2	0.1	3	0.1	3	0.1
50-60°S	0.0	1	0.0	1	1.6	1	0.0	1	0.4
60-70°S	0.0	1	0.0	1	0.2	1	0.1	1	0.1
70-80°S	0.0	E	0.0	E	0.1	E	0.1	E	0.0
80-90°S	0.0	E	0.0	E	0.0	E	0.0	E	0.0
Global Average	0.0		0.0		0.2		0.1		0.1

*E indicates that no sampling sites are in the latitude band, and the data was obtained by extrapolating the results to a value of zero at the poles.

TABLE 9

AVERAGE ^{90}Sr DEPOSITS IN 10^{o} LATITUDE BANDS DURING 1990 (Bq m^{-2})

Latitude Band	First Quarter		Second Quarter		Third Quarter		Fourth Quarter		1990 Annual Average
	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	Average Deposit	Number of Sites*	
80-90°N	0.0	E	0.0	E	0.0	E	0.0	E	0.0
70-80°N	0.0	E	0.0	E	0.1	E	0.0	E	0.0
60-70°N	0.0	3	0.0	3	0.1	2	0.1	2	0.1
50-60°N	0.0	2	0.0	2	0.1	2	0.0	2	0.0
40-50°N	0.0	7	0.1	8	0.1	8	0.1	8	0.1
30-40°N	0.0	7	0.0	7	0.0	7	0.1	7	0.0
20-30°N	0.1	4	0.0	4	0.0	3	0.1	4	0.0
10-20°N	0.0	7	0.1	7	0.1	7	0.1	7	0.1
0-10°N	0.0	6	0.0	6	0.0	5	0.1	6	0.0
0-10°S	0.4	3	0.0	3	0.3	3	0.0	3	0.2
10-20°S	0.3	6	0.1	6	0.1	6	0.1	7	0.1
20-30°S	0.0	5	0.0	6	0.1	6	0.1	5	0.0
30-40°S	0.3	6	0.1	6	0.0	6	0.1	6	0.1
40-50°S	0.0	3	0.0	3	0.1	3	0.1	3	0.0
50-60°S	0.0	1	0.0	1	0.1	1	0.1	1	0.0
60-70°S	0.0	1	0.0	1	0.0	1	0.1	1	0.0
70-80°S	0.0	E	0.0	E	0.0	E	0.0	E	0.0
80-90°S	0.0	E	0.0	E	0.0	E	0.0	E	0.0
Global Average	0.1		0.0		0.1		0.1		0.1

*E indicates that no sampling sites are in the latitude band, and the data was obtained by extrapolating the results to a value of zero at the poles.

TABLE 10

TOTAL ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1987 (TBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit	1987 Annual Total
80-90°N	0.0	0.0	0.0	0.1	0.1
70-80°N	0.2	0.5	0.0	0.8	1.5
60-70°N	0.5	1.4	0.0	2.2	4.1
50-60°N	0.2	0.0	2.4	6.6	9.2
40-50°N	3.5	5.4	2.7	5.0	16.6
30-40°N	0.8	0.7	1.7	1.9	5.1
20-30°N	6.6	1.9	2.9	4.4	15.8
10-20°N	0.4	1.0	3.5	3.4	8.4
0-10°N	0.0	1.0	2.2	5.4	8.6
0-10°S	4.0	8.6	0.8	20.4	33.9
10-20°S	8.8	8.2	4.8	40.0	61.9
20-30°S	6.1	10.2	6.6	6.5	29.4
30-40°S	0.9	1.7	3.1	16.6	22.3
40-50°S	12.3	0.0	2.8	3.6	18.7
50-60°S	0.0	0.0	1.4	6.3	7.7
60-70°S	1.1	0.0	4.1	1.5	6.7
70-80°S	0.4	0.0	1.5	0.6	2.5
80-90°S	0.0	0.0	0.1	0.1	0.2
Global Total	45.9	40.6	40.8	125.4	252.7

TABLE 11

TOTAL ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1988 (TBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit	1988 Annual Total
80-90°N	0.0	0.0	0.0	0.0	0.0
70-80°N	1.3	0.1	1.0	0.0	2.5
60-70°N	3.6	0.3	2.7	0.0	6.7
50-60°N	2.8	2.4	3.1	1.7	10.1
40-50°N	5.6	2.6	3.1	3.0	14.3
30-40°N	4.0	0.6	2.7	2.9	10.2
20-30°N	4.4	1.9	1.6	3.8	11.7
10-20°N	2.0	0.7	1.0	4.6	8.2
0-10°N	1.4	2.8	2.2	4.2	10.6
0-10°S	2.0	5.1	3.0	9.9	20.0
10-20°S	11.1	6.7	3.1	5.8	26.7
20-30°S	6.4	6.3	2.9	2.7	18.3
30-40°S	8.6	4.0	2.0	11.9	26.6
40-50°S	4.9	2.4	8.6	4.3	20.2
50-60°S	0.0	2.1	3.5	2.8	8.4
60-70°S	0.0	1.5	1.5	2.6	5.7
70-80°S	0.0	0.6	0.6	0.9	2.1
80-90°S	0.0	0.1	0.1	0.1	0.2
Global Total	58.0	40.2	42.9	61.3	202.5

TABLE 12

TOTAL ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1989 (TBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit	1989 Annual Total
80-90°N	0.0	0.0	0.0	0.0	0.0
70-80°N	1.0	0.3	0.7	0.2	2.3
60-70°N	2.8	0.7	2.0	0.6	6.2
50-60°N	1.7	0.0	4.4	0.9	7.1
40-50°N	2.3	2.2	4.4	2.8	11.7
30-40°N	2.0	0.9	0.4	1.0	4.3
20-30°N	5.2	1.0	0.2	2.3	8.7
10-20°N	1.6	0.9	8.0	1.1	11.6
0-10°N	0.4	4.7	5.9	0.0	10.9
0-10°S	1.9	1.7	1.5	11.8	16.9
10-20°S	1.1	0.7	59.8	8.7	70.4
20-30°S	0.2	0.7	1.8	0.4	3.1
30-40°S	1.5	0.4	4.3	1.5	7.7
40-50°S	1.4	0.0	2.5	2.4	6.3
50-60°S	0.0	0.0	41.1	0.0	41.1
60-70°S	0.0	0.0	4.0	1.9	5.9
70-80°S	0.0	0.0	1.5	0.7	2.2
80-90°S	0.0	0.0	0.1	0.1	0.2
Global Total	23.2	14.2	142.5	36.6	216.5

TABLE 13

TOTAL ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1990 (TBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit	1990 Annual Total
80-90°N	0.0	0.0	0.0	0.0	0.0
70-80°N	0.2	0.2	0.9	0.5	1.8
60-70°N	0.5	0.5	2.6	1.3	4.9
50-60°N	0.2	0.3	1.7	1.0	3.3
40-50°N	1.0	2.2	2.2	2.2	7.5
30-40°N	1.2	1.2	0.9	2.9	6.1
20-30°N	3.2	0.5	0.5	2.8	7.0
10-20°N	1.1	2.6	3.3	2.9	9.8
0-10°N	1.1	1.1	1.9	2.4	6.5
0-10°S	18.3	1.5	11.6	2.0	33.3
10-20°S	12.7	3.8	4.5	2.6	23.6
20-30°S	0.6	0.7	2.1	2.8	6.3
30-40°S	10.5	4.9	1.0	4.1	20.5
40-50°S	0.6	0.5	2.0	1.7	4.9
50-60°S	0.3	1.0	2.1	1.4	4.8
60-70°S	0.0	0.7	0.4	1.5	2.6
70-80°S	0.0	0.3	0.1	0.6	1.0
80-90°S	0.0	0.0	0.0	0.1	0.1
Global Total	51.5	21.8	38.0	32.7	144.0

TABLE 14

CUMMULATIVE ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1987 (PBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit
80-90°N	0.7	0.7	0.7	0.7
70-80°N	4.8	4.7	4.7	4.7
60-70°N	18.2	18.1	18.0	17.9
50-60°N	42.4	42.2	41.9	41.7
40-50°N	57.8	57.4	57.1	56.7
30-40°N	48.2	47.9	47.6	47.4
20-30°N	38.6	38.3	38.1	37.9
10-20°N	27.1	27.0	26.8	26.7
0-10°N	19.5	19.4	19.3	19.1
0-10°S	10.7	10.7	10.6	10.6
10-20°S	9.9	9.8	9.7	9.7
20-30°S	15.7	15.6	15.5	15.5
30-40°S	16.4	16.3	16.2	16.1
40-50°S	16.4	16.3	16.2	16.1
50-60°S	8.0	7.9	7.9	7.8
60-70°S	4.0	4.0	3.9	3.9
70-80°S	1.5	1.5	1.5	1.5
80-90°S	0.2	0.2	0.2	0.2
Global Total	340.0	338.0	336.0	334.1

TABLE 15

CUMMULATIVE ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1988 (PBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit
80-90°N	0.7	0.7	0.7	0.7
70-80°N	4.7	4.6	4.6	4.6
60-70°N	17.8	17.7	17.6	17.4
50-60°N	41.4	41.2	41.0	40.7
40-50°N	56.4	56.1	55.7	55.4
30-40°N	47.1	46.8	46.5	46.2
20-30°N	37.7	37.4	37.2	37.0
10-20°N	26.5	26.3	26.2	26.0
0-10°N	19.0	18.9	18.8	18.7
0-10°S	10.5	10.5	10.4	10.3
10-20°S	9.7	9.6	9.6	9.5
20-30°S	15.4	15.3	15.2	15.1
30-40°S	16.0	16.0	15.9	15.8
40-50°S	16.0	15.9	15.9	15.8
50-60°S	7.8	7.7	7.7	7.6
60-70°S	3.9	3.9	3.8	3.8
70-80°S	1.5	1.4	1.4	1.4
80-90°S	0.2	0.2	0.2	0.2
Global Total	332.2	330.2	328.3	326.4

TABLE 16

CUMMULATIVE ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1989 (PBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit
80-90°N	0.7	0.7	0.7	0.7
70-80°N	4.6	4.5	4.5	4.5
60-70°N	17.3	17.2	17.1	17.0
50-60°N	40.5	40.2	40.0	39.8
40-50°N	55.1	54.7	54.4	54.1
30-40°N	46.0	45.7	45.4	45.1
20-30°N	36.8	36.6	36.3	36.1
10-20°N	25.9	25.7	25.6	25.4
0-10°N	18.6	18.5	18.4	18.3
0-10°S	10.3	10.2	10.2	10.1
10-20°S	9.5	9.4	9.4	9.4
20-30°S	15.0	14.9	14.8	14.7
30-40°S	15.7	15.6	15.5	15.4
40-50°S	15.7	15.6	15.5	15.4
50-60°S	7.6	7.5	7.5	7.5
60-70°S	3.8	3.8	3.8	3.7
70-80°S	1.4	1.4	1.4	1.4
80-90°S	0.2	0.2	0.2	0.2
Global Total	324.4	322.5	320.7	318.8

TABLE 17

CUMMULATIVE ^{90}Sr DEPOSITS IN 10° LATITUDE BANDS DURING 1990 (PBq)

Latitude Band	First Quarter Total Deposit	Second Quarter Total Deposit	Third Quarter Total Deposit	Fourth Quarter Total Deposit
80-90°N	0.6	0.6	0.7	0.6
70-80°N	4.4	4.4	4.4	4.4
60-70°N	16.9	16.8	16.7	16.6
50-60°N	39.5	39.3	39.0	38.8
40-50°N	53.8	53.5	53.1	52.8
30-40°N	44.9	44.6	44.3	44.1
20-30°N	35.9	35.7	35.5	35.3
10-20°N	25.3	25.1	25.0	24.8
0-10°N	18.2	18.1	17.9	17.8
0-10°S	10.1	10.0	10.0	9.9
10-20°S	9.3	9.3	9.2	9.2
20-30°S	14.7	14.6	14.5	14.4
30-40°S	15.3	15.2	15.1	15.1
40-50°S	15.3	15.2	15.1	15.0
50-60°S	7.5	7.4	7.4	7.3
60-70°S	3.7	3.7	3.7	3.7
70-80°S	1.4	1.4	1.4	1.4
80-90°S	0.2	0.2	0.2	0.2
Global Total	317.0	315.1	313.3	311.4

TABLE 18

ANNUAL FISSION YIELDS OF ATMOSPHERIC WEAPONS TESTS AND ^{90}Sr DEPOSITION FOR THE NORTHERN AND SOUTHERN HEMISPHERES

Year	Northern Hemisphere		Southern Hemisphere	
	Fission Yields (MT)	^{90}Sr Deposition (PBq)	Fission Yields (MT)	^{90}Sr Deposition (PBq)
1958	29.0	23.3	0.0	9.6
1959	0.0	38.9	0.0	6.7
1960	0.1	9.6	0.0	6.3
1961	25.0	13.0	0.0	6.3
1962	77.0	53.3	0.0	9.6
1963	0.0	96.9	0.0	11.5
1964	0.0	61.4	0.0	15.5
1965	0.0	28.5	0.0	13.3
1966	0.6	12.2	0.7	7.8
1967	1.7	6.3	0.2	4.1
1968	1.2	7.4	4.1	3.7
1969	2.0	5.6	0.0	5.2
1970	2.0	7.8	2.6	4.8
1971	0.0	7.0	2.0	5.6
1972	0.1	3.2	0.1	3.6
1973	1.6	1.2	0.1	1.2
1974	0.5	4.5	1.1	1.4
1975	0.0	2.2	0.0	1.3
1976	2.4	1.0	0.0	0.8
1977	0.0	3.0	0.0	0.8
1978	0.0	3.7	0.0	0.7
1979	0.0	1.1	0.0	0.4
1980	0.5	0.6	0.0	0.3
1981	0.0	1.6	0.0	0.3
1982	0.0	0.5	0.0	0.2
1983	0.0	0.3	0.0	0.2
1984	0.0	0.3	0.0	0.1
1985	0.0	0.1	0.0	0.1
1986	0.0	1.5	0.0	0.2
1987	0.0	0.1	0.0	0.2
1988	0.0	0.1	0.0	0.1
1989	0.0	0.1	0.0	0.2
1990	0.0	0.0	0.0	0.1