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RADIOACTIVITY FROM NUCLEAR EXPLOSIONS IN GROUND LEVEL AIR AT THREE SWEDISH SAMPLING STATIONS. Ge(Li)-MEASUREMENTS UP TO MID-YEAR 1975

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Summary

Ge(Li)-detector measurements of radioactive nuclides in ground level air up to mid-year 1975 at three Swedish sampling stations, Ljungbyhed, Grindsjön and Kiruna, are reported. Ljungbyhed values are given from April 1974, Grindsjön values from August 1972 and Kiruna values from August 1973. The main source of particulate radioactivity during the period of interest was the Chinese nuclear explosions of March 1972, June 1973 and June 1974. Specific discussions are given for the ^{7}Be-, ^{54}Mn-, ^{88}Y-, ^{95}Zr-, ^{103}Ru-, ^{106}Ru-, ^{125}Sb-, ^{131}I-, ^{137}Cs-, ^{140}Ba-, ^{141}Ce-, ^{144}Ce- and ^{155}Eu-activities.

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CONTENTS

INTRODUCTION

Radioactivity in ground level air has been collected on glass-fibre filters and measured by the National Defence Research Institute since 1955. Today seven sampling stations distributed over Sweden (fig 1) are in operation with high capacity centrifugal pumps. Monthly averages from measurement on NaI(Tl)-detectors have been reported through the years (Lindblom 1965, Lindblom 1969, Bernström 1969, Bernström 1974). Since 1967 the routine NaI(Tl)-setup has been increasingly supported by a system using high resolving Ge(Li)-detectors, which has completely taken over with the beginning of 1976.

Since August 1972 the Grindsjön station (Tumba in Bernström 1969) has delivered filters both to the monthly NaI(Tl)-measurements and to weekly Ge(Li)-measurements. Kiruna in northern Sweden started to do the same in the fall of 1973 and Ljungbyhed in southern Sweden in spring of 1974. The Ge(Li)-results from these three stations up to mid-year 1975 are discussed in the present report. The corresponding NaI(Tl)-data will be published later (Bernström 1976).

SAMPLING PROGRAM

The complete program of air and precipitation sampling is described in Bernström 1969. Since the start of the Ge(Li)-measurements reported here the Ljungbyhed and Kiruna stations have been equipped with larger (0.56 × 0.56 m^2) filter devices and higher capacity centrifugal pumps (pressure fall 5400 Pa, capacity 26000 m^3/day) while at Grindsjön the 52000 m^3/day sampler has been used since 1971. All the stations are run continuously with changing of glass-fibre filters three times a week at Ljungbyhed and Kiruna and once a week at Grindsjön. Thirty grams of filter from one week is pressurized by 70 MPa to a 14 mm high, Ø = 64 mm, disc that exactly fits the top of a Ge(Li)-endcap. From the stations delivering three filters a week ten grams are taken from each to give a proper average. Through the filter mass of a Grindsjö disc about 220000 m^3 of air has passed while for the other two stations the discs correspond to about 90000 m^3.

MEASUREMENTS AND ANALYSIS

The weekly samples have been measured for up to 4000 minutes starting one week after taking down the last filter. The detectors have been one 6 %, 2.2 keV FWHM ORTEC true coaxial, two 10 %, 2.0 keV FWHM ORTEC VIP-detectors and one 20 %, 1.9 keV FWHM anticompton guarded closed-end Princeton Gammatech crystal. The energy region covered has been 0-2 MeV, usually in 4096 channels. From the anticompton system the supressed and normal spectra have both been stored. The data aquisition and handling have been done by a 32K PDP-11/10 computer connected to a 16K PDP-15 computer equipped with an on-line display with light pen, four DEC-tape units and an incremental plotter. An interface for up to 4 8K-ADC:s with the possibility of supplying both computers with data has been developed. The efficiencies of the detectors have been determined with an error of less than 5 % by disc-shaped sources of ^{166m}Ho and ^{110m}Ag (Eriksen 1975). All spectra have been analysed by an automatic peaksearching and gaussian fitting code written for the PDP-15 with the possibility to visually check on the display the goodness of the fits. In the case of very weak peaks a simple integration procedure has been employed.

RESULTS

The data is presented in tables 1-3 for the Ljungbyhed, Grindsjön and Kiruna stations respectively. Results are given for the cosmic ray produced ^{7}Be (53d), the neutron reaction products ^{54}Mn (312d), ^{88}Y (107d) and ^{237}U (6.75d) and the fission products ^{95}Zr (65.5d), ^{103}Ru (39.6d), ^{106}Ru (369d), ^{125}Sb (2.73y), ^{131}I (8.04d), ^{137}Cs (30.1y), ^{140}Ba (12.8d), ^{141}Ce (32.5d), ^{144}Ce (284d) and ^{155}Eu (1.81y) with the halflives given in the parantheses. The activity concentrations are given in fCi/kg air for the time of the sampling week (midweek).

For nuclei with peaks well above the limit of detection the overall counting and analysis error should be slightly above the 5 % introduced by the efficiency uncertainty of the Ge(Li)-spectrometer. When approaching the limit of detection the statistical error of course increases. When very weak activities are detected only an upper concentration limit is given in the tables. When no activity is detected there is a space in the tables.

The amount of air that has passed the filter medium can be determined to within 10 %. Usually the air flow is measured only when the filters are put up and taken down i.e. twice for each filter and then the mean is used in the calculations. At Grindsjön a continuous gauge is mounted and comparing the results from this with the simpler method for 46 weeks a standard deviation of ± 7 % could be determined for the latter. Together with some errors originating in the preparation, and other minor uncertainties, the sampling and analysis errors should add up to less than 15 % for activities well above the limits of detection. To enhance interesting features and reduce much of the errors just discussed most activities are plotted as quotients to the ^{95}Zr-activity which is often used as a reference (Edvarson et al 1959). This is done for:

	Ljungbyhed	Grindsjön	Kiruna
^{54}Mn	in fig 2	17	33
^{88}Y	3	18	34
^{103}Ru	4	19	35
^{106}Ru	5	20	36
^{125}Sb	6	21	37
^{137}Cs	7	22	38
^{140}Ba	8	23	39
^{141}Ce	9	24	40
^{144}Ce	10	25	41
^{155}Eu	11	26	42

The absolute activity concentrations are plotted for:

	Ljungbyhed	Grindsjön	Kiruna
^{7}Be	in fig	27	
^{95}Zr	12	28	43
^{137}Cs	13	29	44
^{140}Ba	14	30	45

and two "chemical" quotients are plotted:

	Ljungbyhed	Grindsjön	Kiruna
$^{103}Ru/^{106}Ru$	in fig 15	31	46
$^{141}Ce/^{144}Ce$	16	32	47

DISCUSSIONS

During the period of interest three atmospheric nuclear tests have been performed in the northern hemisphere being the Chinese ones of March 18 1972, June 27 1973 and June 17 1974 (Zander et al 1976). In the southern hemisphere France has conducted two test series, July 21 - August 25 1973 and June 16 - September 15 1974 including four and eight events respectively (Zander et al 1976). It is evident from the quotients plotted, the $T_{1/2}$ = 12.8d ^{140}Ba activity and the usually very low rate interhemispheric mixing of air that the larger part of the observed activity is due to the three Chinese tests. No activity has been found to be due to the venting of any underground explosion as was the case in 1966, 1968 and 1971 (Persson 1969, Persson 1971, Eriksen 1972). On some occasions small activities from local releases, especially of ^{131}I used in hospitals, have been detected in filters from the Ljungbyhed and Grindsjön stations.

^{7}Be

The ^{7}Be activity has been varying between 10 and 200 fCi/kg with not so evident spring maxima in July 1973 and June 1975 and a clear one in May 1974. The ^{7}Be-concentrations for the Grindsjön station is plotted in fig 27.

^{54}Mn

^{54}Mn has been detected in concentrations between 0.01 and 0.76 fCi/kg. The activity quotients with ^{95}Zr in figs 2, 17 and 33 points at ratios of $1.5 \cdot 10^{-3}$ at the time of formation in the two 1973 and 1974 Chinese nuclear explosions. Disregarding possible minor fractionation effects this corresponds to about 5 mg ^{54}Mn induced per kt fission. The fission yield of the 1973 test has been estimated (Telegadas 1976) to 1.4 Mt which thus should have resulted in 7g or 54 kCi of ^{54}Mn. .

^{88}Y

^{88}Y has been detected in ground level air in concentrations between 0.01 and 0.19 fCi/kg since mid August 1974, two months after the Chinese high yield test of June 17th. The activity ratios with ^{95}Zr (figs 3, 18 and 34) indicate 8.4 mg of ^{88}Y formed per kt fission or about the same number of atoms as for ^{54}Mn. It has been suggested (Thomas 1975) that the northern hemisphere ^{88}Y present in the fall of 1974 should be due to the French southern hemisphere tests in the preceding summer. This was partly based on measurements of fresh Chinese debris which yielded no ^{88}Y. Our findings are however contradictory as the first sample of fresh Chinese debris, collected by the Swedish Airforce on the 4th of July only 18 days after the first French test that year, also was the first to show detectable amounts of ^{88}Y.

^{95}Zr

^{95}Zr has been present in the reported samples in concentrations varying between 0.01 and 31 fCi/kg (figs 12, 28 and 43). The minimum level was reached in the spring of 1973, just before the Chinese test of June 27 rapidly increased the level about ten times. After that the increase could be characterized by two doubling times, 65 days during the fall and 33 days during the following spring. These findings are consistent with the picture of an explosion injecting a large fraction of its debris into the stratosphere which the Chinese June 27 1973 explosion has been reported to have been (Telegadas 1976). In fig 48 the ^{95}Zr activity concentration at Grindsjön is plotted with decay corrected to the time of formation. Apart from the short periods where small uncertainties in the dating result in large errors in the decay-corrected values it is surprising how well the concentrations can be reproduced by the three exponentials drawn in the figure.

^{103}Ru

^{103}Ru has been detected in concentrations between less than 0.01 and 8.2 fCi/kg. In figs 4, 19 and 35 where the ratios to ^{95}Zr are plotted the deviations from theoretical behaviour can tell whether the debris has been fractionated. The theoretical lines drawn for this nuclide and the other fission product ratios are based on the cumulative yield-values given by Harley et al (Harley et al 1965) for nuclear explosions in the Mt-range. The quotient between the experimental and theoretical lines gives the fractionation factor $f_{A-95} = \left(\frac{N_A}{N_{Zr}}\right)_{exp} / \left(\frac{N_A}{N_{Zr}}\right)_{th}$ (Edvarson et al 1959). No fractionation effects are observed for ^{103}Ru in the 1973 and 1974 Chinese explosions while the debris from the 1972 test appears to be enhanced in mass chain 103. As this is a chain forming volatile oxides which should result in depletion in the larger particles formed by condensation at the cooling of the fireball the observed opposite fractionation could be due to mirror fractionation of material not incorporated in hot particles (Sisefsky et al 1970).

^{106}Ru

^{106}Ru concentrations varies between 0.2 and 44.3 fCi/kg. The ratios to ^{95}Zr in figs 5, 20 and 36 display no fractionation for the debris from the 1973 and 1974 Chinese explosions. In

1972 and spring of 1973 a large fraction of the longlived ^{106}Ru originates in earlier events than the ones considered. A continuous injection of old stratospheric debris explains the deviation of the measured slope from the theoretical one.

^{125}Sb

^{125}Sb is detected in concentrations between 0.03 and 5.2 fCi/kg. This longlived ($T_{1/2}$ = 2.73y) nuclide shows the characteristics of ^{106}Ru even more pronounced (figs 6, 21 and 37). The bump in the Grindsjön curve in the winter of 1972 was due to some ^{125}Sb present in the lead used for shielding at that time.

^{131}I

^{131}I was found in ground level air at Kiruna and Grindsjön after the Chinese explosions in concentrations up to 0.12 fCi/kg. At Ljungbyhed detectable amounts were not present in 1974 before late August, more than eight halflives after the Chinese event of that year. This late arrival is consistent with findings at other laboratories (Van Middlesworth 1975, Lidén et al 1975) of high ^{131}I concentrations in thyroid glands of grazing animals during the fall of 1974. Whether that is due to delayed fallout from the Chinese explosion or to an injection from the French tests in the southern hemisphere or both is difficult to tell. However, as will be seen from the analysis of the ratios of ^{140}Ba to ^{95}Zr and ^{141}Ce, the first explanation seems more plausible as six out of eight French tests were performed more than one month later than the Chinese one which if the French series contributed significantly should cause irregularities in the ratios mentioned.

^{137}Cs

^{137}Cs has been detected in concentrations between 0.07 and 8.67 fCi/kg during the considered period. The concentration plots in figs 13, 29 and 44 show clear maxima in May 1974 consistent both with the spring maximum findings for ^{7}Be and the streched increase in ^{95}Zr-activity due to a large stratospheric injection by the 1973 Chinese test. The ratios to ^{95}Zr in figs 7, 22 and 38 agree well with the picture given above for ^{106}Ru and ^{125}Sb.

^{140}Ba

^{140}Ba was detected at Grindsjön from the Chinese 1973 event at a maximum concentration of 0.56 fCi/kg while the Chinese 1974 explosion yielded a maximum of 0.74 fCi/kg. In figs 30 and 23 where ^{140}Ba and $^{140}Ba/^{95}Zr$ are plotted for the sensitive Grindsjön station an extra injection in the winter 1974/75 looks obvious. However a careful analysis of old and new ^{95}Zr gives another picture when only the ratio to $^{95}Zr_{new}$ is plotted, which is done in fig 49. The division of ^{95}Zr into old and new fractions was done by analysing the $^{95}Zr/(^{95}Zr+^{95}Nb)$-ratio and by correlation to the $T_{1/2}$ = 32.5d ^{141}Ce-activity (see ^{141}Ce for further discussions). A small increase in the $^{140}Ba/^{95}Zr$-ratio which still appears to be present in late 1974 and early 1975 is believed to be due to the mirror fractionation phenomena discussed for ^{103}Ru as this would be consistent with ^{140}Ba fractionation factors as low as 0.01 found in fresh particles from the Chinese 1974 explosion (Sisefsky 1976).

^{141}Ce

^{141}Ce is reported in concentrations between 0.02 and 3.56 fCi/kg. An attempt has been made to reproduce the behaviour of the $^{141}Cr/^{95}Zr$-curves for the fall of 1974 (figs 9, 24 and 40) when debris from the 1973 and 1974 Chinese nuclear tests were mixing. If p(t), $(0 \leq p \leq 1)$, is the function describing the ingrow of debris from the 1974 event into a common inventory, s is the ratio of fission yields between the 1974 and 1973 explosions and F_o is the ratio at formation of one activity to another then F(t), the same ratio as a function of time, t, after the 1973 test, can be written:

$$F(t) = F_o e^{-(\lambda_n-\lambda_d)\cdot t} \cdot \frac{(1+sp(t)e^{\lambda_n \Delta t})}{(1+sp(t)e^{\lambda_d \Delta t})}$$

Here λ_n and λ_d are the decay constants of the nominator and denominator nuclides respectively and Δt is the time between the two explosions (355 days). The formula is easily derived by forming the expressions for the number of atoms of the nominator and denominator isotopes in the common inventory from the two explosions. By solving sp(t) for the experimental values of F(t) for $^{141}Ce/^{95}Zr$ we found that an empirical relation

$$\begin{cases} sp(t) = \exp\,[3.6\cdot \ln(t-\Delta t)-20.7] & t <= 416 \\ sp(t) = \exp\,[1.3\cdot(\ln(t-\Delta t))^2-7.1\cdot \ln(t-\Delta t)+1.3] & t > 416 \end{cases}$$

could be fitted.

Resulting analytical F-functions are drawn in the Grindsjön plots for $^{141}Ce/^{95}Zr$ (fig 24), $^{140}Ba/^{95}Zr$ (fig 23), $^{141}Ce/^{144}Ce$ (fig 32) and $^{103}Ru/^{106}Ru$ (fig 31) for which a rather good resemblance is achieved.

From the sp(t)-function mixing ratios between new and old activity fractions of different nuclides can be computed as

$$H_i = \frac{\text{new activity } i}{\text{new + old activity } i} = \frac{1}{1 + \frac{e^{-\lambda_i \Delta t}}{sp(t)}}$$

H_i for some interesting nuclides are plotted in fig 50 for the fall of 1974. The ^{95}Zr-mixing function was the one used in the correction of the $^{140}Ba/^{95}Zr$-curve discussed above.

^{144}Ce

^{144}Ce is present during the period considered in concentrations between 0.2 and 108 fCi/kg. The ratios to ^{95}Zr (figs 10, 25 and 41) very much resemble the ones for other longlived nuclides like

^{106}Ru and ^{125}Sb. A bump in March 1974 at Grindsjön is obvious and when examining the other isotope ratios to ^{95}Zr the same bump seems to be present also for ^{125}Sb, ^{141}Ce and ^{155}Eu at Grindsjön. As it appears at only one station it should be due to some local release.

^{155}Eu

^{155}Eu has been detected in concentrations up to 1.11 fCi/kg. No "weapon" yield values are given by Harley (Harley et al 1965). In fig 26 showing $^{155}Eu/^{95}Zr$ for the Grindsjön station three different decay lines are drawn based on fission yield values given in Meek et al 1968 for fission and 14MeV neutrons on ^{235}U, fission and 14MeV neutrons on ^{238}U and fission neutrons on ^{239}Pu. The data indicate ^{235}U to have been the trigger charge in the Chinese 73 and 74 thermonuclear explosions.

Chemical ratios

In figs 15, 31, 46, 16, 32 and 47 the "chemical" ratios $^{103}Ru/^{106}Ru$ and $^{141}Ce/^{144}Ce$ are plotted. It is remarkable how well the observed values for these ratios agree with the theoretical decay in comparison to other activity ratios discussed. The reason must be that the nominator and denominator decay chains contain the same or very similar chemical elements at the time of particle formation. For example the decays of masschains 141 and 144 both "go through" Xe, Cs, Ba and La to Ce. By looking at independent yield values, chemical properties at high temperatures and halflives of these elements and correlating that to some goodness parameter of the experimental ratio function it should be possible to tell something about the cooling time of the fireball.

COMPARISION BETWEEN THE THREE STATIONS

The activity and activity ratios for the three stations are in general quite similar, the only evident difference being a slower increase of the $^{103}Ru/^{95}Zr$-ratio at Grindsjön after the Chinese 1974-explosion. The behaviour of this ratio for Ljungbyhed and Kiruna fits well the function derived above from the $^{141}Ce/^{95}Zr$-ratio while the Grindsjön data is up to three times smaller during the fall of 1974.

For the time covered by all three stations (April 1974- June 1975) the time integrated activity concentrations are tabulated in table 4. The Ljungbyhed and Grindsjön results are about the same while the time-integrated concentrations at Kiruna tend to be 10-20 % lower.

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Table 1.

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed January-June 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN							
FEB							
MAR							
APR 05	83.1	0.27		17.3	4.46	16.1	1.88
10	66.0	0.22		11.8	2.86	12.3	1.25
19	43.3	0.16		9.15	2.04	8.95	1.11
26	101.	0.35		19.4	4.36	21.5	2.38
MAY 03	99.7	0.32		17.9	3.52	21.5	2.35
10	92.2	0.36		16.1	3.16	21.5	2.53
17	92.6	0.43		18.0	3.35	24.5	2.76
24	53.8	0.26		10.0	1.69	14.3	1.62
31	78.2	0.27		12.6	2.04	18.1	2.22
JUN 05	81.2	0.31		12.0	1.75	18.5	2.32
14	166.	0.65		22.7	3.29	38.3	4.65
19	96.6	0.45		13.9	1.91	24.5	2.96
28	120.	0.49		16.0	2.13	29.3	3.39

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed January-June 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN							
FEB							
MAR							
APR 05		2.97		1.60	36.0	0.35	
10		2.16		0.98	24.8	0.30	
19		1.73		0.74	21.9	0.42	
26		3.95		1.42	47.2	0.52	
MAY 03		4.02		1.16	46.0	0.43	
10		3.89		0.94	43.4	0.53	
17		4.56		1.02	53.9	0.61	
24		2.61		0.53	31.7	0.44	
31		3.72		0.62	42.5	0.40	
JUN 05		3.63		0.57	41.2	0.43	
14		8.14		0.95	87.1	1.11	
19		5.04		0.56	55.7	0.54	
28		6.54		0.71	69.0	0.72	

Table 1.

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed July-December 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL 05	76.8	0.27		8.26	0.98	16.1	2.09
10	59.9	0.20		5.22	0.78	11.0	1.39
19	91.1	0.29		7.05	0.96	15.8	2.20
26	59.1	0.17		3.93	0.52	9.95	1.20
AUG 02	67.9	0.17		3.86	0.62	9.98	1.13
09	90.8	0.18		4.85	1.12	11.1	1.40
16	85.8	0.16		3.59	0.95	3.24	1.13
23	99.8	0.16		4.04	1.30	8.90	1.31
30	107.	0.14		4.04	1.22	7.57	1.01
SEP 06	59.2	0.09	0.06	[illegible].63	0.60	3.93	0.62
13	95.6	0.12	<0.03	3.75	1.02	6.26	0.84
20	67.1	0.07	0.04	5.29	0.51	3.30	0.50
27	59.3	0.07	0.11	8.56	0.53	3.38	0.43
OCT 04	50.1	0.06	<0.02	1.64	0.40	2.53	0.38
11	47.1	0.10	0.04	3.37	0.45	2.65	0.33
18	38.5	0.03	<0.02	1.10	0.44	1.43	0.26
25	28.2	<0.02	<0.02	2.75	0.29	1.12	0.18
NOV 01	24.5	<0.02	<0.02	1.34	0.42	1.12	0.17
08	74.3	0.07	0.06	4.81	1.92	3.16	0.48
15	59.4	0.08	0.06	5.49	2.07	2.53	0.39
22	41.2	0.05	0.08	4.77	1.28	2.21	0.26
27	37.7	0.07	0.05	3.00	1.21	1.68	0.23
DEC 06	52.7	<0.05	<0.04	5.28	1.86	3.02	0.19
13	45.9	0.03	0.05	4.88	1.69	1.99	0.28
20	57.9	<0.04	0.09	7.29	2.49	3.37	0.40
27	56.0	0.08	0.10	7.48	2.33	3.68	0.40

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed July-December 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL 05		3.75	<0.04	0.56	35.5	0.33	<0.26
10		2.58	<0.04	0.61	25.9	0.20	0.60
19		3.85	<0.15	0.70	34.5	0.34	<0.29
26		2.38	<0.11	0.37	19.3	0.28	<0.19
AUG 02		2.33	0.09	0.25	21.6	0.25	<0.14
09		2.85	0.46	1.04	23.9	0.24	<0.27
16		1.93	0.33	0.98	19.3	0.24	<0.16
23		2.12	0.44	1.59	21.9	0.24	<0.17
30	<0.06	2.26	0.40	1.24	17.8	0.22	<0.18
SEP 06		1.33	0.12	0.48	8.49	0.19	
13		1.39	0.17	0.89	11.8	0.19	
20		0.93	0.09	1.12	8.95	0.12	
27		0.92	0.03	1.08	7.96	0.11	
OCT 04		0.79	<0.03	0.40	6.42	0.07	
11		0.65	<0.04	0.71	6.51	0.05	
18		0.53	<0.03	0.45	4.04	0.03	
25		0.34	<0.03	0.44	3.21	<0.06	
NOV 01		0.35	<0.03	0.41	2.60	<0.05	
08		0.77	0.05	1.55	7.75	0.09	
15		0.67	0.03	1.71	6.77	0.12	
22		0.50	<0.04	1.09	5.67	0.08	
27		0.43	<0.03	0.88	4.27	0.08	
DEC 06		0.67	<0.06	1.32	6.85	<0.11	
13		0.56	<0.04	1.16	6.25	0.08	
20		0.64	<0.04	2.00	8.85	0.07	
27		0.73	<0.03	1.68	9.44	0.11	

Table 1.

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed January-June 1975

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN 03	47.4	0.08	0.09	7.90	1.98	2.91	0.48
10	85.3	0.16	0.16	11.4	4.00	6.04	0.72
17	48.2	0.11	0.10	8.55	2.65	4.34	0.63
24	35.7	0.07	0.08	5.10	1.50	3.21	0.37
31	20.0	0.05	0.04	2.78	0.91	2.02	0.26
FEB 07	83.8	0.20	0.19	12.3	3.41	7.93	1.05
14	47.1	0.08	0.07	4.77	1.38	3.43	0.50
21	36.2	0.10	0.06	4.45	1.34	3.62	0.47
28	63.6	0.23	0.16	10.8	2.88	8.79	1.19
MAR 07	42.9	0.11	0.09	5.11	1.42	4.67	0.51
14	41.5	0.09	0.07	4.31	1.06	3.94	0.59
21	51.3	0.12	0.08	5.01	1.24	4.91	0.61
26	35.1	0.15	0.09	4.24	0.88	5.15	0.64
APR 04	30.2	0.10	0.07	3.38	0.76	4.10	0.48
11	43.7	0.12	0.08	4.17	0.89	5.41	0.61
18	86.0	0.23	0.17	7.54	1.57	10.4	1.36
25	55.3	0.18	0.09	3.70	0.74	5.79	0.73
MAY 02	81.4	0.19	0.13	5.53	1.06	8.74	1.18
09	55.9	0.12	0.08	3.30	0.60	5.65	0.74
16	34.4	0.08	0.06	1.79	0.33	3.11	0.46
23	42.9	0.10	0.05	2.05	0.34	3.91	0.60
JUN 02	50.7	0.10	0.08	2.20	0.37	4.49	0.64
06	74.8	0.13	0.06	2.49	0.41	5.60	0.77
11	70.3	0.11	0.06	1.98	0.30	4.75	0.67
20	74.6	0.08	0.05	1.67	0.24	4.23	0.61
27	48.4	0.06	0.03	1.11	0.15	2.82	0.40

Activity concentration (fCi/kg) in air near ground level at Ljungbyhed January-June 1975

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 03		0.84		1.47	9.64	0.11	
10		1.25		2.47	14.6	0.14	
17		0.99		1.71	13.1	0.09	
24		0.69		0.91	7.65	0.08	
31		0.46		0.51	4.64	0.05	
FEB 07		1.75		2.00	21.4	0.22	
14		0.80		0.60	7.64	0.05	
21		0.84		0.65	8.21	0.10	
28		1.80		1.59	22.6	0.20	
MAR 07		1.11		0.60	10.6	0.08	
14		0.94		0.50	9.63	0.08	
21		1.22		0.48	11.6	0.08	
26		0.99		0.46	11.6	0.13	
APR 04		0.91		0.32	8.58	0.08	
11		1.22		0.38	11.9	0.17	
18		2.56		0.66	23.0	0.25	
25		1.32		0.30	11.7	0.12	
MAY 02		2.13		0.41	18.4	0.19	
09		1.45		0.24	12.2	0.15	
16		0.96		0.12	6.60	<0.05	
23		1.04		0.15	9.27	0.11	
JUN 02		1.17		0.11	8.22	0.12	
06		1.52		0.13	11.1	0.12	
11		1.32		0.11	9.56	0.12	
20		1.27		0.10	8.51	0.12	
27		0.89		0.04	5.91	0.06	

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1972

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL							
AUG 04	40.9	0.04		4.83	5.16	3.66	0.45
11	43.0	0.01		3.29	3.97	3.41	0.46
18	44.4			2.71	3.33	2.66	0.40
25	54.2			2.34	2.84	2.30	0.34
SEP 01	62.1			2.43	3.19	4.03	0.47
08	28.6			1.01	1.13	1.25	0.15
15	29.6			0.97	0.89	1.27	0.17
22	25.2			0.61	0.61	1.04	0.08
29	52.7	0.02		1.25	1.27	2.47	0.25
OCT 06	25.7	0.01		0.73	0.57	1.51	0.15
13	42.3	0.01		0.61	0.51	1.16	0.21
20	27.7			0.36	0.30	0.77	0.09
27	38.7			0.50	0.36	1.16	0.26
NOV 03	39.7			0.44	0.31	1.15	0.22
10	32.0			0.26	0.17	0.70	0.19
17	12.5			0.10	0.05	0.19	0.11
24	20.1			0.13	0.07		0.15
DEC 01	29.9			0.13	0.06	0.40	0.13
08	56.7			0.26	0.14	0.84	0.19
15	37.9			0.15	0.07	0.59	0.17
22	39.7			0.11	0.07	0.62	0.19
29	60.0			0.14	0.08	0.66	0.22

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1972

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL							
AUG 04		1.15		3.56	5.94	0.05	
11		0.82		2.04	3.86		
18		0.86		1.67	3.77		
25		0.82		1.41	3.74		
SEP 01		0.96		1.25	3.77		
08		0.46		0.64	2.17		
15		0.45		0.49	2.01		
22		0.30		0.22	0.96		
29		0.55		0.50	2.71	0.09	
OCT 06		0.36		0.28	1.71	0.05	
13		0.39		0.22	1.70	0.03	
20		0.30		0.09	0.70		
27		0.36		0.13	1.40		
NOV 03		0.32		0.08	1.02	0.03	
10		0.25		0.08	0.94	0.03	
17		0.14		0.04	0.60		
24		0.17		0.04	0.66		
DEC 01		0.20		0.03	0.73	0.02	
08		0.37		0.04	1.43	0.04	
15		0.29		0.02	0.93	0.02	
22		0.24		0.03	0.85	0.02	
29		0.38			1.08		

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1973

Week starting	Be-7	Mn-54	[illegible]	Zr-95	Ru-103	Ru-106	Sb-125
JAN 03	43.[illegible]			0.14	0.04	0.58	0.20
08	35.5	0.01		0.11	0.05	0.53	0.10
19	47.[illegible]			0.08	0.05	0.48	<0.14
26	30.6			0.06	0.03	0.43	<0.14
FEB 02	52.7			0.10	0.04	0.63	<0.14
09	52.6			0.11	0.05	0.92	<0.14
16	34.4			0.06	0.02	0.67	<0.14
23	54.1			0.05	0.02	0.79	<0.14
MAR 02	47.4	0.01		0.05	0.02	0.73	<0.14
09	63.[illegible]	0.01		0.09	0.03	1.10	0.17
16	46.5			0.04	0.01	0.67	0.10
26	32.3			0.04	0.01	0.68	<0.14
30	4[illegible].1	0.01		0.05	0.01	0.73	0.16
APR 06	28.3	0.01		0.02	<0.01	0.43	<0.10
13	18.1	0.01		0.02	<0.01	0.27	<0.10
19	26.8	0.01		0.02	<0.01	0.46	0.10
27	65.2	0.02		0.03	<0.01	0.97	0.30
MAY 04	35.7	0.02		0.02	<0.01	0.71	0.17
11	55.8	0.01		0.03	0.01	0.91	0.18
18	27.5	0.01		0.01	<0.01	0.53	0.11
25	46.6	0.02		0.02	<0.01	0.82	0.25
30	64.2	0.02		0.02	0.01	1.14	0.28
JUN 08	56.9	0.01		0.02	0.01	0.87	0.22
15	1[illegible]2.	0.02		0.02	<0.01	1.47	0.38
21	92.3	0.03		0.03	<0.01	1.56	0.40
29	97.6	0.02		0.02	<0.01	2.03	0.48

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1973

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 03		0.30			0.80	0.04	
08		0.24		0.02	1.10		
19		0.27			0.70		
26		0.23			0.48		
FEB 02		0.34			1.08		
09		0.44			1.20	0.03	
16		0.31			0.89		
23		0.48			1.17	0.03	
MAR 02		0.37			1.07		
09		0.59			1.44	0.05	
16		0.41			0.86	0.02	
26		0.49			0.93	0.02	
30		0.47			1.23	0.05	
APR 06		0.32			0.71	0.02	
13		0.25			0.69	0.02	
19		0.31			0.81	0.03	
27		0.78			1.94	0.07	
MAY 04		0.50			1.25	0.05	
11		0.61			1.16	0.03	
18		0.35			0.79	0.04	
25		0.60			1.44	0.04	
30		0.75			1.52	0.06	
JUN 08		0.63			1.18	0.06	
15		1.00			1.72	0.07	
21		1.14			2.00	0.05	
29		1.45			2.60	0.06	

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1973

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL 06	34.7			0.05	0.04	0.52	0.12
13	51.2			0.21	0.32	0.85	0.13
20	52.9			0.11	0.21	0.54	0.11
27	58.7			0.26	1.51	0.75	0.14
AUG 03	55.0			0.27	0.37	0.44	0.09
10	81.0			0.35	0.60	0.65	0.08
16	103.			0.64	0.79	0.61	0.08
24	42.3			0.32	0.49	0.37	0.05
31	28.6			0.39	0.43	0.22	0.03
SEP 07	48.6			0.54	0.71	0.29	0.07
14	37.1			0.46	0.58	0.37	0.09
21	48.6			0.59	0.70	0.29	0.09
28	42.9			0.85	0.75	0.31	0.08
OCT 05	24.3			0.43	0.39	0.15	0.03
12	27.1			0.65	0.55	0.22	0.10
19	25.7			0.51	0.48	0.19	0.08
26	45.7			0.86	0.78	0.35	0.11
NOV 02	34.2			1.05	0.82	0.48	0.12
09	32.9			0.69	0.46	0.29	0.19
16	35.7			1.02	0.64	0.39	0.06
23	45.7			1.15	0.80	0.44	0.11
30	27.1			1.01	0.50	0.38	0.07
DEC 07	31.4			1.16	0.63	0.73	0.14
14	32.9			1.38	0.66	0.52	0.11
21	20.0			1.36	0.56	0.38	0.13
28	26.9			2.02	0.76	0.75	0.14

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1973

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL 06	<0.01	0.39	0.06	0.03	0.75		0.19
13	0.09	0.65	0.56	0.34	1.20		0.60
20	0.05	0.50	0.17	0.17	0.75		0.23
27	0.06	0.62	0.42	0.41	1.15		3.34
AUG 03		0.51	0.34	0.47	0.93		0.21
10		0.53	0.24	0.38	0.70		0.20
16		0.54	0.24	0.51	0.88		0.12
24		0.32	0.19	0.43	0.67		
31		0.25	0.09	0.31	0.31		
SEP 07		0.22	0.12	0.37	0.41		
14		0.26	0.10	0.41	0.40		
21		0.24	0.06	0.43	0.44		
28		0.23	0.05	0.59	0.63		
OCT 05		0.14	0.03	0.27	0.30		
12		0.15	0.04	0.60	0.71		
19		0.11		0.30	0.34	0.02	
26		0.16		0.48	0.64		
NOV 02		0.18		0.62	0.89	0.02	
09		0.23		0.26	0.43		
16		0.26		0.36	0.66		
23		0.17		0.46	0.96	0.02	
30		0.13		0.31	0.74		
DEC 07		0.17		0.41	1.11		
14		0.15		0.36	1.12		
21		0.15		0.44	1.57		
28		0.18		0.48	1.80		

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN 04	42.4	0.06		2.30	0.99	1.04	0.19
11	20.2			1.50	0.52	0.68	0.08
18	26.7	0.03		3.16	0.95	1.13	0.20
25	25.6	0.03		2.69	0.83	1.22	0.18
FEB 01	40.3	0.03		3.50	1.22	2.09	0.31
08	62.7	0.07		6.36	2.43	3.89	0.43
15	59.9	0.07		5.30	1.97	3.46	0.42
22	54.3	0.07		5.49	1.69	3.37	0.42
MAR 01	87.0	0.13		8.40	2.57	5.69	0.68
08	51.9	0.14		8.21	2.33	5.70	0.80
15	45.3	0.14		7.13	2.16	5.86	0.73
22	70.0	0.13		9.69	2.83	8.60	0.87
29	101.	0.31		17.0	4.64	15.2	1.59
APR 05	114.	0.37		23.8	6.08	23.5	2.47
11	75.0	0.18		11.3	2.80	11.6	1.17
19	76.9	0.24		14.1	3.19	14.9	1.61
26	150.	0.51		27.0	6.04	31.0	3.30
MAY 03	113.	0.34		18.1	3.79	22.0	2.41
10	166.	0.65		31.1	6.03	38.9	4.54
17	138	0.76		30.4	5.40	37.8	5.16
22	75.9	0.42		16.7	2.86	22.3	2.94
31	70.0	0.32		11.5	1.97	17.6	2.27
JUN 07	85.0	0.35		12.2	1.97	20.0	2.41
14	183.	0.74		25.9	3.97	44.3	5.15
20	54.5	0.40		11.5	1.53	19.4	2.80
28	74.1	0.38		11.6	1.57	21.4	2.77

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 04		0.25		0.51	2.16		
11		0.15		0.32	1.36		
18		0.30		0.67	3.66		
25		0.29		0.58	3.61		
FEB 01		0.37		0.59	4.27		
08		0.66		1.18	9.03	0.07	
15		0.62		0.93	8.24	0.06	
22		0.67		1.00	10.1	0.09	
MAR 01		1.01		1.47	17.0	0.14	
08		1.22		1.56	20.3	0.16	
15		1.10		1.06	15.9	0.12	
22		1.39		1.03	17.4	0.15	
29		2.47		1.91	36.0	0.32	
APR 05		4.12		2.30	49.3	0.41	
11		2.00		0.92	23.1	0.22	
19		2.66		1.14	32.6	0.30	
26		5.61		2.10	67.6	0.55	
MAY 03		4.01		1.24	47.0	0.43	
10		7.20		2.06	90.1	0.83	
17		8.32		2.16	108.	0.96	
22		4.70		1.10	59.6	0.57	
31		3.72		0.76	48.7	0.43	
JUN 07		3.91		0.62	45.7	0.48	
14		8.67		1.15	95.8	1.00	
20		4.28		0.58	57.3	0.52	
28		4.32		0.52	57.0	0.57	

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL 05	43.7	0.21		7.01	0.95	13.6	1.60
12	37.6	0.20		5.27	0.73	11.1	1.28
19	65.7	0.27		6.56	0.96	14.4	1.91
26	45.0	0.17		4.63	0.61	11.3	1.34
AUG 02	59.0	0.17		3.70	0.56	9.61	1.24
09	33.7	0.14		2.80	0.44	6.94	1.07
16	47.0	0.10	0.03	4.33	0.43	5.31	0.85
23	63.[illegible]	0.16	0.05	8.70	1.05	13.8	1.40
30	42.1	0.13	0.02	4.11	0.61	6.01	0.99
SEP 06	43.[illegible]	0.08	0.03	4.06	0.46	3.39	0.55
13	56.[illegible]	0.07	0.04	4.36	0.56	4.31	0.53
20	40.0	0.07	0.02	2.74	0.42	3.37	0.47
27	63.1	0.09	0.02	3.08	0.57	6.71	0.63
OCT 04	40.7	0.07	0.03	3.23	0.38	4.23	0.50
11	21.8	0.03	0.01	1.16	0.21	1.35	0.20
18	23.6	0.04	0.02	2.36	0.31	1.17	0.25
25	16.3	0.03	0.02	1.89	0.25	0.75	0.10
NOV 01	16.7	0.02	0.02	1.67	0.26	0.88	0.09
08	33.4	0.05	0.04	4.44	0.81	1.36	0.30
15	52.7	0.07	0.04	4.51	1.35	3.7[illegible]	0.37
22	25.1	0.05	0.03	3.11	0.80	1.27	0.22
29	29.2	0.04	0.03	2.79	0.89	1.50	0.17
DEC 06	30.9	0.05	0.06	4.70	1.20	2.04	0.34
13	41.3	0.0[illegible]	0.06	4.50	1.43	3.16	0.34
20	25.5	0.06	0.04	3.89	1.11	1.41	0.30
27	Same as above (14 days sample)						

Activity concentration (fCi/kg) in air near ground level at Grindsjön July-December 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL 05		2.64	0.05	0.26	28.6	0.32	
12	<0.03	2.29	0.14	0.32	25.9	0.28	0.27
19	<0.03	3.31	0.17	0.44	34.3	0.37	0.34
26	<0.02	2.43	0.11	0.25	24.4	0.25	<0.14
AUG 02	<0.02	2.49	0.09	0.25	20.6	0.23	<0.14
09	<0.02	1.59	0.13	0.38	20.1	0.19	<0.14
16		1.44	0.19	0.61	13.4	0.15	<0.14
23		2.41	0.47	1.31	16.0	0.25	
30		1.69	0.35	1.26	19.0	0.26	
SEP 06		0.89	0.18	1.00	10.7	0.13	
13		1.18	0.13	0.93	8.33	0.12	
20		0.90	0.07	0.57	7.63	0.10	
27		1.42	0.05	0.52	6.10	0.09	
OCT 04		1.13	0.03	0.52	6.66	0.09	
11		0.91	0.01	0.24	2.93	0.05	
18		0.44	0.03	0.58	4.40	0.05	
25		0.22	0.01	0.29	2.16	0.05	
NOV 01		0.29	0.02	0.28	1.93	0.04	
08		0.42	0.05	1.27	6.70	0.08	
15		0.96	0.05	1.21	5.56	0.06	
22		0.41	0.02	0.97	4.87	0.06	
29		0.37	0.02	0.62	3.04	0.05	
DEC 06		0.51	0.01	1.11	6.16	0.09	
13		0.63	0.02	0.95	5.27	0.06	
20		0.36	0.02	1.23	6.11	0.07	
27	Same as above (14 days sample)						

Table 2.

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1975

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN 03	51.5	0.07	0.08	5.97	1.78	2.86	0.41
10	55.3	0.14	0.14	9.29	2.58	3.89	0.65
17	40.0	0.10	[illegible]	6.77	2.04	3.42	0.54
24	27.5	0.06	0.06	3.90	1.12	2.17	0.35
31	26.4	0.07	0.06	4.24	1.15	2.36	0.38
FEB 07	52.3	0.12	0.11	7.38	1.85	4.22	0.63
14	38.3	0.08	0.08	4.72	1.21	3.07	0.46
21	52.5	0.16		7.46	2.03	5.40	0.84
28	39.8	0.22	0.14	8.24	2.04	6.37	1.11
MAR 07	35.4	0.10	0.07	4.20	1.12	3.83	0.50
14	55.9	0.11	0.11	5.20	1.34	5.38	0.65
21	51.3	0.17	0.12	6.13	1.44	6.30	0.93
27	25.1	0.09	0.07	2.97	0.67	3.31	0.48
APR 04	22.4	0.08	0.06	2.40	0.61	3.64	0.45
11	59.0	0.13	0.10	5.08	1.16	7.07	0.82
18	47.5	0.19	0.12	4.82	0.96	6.30	1.09
25	55.8	0.12	0.09	3.91	0.79	6.18	0.73
MAY 05	74.4	0.18	0.12	4.89	0.98	8.64	1.13
12	75.8	0.14	0.12	4.64	0.91	9.16	0.94
16	56.3	0.11	0.08	2.83	0.52	5.36	0.70
23	51.0	0.10	0.07	2.64	0.44	5.14	0.68
30	26.2	0.09	0.05	1.70	0.23	3.08	0.55
JUN 06	77.6	0.13	0.07	2.75	0.43	6.14	0.84
13	53.2	0.07	0.05	1.68	0.25	4.02	0.56
19	81.3	0.09	0.05	1.95	0.29	5.02	0.67
27	81.3	0.09	0.05	1.77	0.23	4.74	0.66

Activity concentration (fCi/kg) in air near ground level at Grindsjön January-June 1975

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 03		0.75	0.02	1.21	8.15	0.09	
10		0.91	0.05	2.23	14.0	0.12	
17		0.81	0.01	1.49	11.4	0.14	
24		0.55	0.01	0.80	7.02	0.08	
31		0.58		0.88	7.91	0.09	
FEB 07		1.04		1.16	12.4	0.13	
14		0.72		0.74	8.86	0.12	
21		1.22		1.18	16.1	0.16	
28		1.34		1.59	22.8	0.20	
MAR 07		0.85		0.54	9.22	0.08	
14		1.20		0.62	12.0	0.14	
21		1.20		0.81	17.3	0.18	
27		0.81		0.38	8.93	0.09	
APR 04		0.80		0.29	7.87	0.09	
11		1.50		0.42	13.5	0.14	
18		1.52		0.56	20.0	0.21	
25		1.46		0.31	12.2	0.14	
MAY 05		2.21		0.40	18.4	0.21	
12		2.22		0.28	14.0	0.17	
16		1.47		0.20	10.7	0.14	
23		1.37		0.17	10.6	0.13	
30		0.94		0.13	9.42	0.11	
JUN 06		1.70		0.15	12.3	0.15	
13		1.23		0.09	8.21	0.11	
19		1.39		0.09	9.26	0.12	
27		1.39		0.08	9.44	0.13	

Table 3.

Activity concentration (fCi/kg) in air near ground level at Kiruna July-December 1973

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL							
AUG 10	40.0			0.20	0.26		0.16
17	30.0			0.23	0.39		
24	24.3			0.21	0.27	0.31	0.70
31	57.9			0.42	0.63		
SEP 07	30.1			0.23	0.44		
14	34.6			0.34	0.51		
21	78.3			0.82	1.01		
28	29.0			0.39	0.25	0.20	
OCT 05	23.0			0.29	0.40		
12	34.1			0.35	0.40	0.20	
19	42.9			0.47	0.48		
26	28.9			0.46	0.44		0.19
NOV 02	48.1			0.81	0.74	0.42	0.14
09	45.4			0.68	0.56	0.31	0.13
16	45.4			0.79	0.56	0.40	0.16
23	27.7			0.59	0.37	0.19	0.09
30	29.1			0.59	0.35	0.18	0.14
DEC 07	33.9			0.79	0.48	0.47	
14	44.7			1.09	0.70	0.44	0.25
21	53.9			1.71	0.93		
28	37.7			1.74	0.90	0.75	0.30

Activity concentration (fCi/kg) in air near ground level at Kiruna July-December 1973

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL							
AUG 10		0.19		0.19	0.43		
17		0.14		0.20	0.29		
24		0.19		0.23			
31		0.26		0.46	0.49		
SEP 07		0.09		0.19	0.21		
14		0.12		0.31	0.33		
21		0.25		0.52	0.59		
28		0.15		0.16	0.17		
OCT 05		0.09		0.23	0.24		
12		0.08		0.22	0.25		
19		0.07		0.30	0.44		
26		0.07		0.27	0.34		
NOV 02		0.12		0.46	0.76		
09		0.12		0.35	0.57		
16		0.12		0.35	0.66		
23		0.27		0.20	0.46		
30		0.12		0.17	0.52		
DEC 07		0.14		0.29	0.70		
14		0.14		0.30	0.82		
21		0.23		0.53	1.37		
28				0.43	1.28		

Table 3.

Activity concentration (fCi/kg) n air near ground level at Kiruna January-June 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN 04	44.9			2.43	1.04	1.57	0.28
11	50.9			3.17	1.28	1.67	0.26
18	41.6			2.70	1.07	1.36	0.18
25	28.1			1.79	0.66	0.82	0.24
FEB 01	39.9			2.57	0.91	1.73	
08	35.4			2.43	0.93	1.61	0.24
15	45.1			3.84	1.46	2.34	0.25
22	46.3	0.06		5.33	1.76	3.69	0.38
MAR 01	154.	0.16		15.4	5.00	10.9	1.20
08	127.	0.23		19.4	6.01	15.0	1.53
15	44.9	0.06		4.19	1.21	3.51	0.33
22	85.6	0.17		13.0	3.61	10.9	1.21
29	144.	0.47		29.7	8.16	27.7	2.69
APR 05	59.4	0.15		10.6	2.36	8.33	1.03
10	81.0	0.19		11.2	2.79	11.0	1.19
19	60.0	0.15		10.0	2.41	10.9	1.20
26	100.	0.36		18.3	4.04	21.0	2.06
MAY 03	57.7	0.19		9.25	1.87	10.8	1.24
08	167.	0.62		31.0	6.06	38.4	4.47
17	136.	0.53		26.0	4.90	34.2	3.99
24	95.0	0.41		18.2	2.99	23.2	3.08
31	88.8	0.37		15.0	2.49	22.2	2.60
JUN 07	89.6	0.35		12.7	1.97	19.1	2.43
14	171.	0.51		20.0	3.23	33.2	4.27
19	114.	0.46		15.5	2.21	26.4	3.18
28	27.7	0.11		6.23	0.43	5.65	0.68

Activity concentration (fCi/kg) in air near ground level at Kiruna January-June 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 04		0.30		0.51	2.34		
11		0.29		0.61	2.86		
18		0.31		0.51	2.67		
25		0.26		0.32	1.76		
FEB 01		0.37		0.39	2.67		
08		0.28		0.42	3.47		
15		0.46		0.60	5.60		
22		0.60		0.78	8.20		
MAR 01		1.91		2.23	25.4	0.29	
08		2.51		2.56	33.6	0.30	
15		0.58		0.51	7.86	0.11	
22		1.87		1.47	24.9	0.21	
29		4.66		2.99	58.7	0.48	
APR 05		1.87		0.90	19.7	0.18	
10		2.06		0.94	24.4	0.25	
19		1.96		0.74	22.6	0.17	
26		3.84		1.37	45.0	0.38	
MAY 03		2.00		0.64	23.6	0.23	
08		7.12		2.03	85.0	0.73	
17		6.53		1.57	77.8	0.78	
24		5.08		1.03	56.1	0.55	
31		4.24		0.75	49.0	0.49	
JUN 07		4.06		0.64	45.0	0.57	
14		6.83		0.85	73.7	0.74	
19		5.32		0.64	59.5	0.62	
28		1.44		0.18	11.8	0.20	

Table 3.

Activity concentration (fCi/kg) in air near ground level at Kiruna July-December 1974

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JUL 05	82.3	0.25		7.60	1.14	15.7	1.90
12	57.9	0.17		5.10	0.74	9.88	1.21
19	73.1	0.18		5.07	0.73	11.7	1.47
26	79.9	0.19		5.25	0.68	12.0	1.71
AUG 02	52.1	0.12		2.89	0.41	7.24	0.98
09	74.4	0.17		3.17	0.48	7.59	0.98
16	71.1	0.10		2.63	0.58	6.63	0.87
23	75.3			2.62	0.87	5.95	0.68
30	74.9	0.10		3.87	0.59	5.16	0.71
SEP 06	50.0	0.09		1.35	0.40	3.17	0.46
13	43.5	0.09		0.98	0.34	2.62	0.34
20	37.2	0.13		0.83	0.26	1.99	0.26
27	47.2	0.09		1.37	0.31	2.14	0.31
OCT 04	29.2	0.07	0.03	3.57	0.15	1.17	0.19
11	57.1	0.06		2.40	0.47	2.22	0.41
18	66.7	0.05	0.05	5.25	0.57	2.49	0.44
25	26.7	0.05		0.83	0.30	0.95	0.10
NOV 01	43.4	0.03		1.23	0.63	1.69	0.33
08	68.6	0.09		2.71	0.78	2.11	0.37
15	62.0	0.08	0.03	2.24	1.03	2.32	0.25
22	53.1	0.07	0.05	3.16	1.20	2.06	0.27
29	43.8		0.04	3.30	0.95	1.59	0.11
DEC 06	3 .5	0.08	0.04	3.00	1.09	1.52	0.21
13	28.3			2.73	0.95	1.34	0.28
20	56.3	0.08	0.06	5.35	2.03	2.84	0.34
26	23.1		0.04	1.96	0.70	0.79	0.15

Activity concentration (fCi/kg) in air near ground level at Kiruna July-December 1974

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JUL 05	0.12	3.53	0.45	0.77	33.7	0.21	
12		2.54		0.60	23.8	0.19	
19		2.87		0.68	25.1	0.23	
26		2.71	0.09	0.32	27.1	0.28	
AUG 02		1.62		0.18	15.2	0.15	
09		2.26		1.11	17.0	0.22	
16		1.58	0.18	0.50	14.3	0.19	
23		1.58	0.74	0.95	12.9	0.17	
30		1.59	0.35	.80	11.0	0.15	
SEP 06		1.14	0.12	0.42	7.37	0.14	
13		0.60	0.06	0.29	4.98	0.11	
20		0.50		0.25	4.49	0.10	
27		0.53		0.32	4.62	0.08	
OCT 04		0.36		0.39	3.76	0.05	
11		0.62	0.09	0.44	5.44	0.08	
18		0.66		0.76	6.55	0.13	
25		0.22		0.22	2.12	0.06	
NOV 01		0.46		0.41	3.86	0.05	
08		0.60		0.62	5.49	0.12	
15		0.[illegible]		0.70	4.86	0.09	
22		0.44		0.94	4.60	0.07	
29		0.41		0.59	3.69		
DEC 06		0.37		0.73	3.81	0.11	
13		0.29		0.68	3.47		
20		0.68		1.26	7.27	0.09	
26		0.25		0.44	2.59	0.05	

Table 3.

Activity concentration (fCi/kg) in air near ground level at Kiruna January-June 1975

Week starting	Be-7	Mn-54	Y-88	Zr-95	Ru-103	Ru-106	Sb-125
JAN 03	21.0	0.03		1.81	0.64	1.16	0.12
10	52.8	0.06	0.06	4.17	1.55	2.62	0.32
17	45.3	0.06		3.67	1.26	2.61	0.34
24	25.1	0.05	0.05	3.34	1.03	1.96	0.28
31	48.4	0.10	0.09	6.43	2.03	4.25	0.55
FEB 07	45.6	0.07	0.07	4.45	1.37	3.28	0.38
14	33.6	0.07	0.05	3.29	1.01	2.66	0.31
21	40.2	0.09	0.08	4.54	1.27	3.70	0.44
28	59.4	0.13	0.11	6.48	1.81	5.68	0.70
MAR 07	31.9	0.08	0.06	3.78	1.03	3.71	0.45
14	41.1	0.08	0.07	3.94	1.02	4.10	0.53
21	59.2	0.14	0.11	6.03	1.42	6.26	0.82
26	22.5	0.05		1.91	0.46	2.02	0.29
APR 04	41.7	0.10	0.07	3.82	0.89	4.96	0.55
11	45.9	0.11	0.07	3.80	0.87	4.95	0.64
18	99.9	0.23	0.16	7.96	1.72	11.3	1.36
23	37.6	0.08	0.06	2.81	0.54	3.89	0.54
MAY 02	43.8	0.09		2.67	0.49	4.21	0.53
09	71.0	0.14		3.[illegible]0	0.70	7.23	0.91
16	53.0	0.09	0.07	2.82	0.46	4.79	0.72
23	43.1	0.07		1.94	0.34	3.65	0.52
30	36.8	0.06	0.04	1.37	0.24	2.95	0.40
JUN 06	34.8	0.04		1.02	0.16	2.34	0.32
13	26.9	0.04		0.71	0.11	1.78	0.24
18	50.5	0.06	0.03	1.23	0.17	2.92	0.43
27	58.4	0.06		1.33	0.17	3.41	0.54

Activity concentration (fCi/kg) in air near ground level at Kiruna January-June 1975

Week starting	I-131	Cs-137	Ba-140	Ce-141	Ce-144	Eu-155	U-237
JAN 03		0.23		0.37	2.66		
10		0.58		0.83	6.41	0.04	
17		0.54		0.74	6.03	0.07	
24		0.44		0.58	4.86	0.04	
31		0.91		1.07	10.1	0.10	
FEB 07		0.68		0.69	7.47	0.11	
14		0.56		0.51	6.01	0.06	
21		0.79		0.63	8.39	0.09	
28		1.23		0.88	12.8	0.12	
MAR 07		0.75		0.49	7.85	0.08	
14		0.85		0.46	8.77	0.08	
21		1.42		0.67	13.9	0.14	
26		0.49		0.22	5.33		
APR 04		1.07		0.38	10.3	0.11	
11		1.13		0.33	10.6	0.10	
18		2.58		0.65	21.9	0.27	
23		0.99		0.22	8.58	0.10	
MAY 02		0.99		0.20	8.66	0.06	
09		1.62		0.27	13.9	0.16	
16		1.24		0.19	10.6	0.1[illegible]	
23		0.98		0.11	7.89	0.07	
30		0.75		0.09	6.02	0.08	
JUN 06		0.62		0.06	4.70	0.06	
13		0.47		0.03	3.30	0.04	
18		0.86		0.09	5.49	0.06	
27		1.04		0.06	7.33	0.08	

Table 4. Decays per kg air April 1974 - June 1975 (kBqs/kg)

	Ljungbyhed	Grindsjön	Kiruna
^{7}Be	94	83	86
^{54}Mn	0.23	0.23	0.20
^{88}Y	0.085	0.063	0.035
^{95}Zr	9.8	10	8.4
^{103}Ru	2.2	2.1	1.8
^{106}Ru	12	13	11
^{125}Sb	1.5	1.6	1.3
^{131}I	0.0013	0.0027	0.0027
^{137}Cs	2.7	2.8	2.4
^{140}Ba	0.066	0.056	0.047
^{141}Ce	1.2	1.2	0.86
^{144}Ce	28	31	24
^{155}Eu	0.31	0.32	0.25
^{237}U	0.050	0.026	-

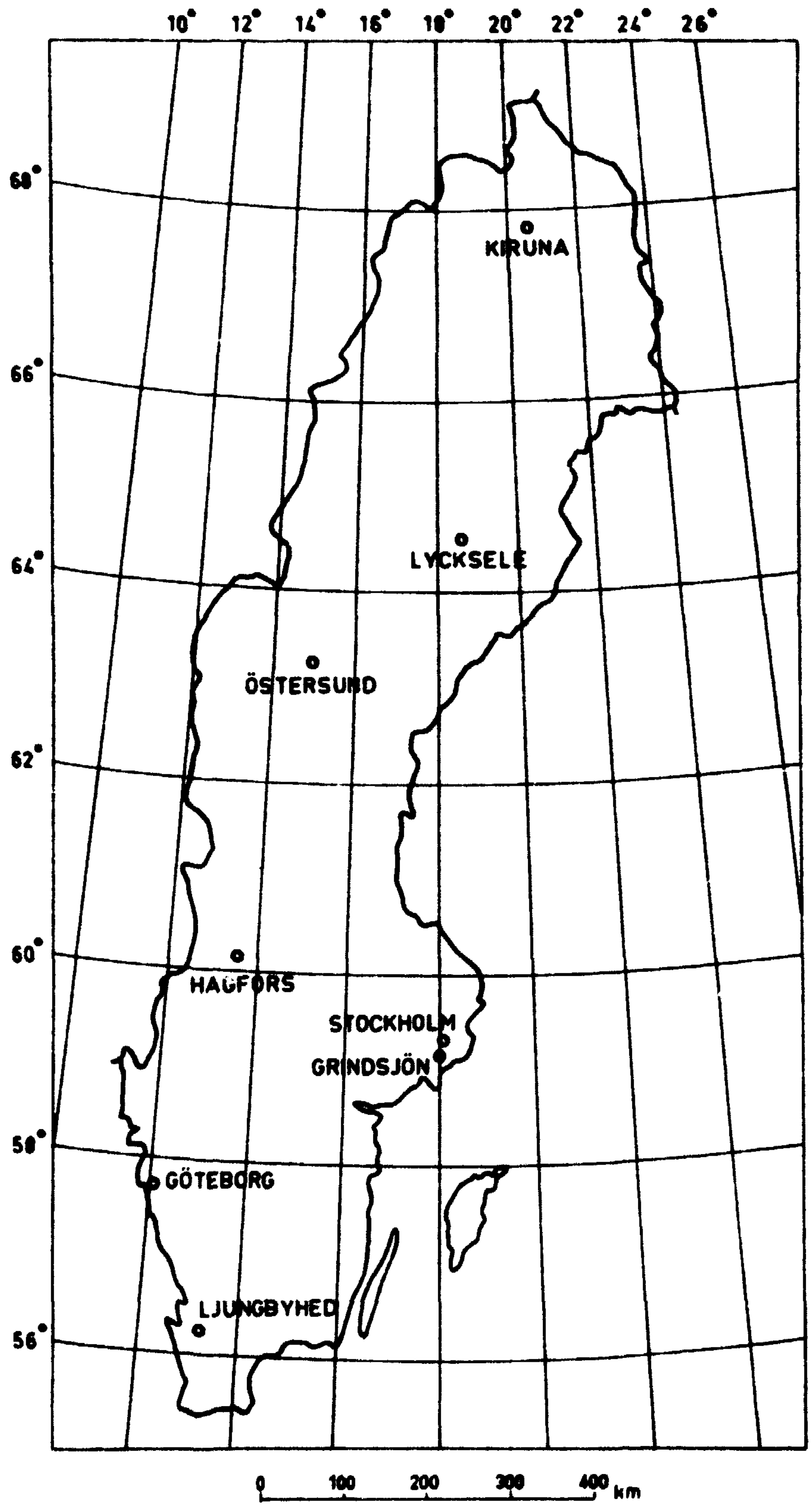

Fig. 1. Swedish stations for sampling of radioactivity in ground-level air and precipitation, operated by National Defence Research Institute.

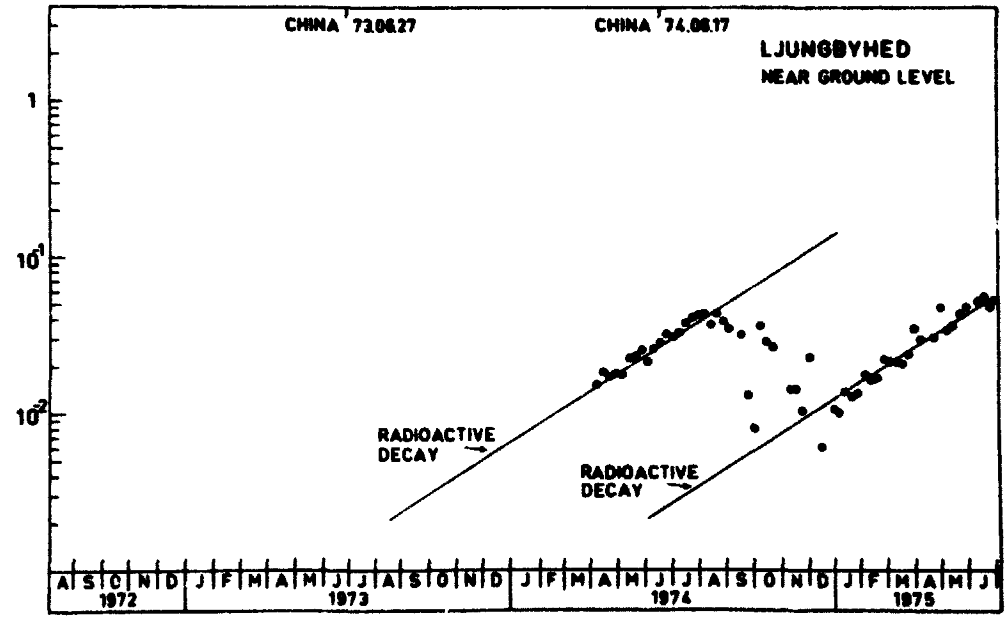

Fig. 2. $^{54}Mn/^{95}Zr$

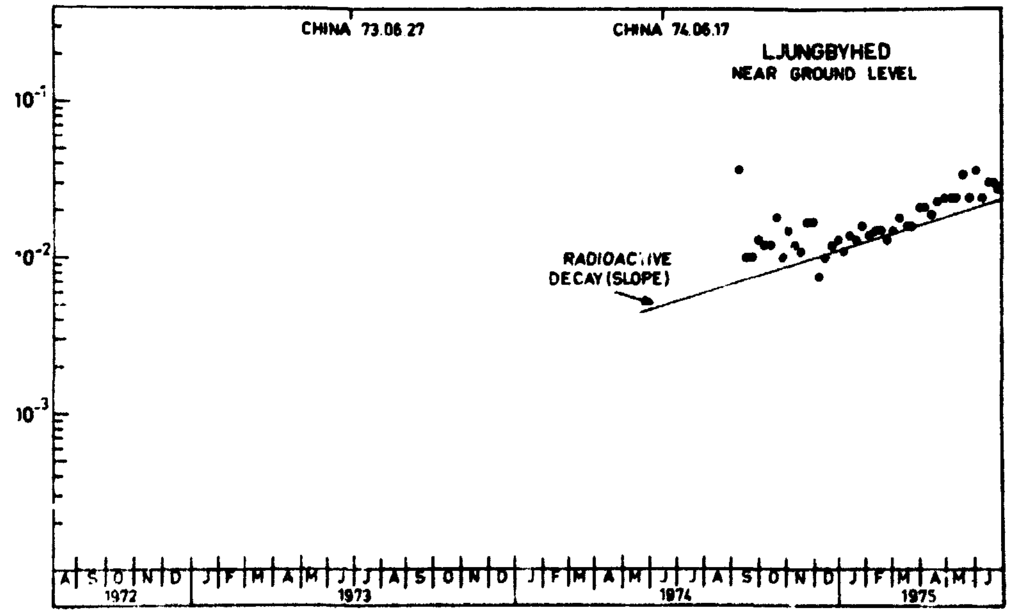

Fig. 3. $^{88}Y/^{95}Zr$

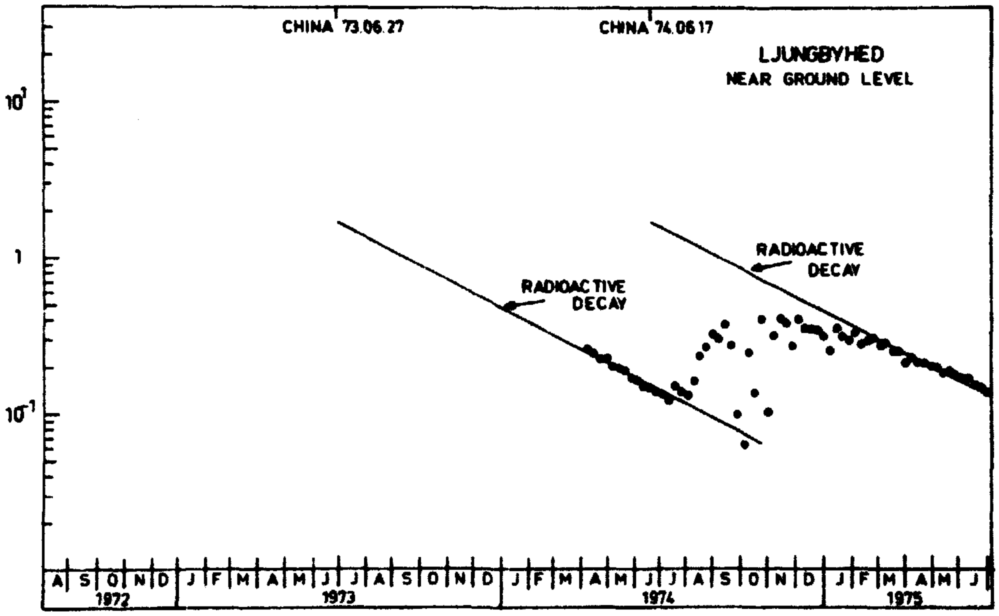

Fig. 4. $^{103}Ru/^{95}Zr$

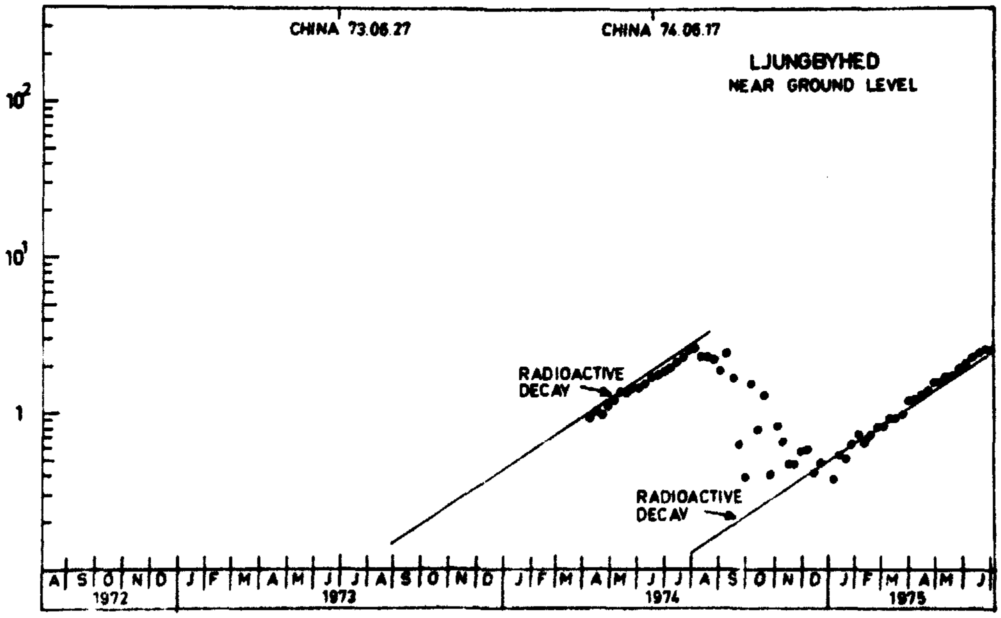

Fig. 5. $^{106}Ru/^{95}Zr$

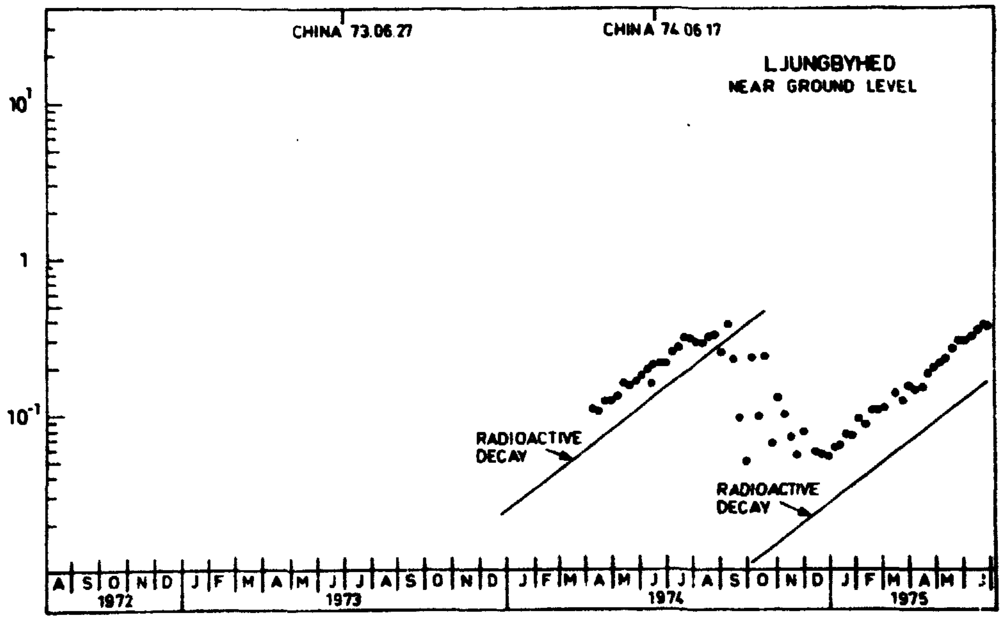

Fig. 6. $^{125}Sb/^{95}Zr$

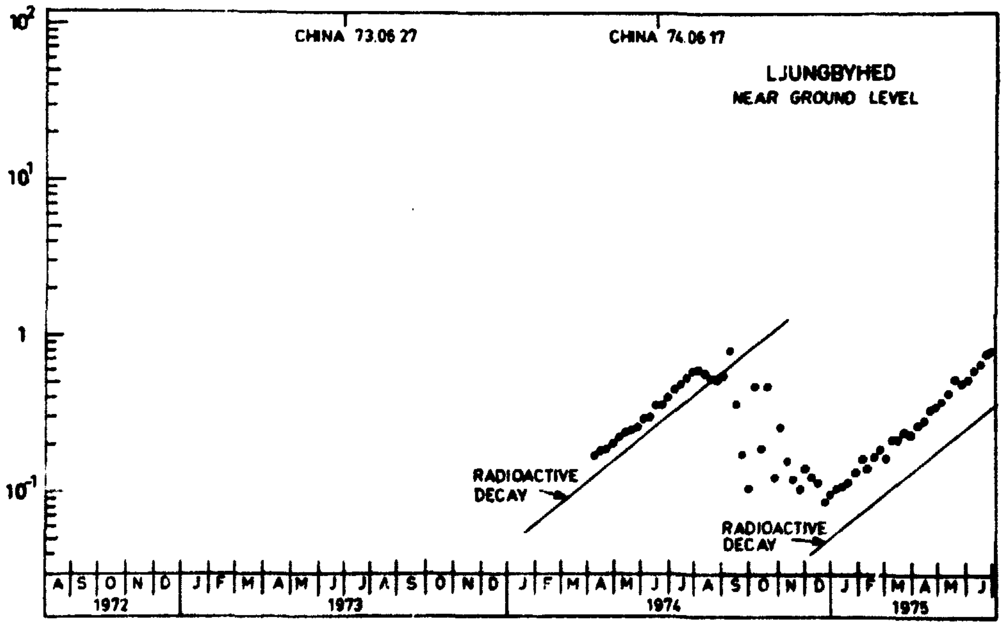

Fig. 7. $^{137}Cs/^{95}Zr$

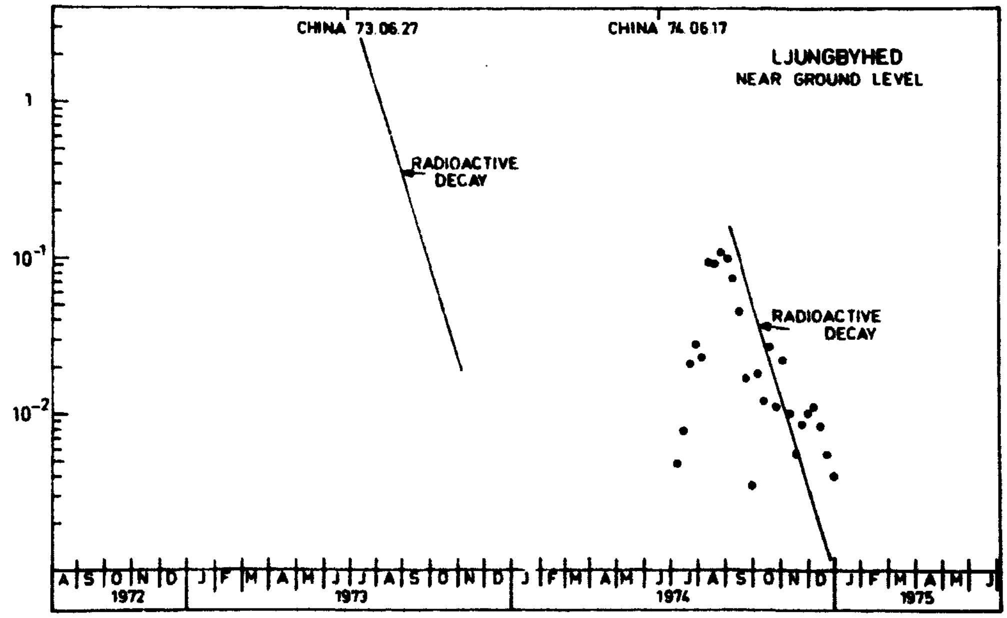

Fig. 8. $^{140}Ba/^{95}Zr$

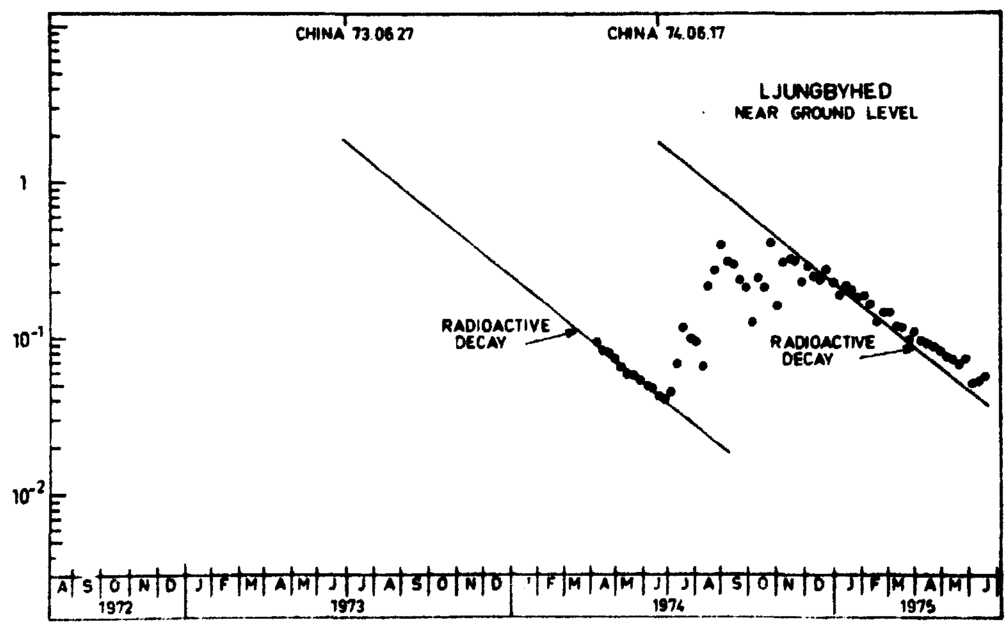

Fig. 9. $^{141}Ce/^{95}Zr$

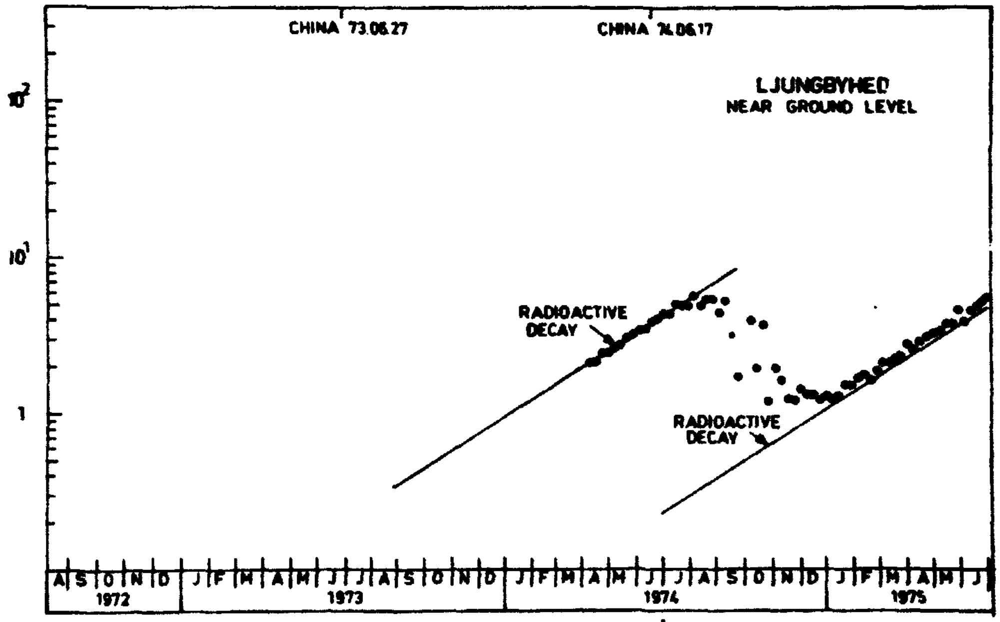

Fig. 10. $^{144}Ce/^{95}Zr$

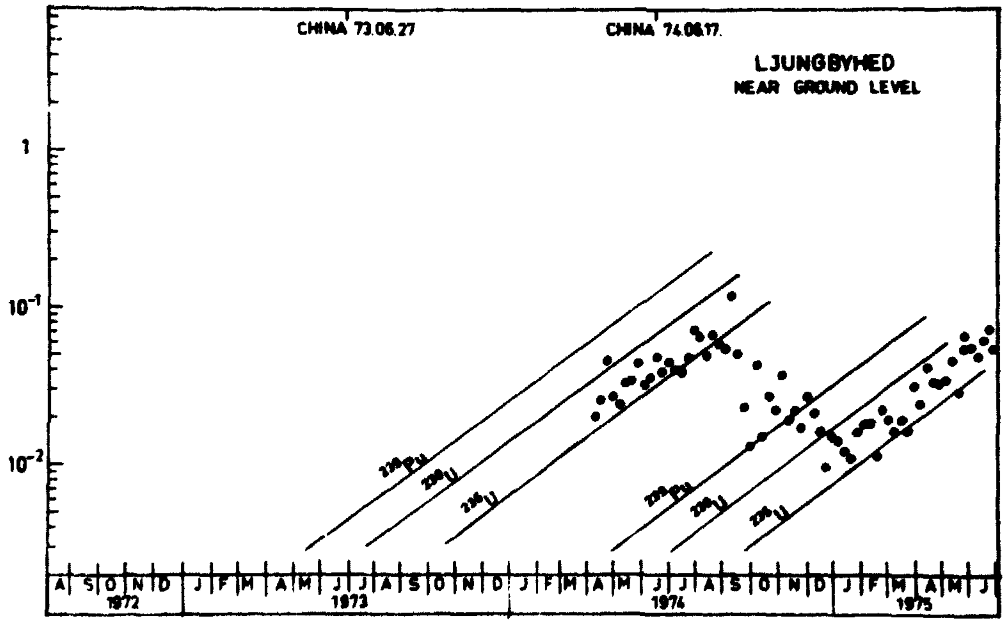

Fig. 11. $^{155}Eu/^{95}Zr$

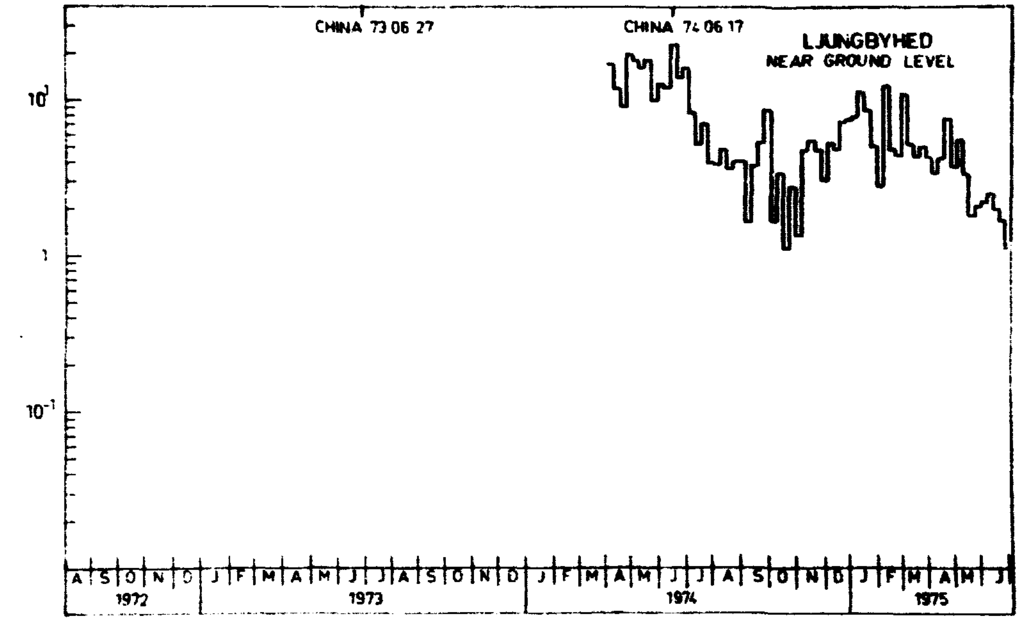

Fig. 12. ^{95}Zr (fCi/kg)

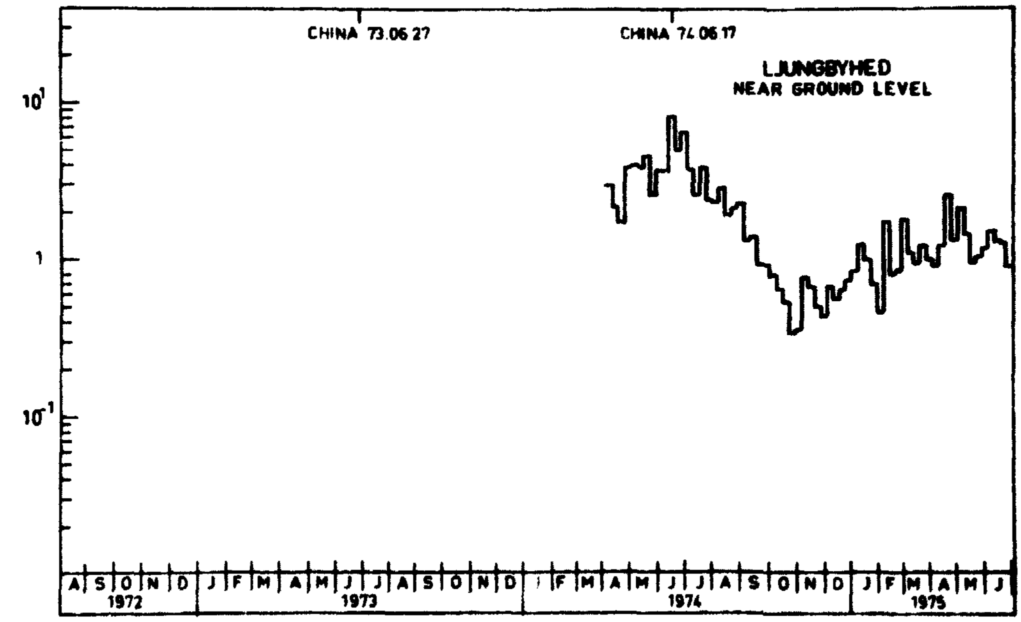

Fig. 13. ^{137}Cs (fCi/kg)

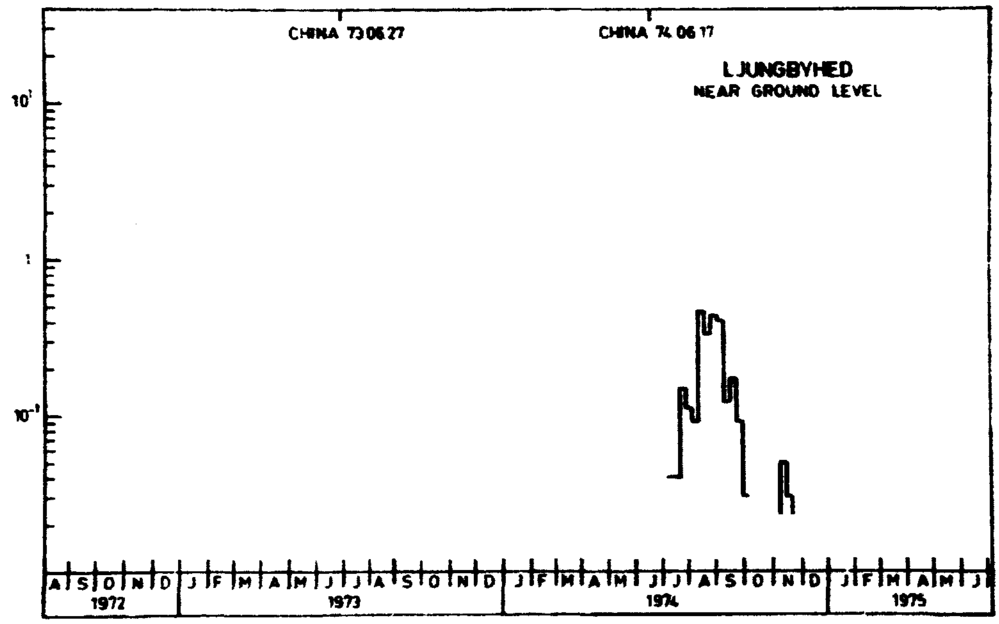

Fig. 14. ^{140}Ba (fCi/kg)

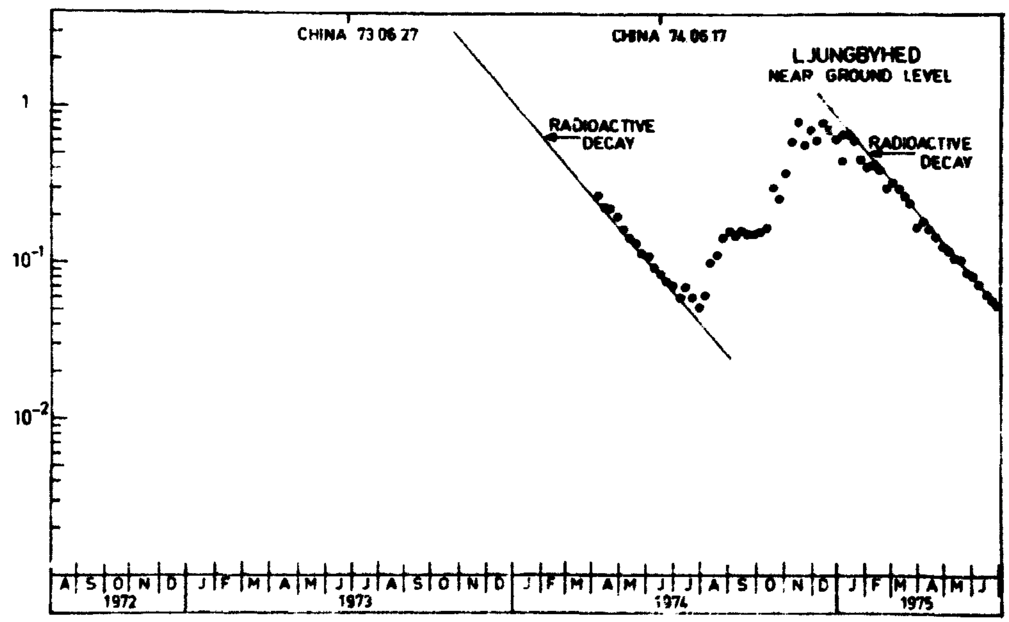

Fig. 15. ^{103}Ru/^{106}Ru

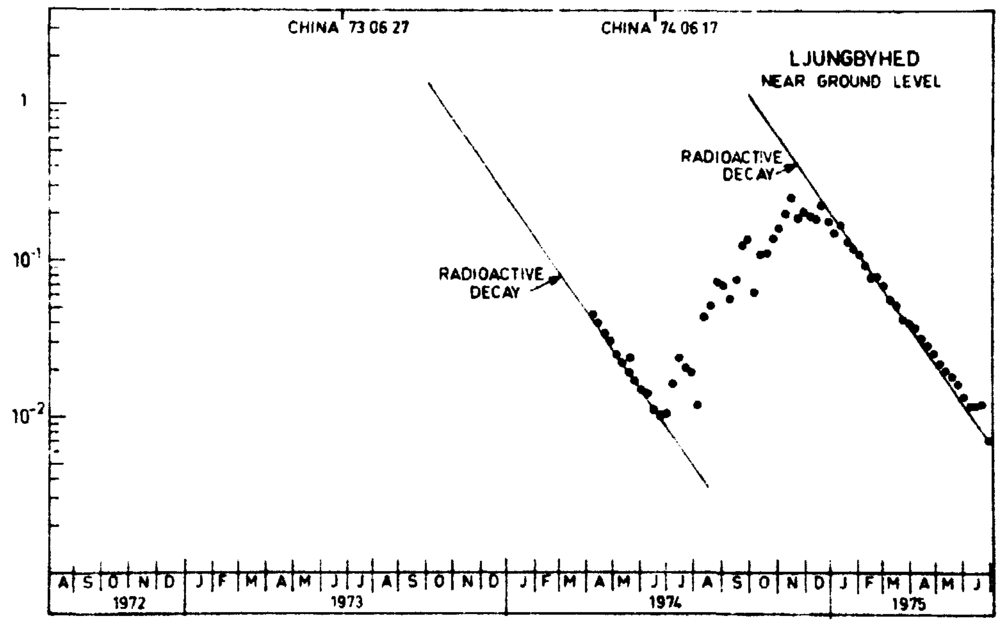

Fig. 16. $^{141}Ce/^{144}Ce$

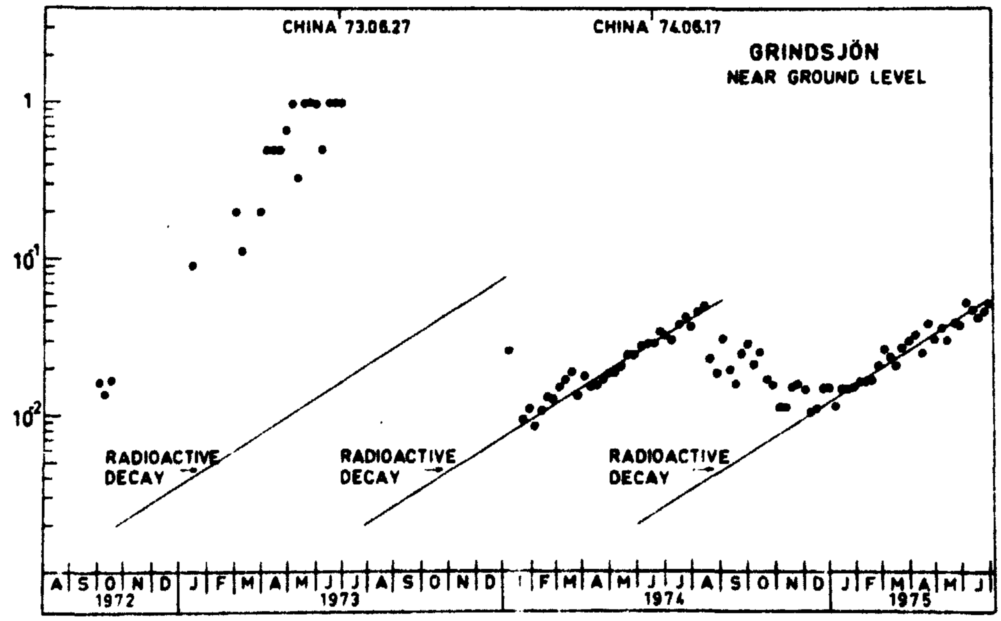

Fig. 17. $^{54}Mn/^{95}Zr$

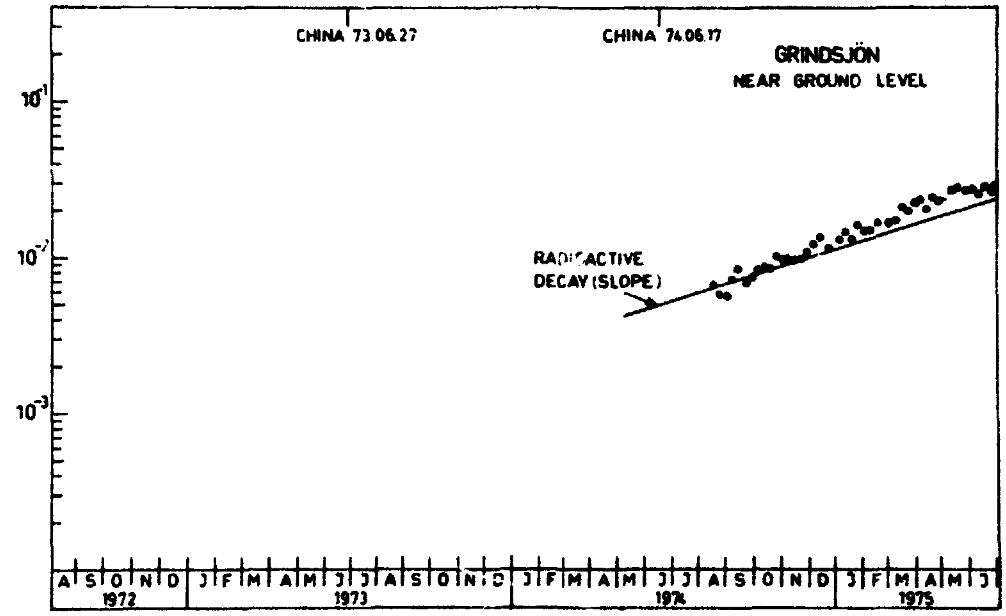

Fig. 18. $^{88}Y/^{95}Zr$

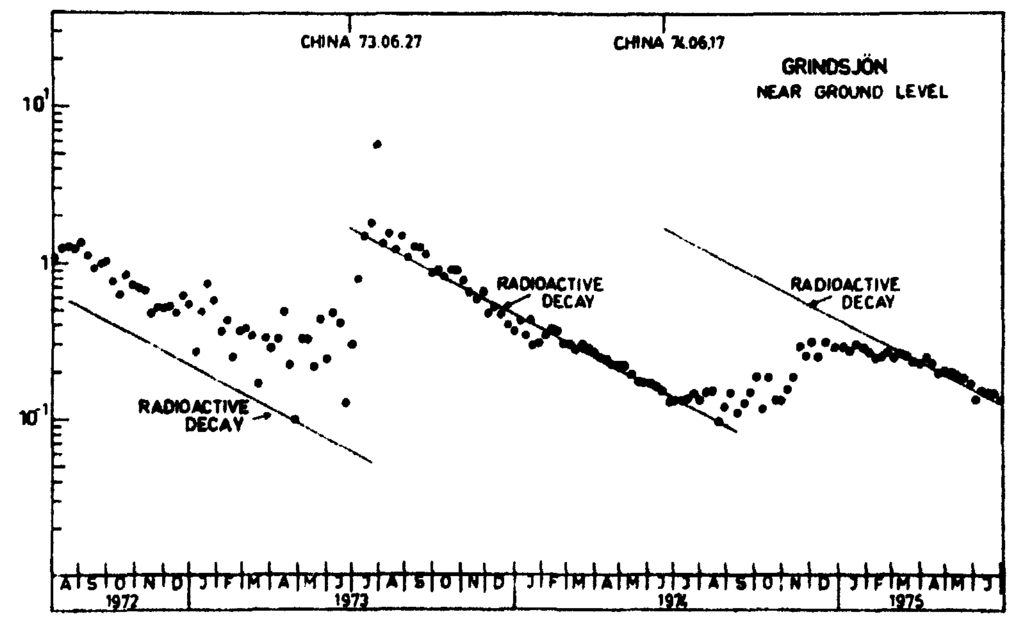

Fig. 19. $^{103}Ru/^{95}Zr$

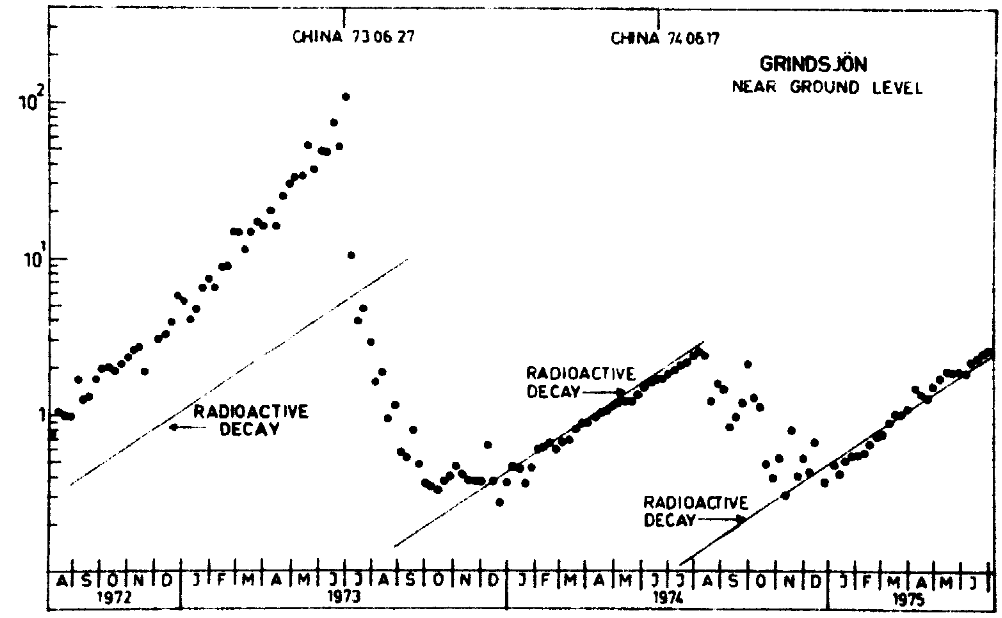

Fig. 20. $^{106}Ru/^{95}Zr$

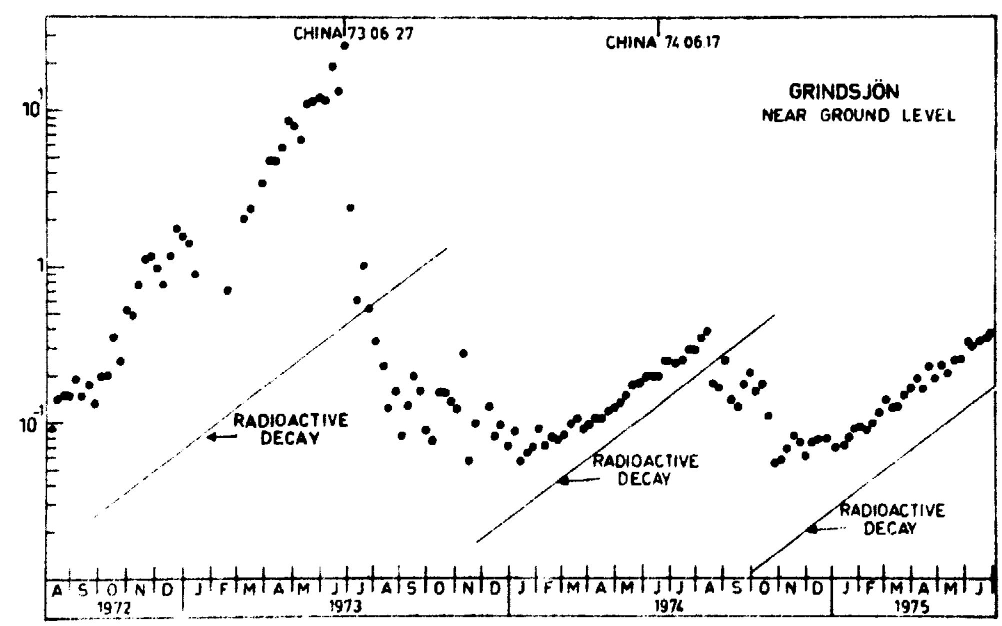

Fig. 21. $^{125}Sb/^{95}Zr$

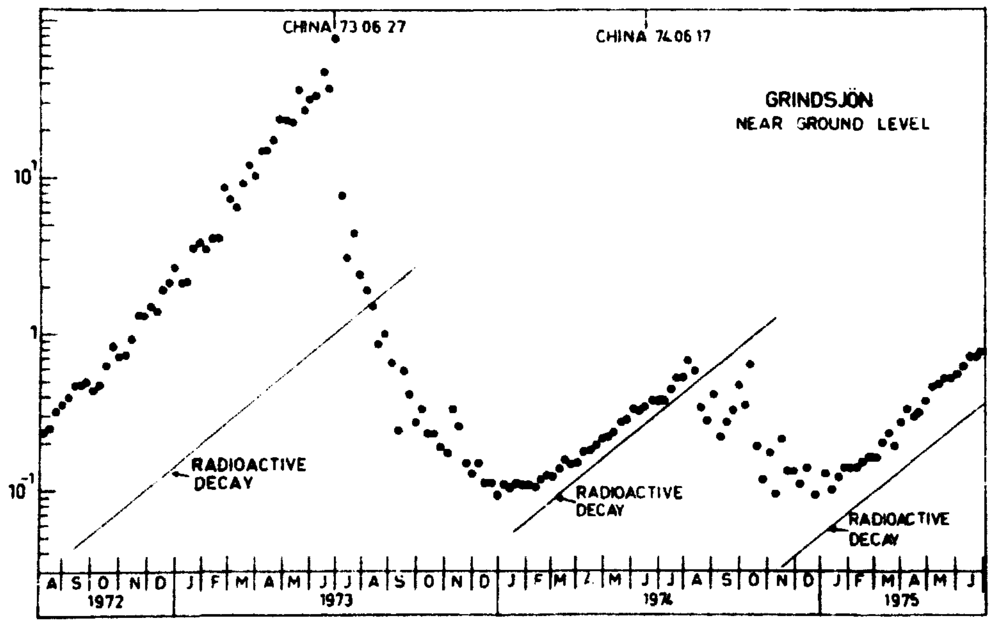

Fig. 22. $^{137}Cs/^{95}Zr$

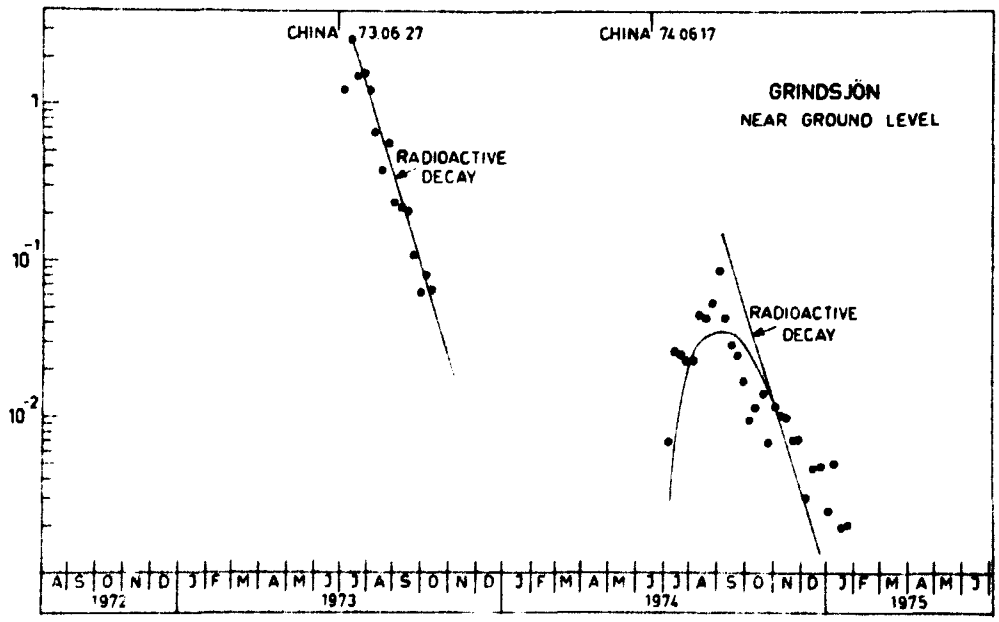

Fig. 23. $^{140}Ba/^{95}Zr$

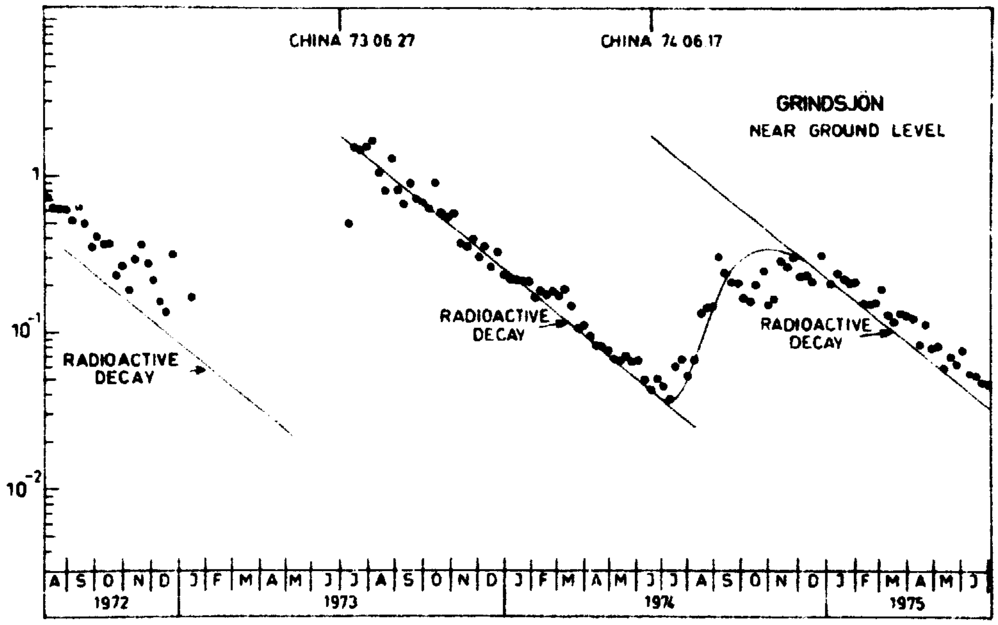

Fig. 24. $^{141}Ce/^{95}Zr$

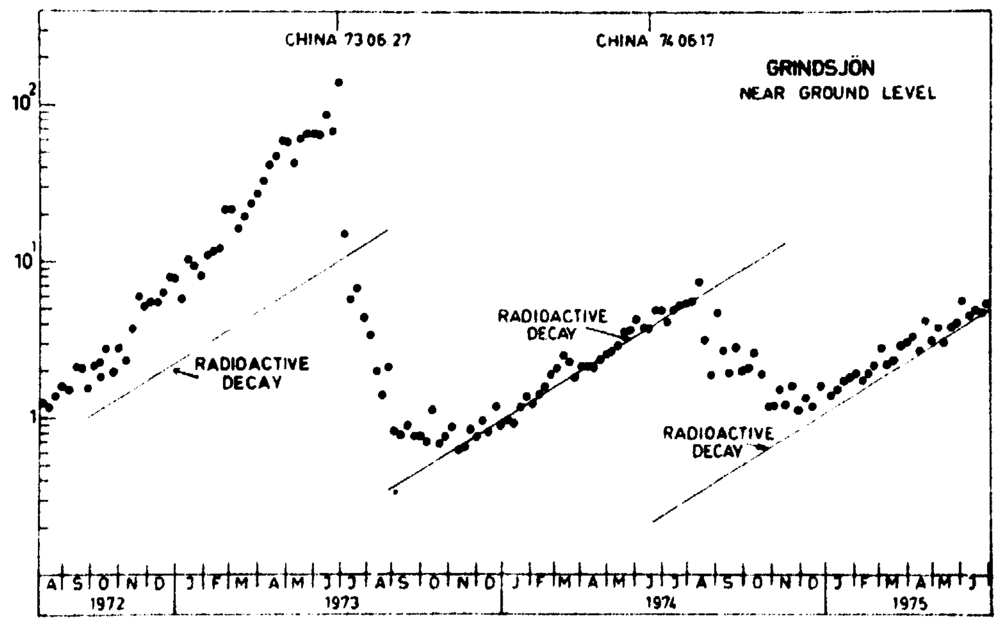

Fig. 25. $^{144}Ce/^{95}Zr$

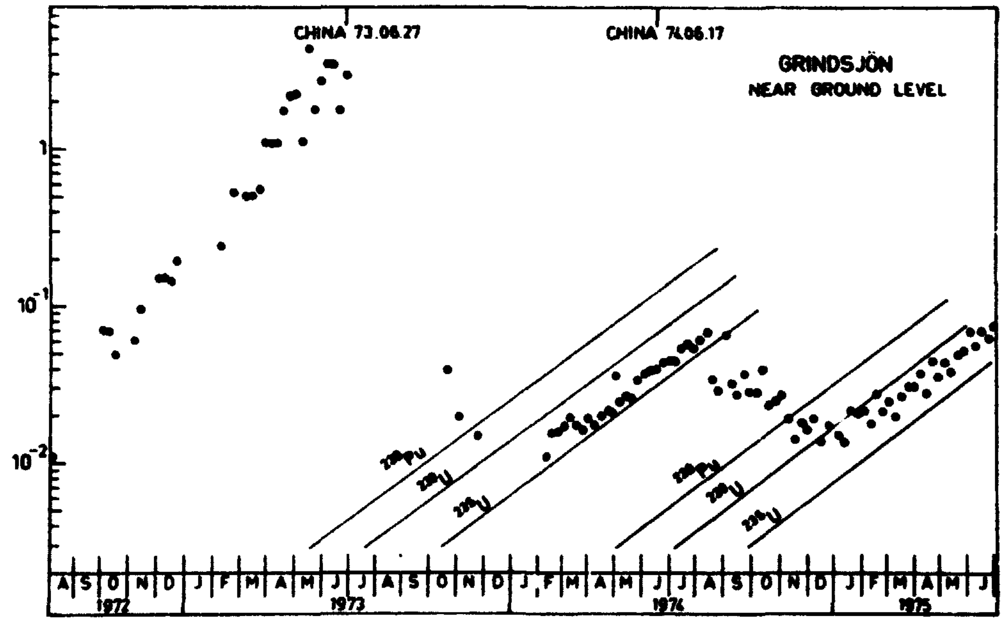

Fig. 26. $^{155}Eu/^{95}Zr$

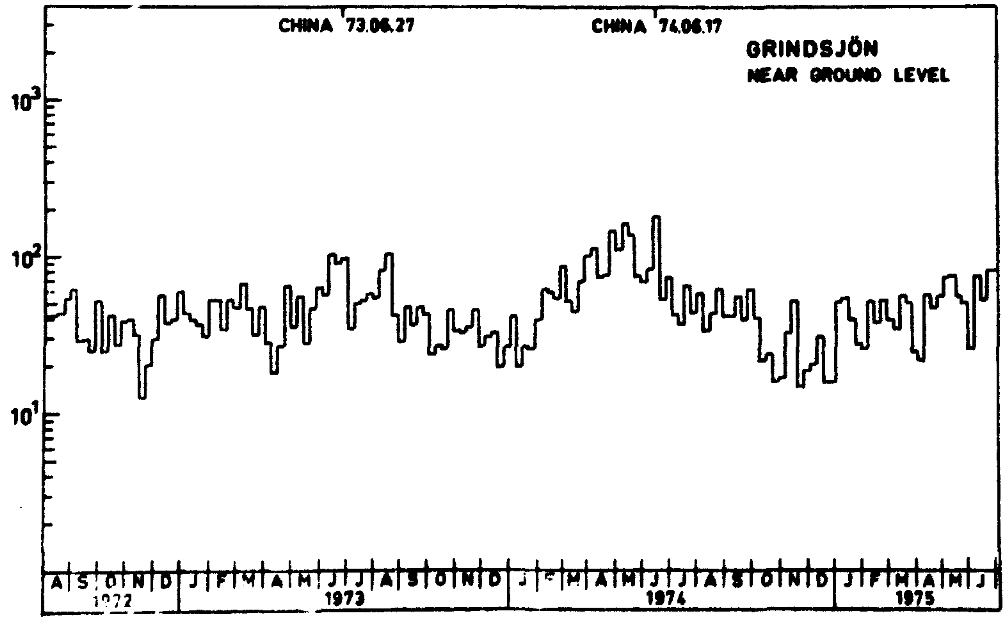

Fig. 27. ^{7}Be (fCi/kg)

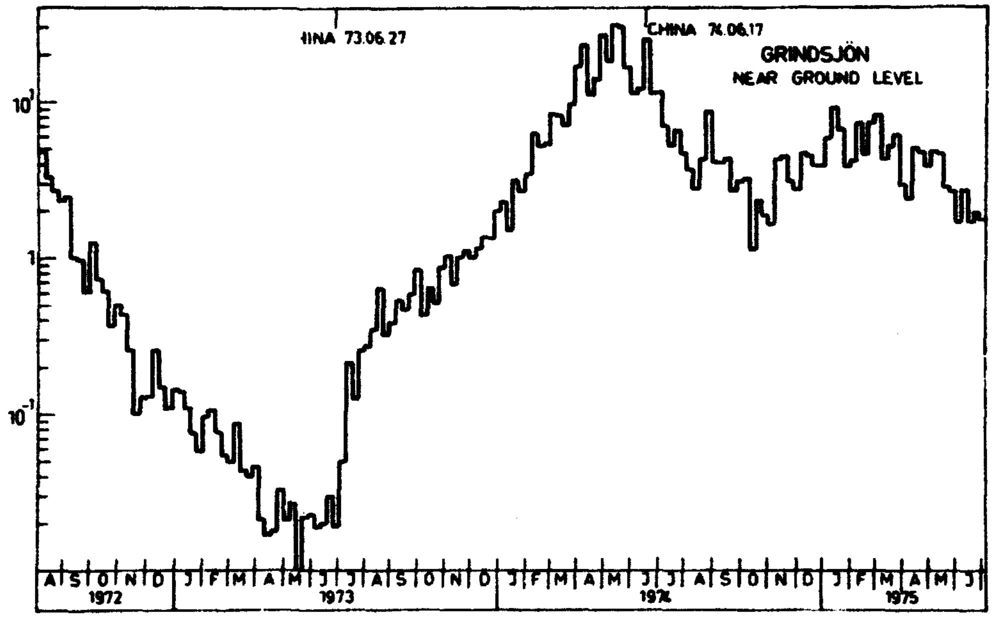

Fig. 28. ^{95}Zr (fCi/kg)

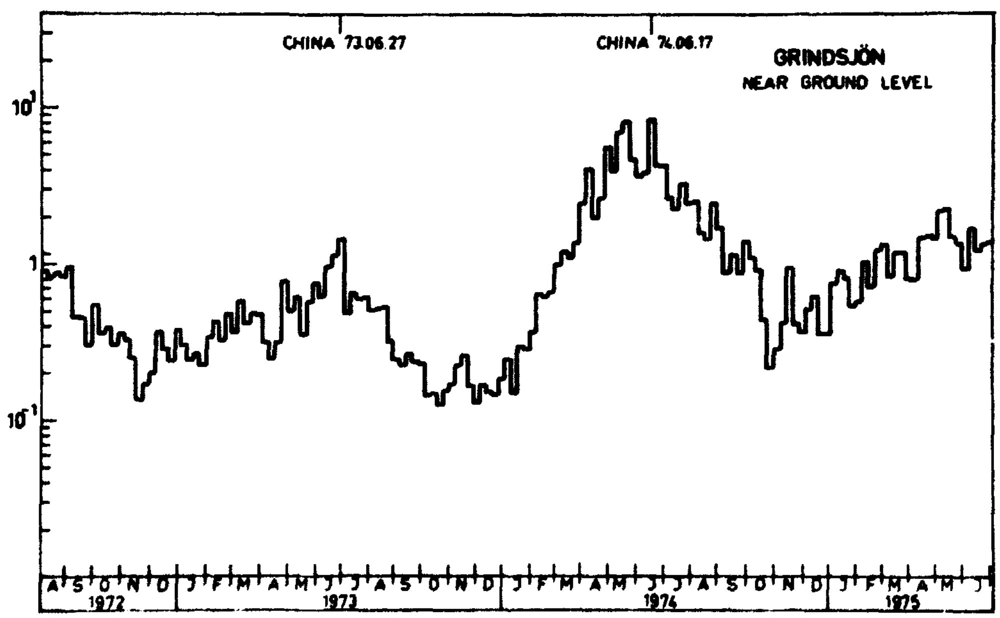

Fig. 29. ^{137}Cs (fCi/kg)

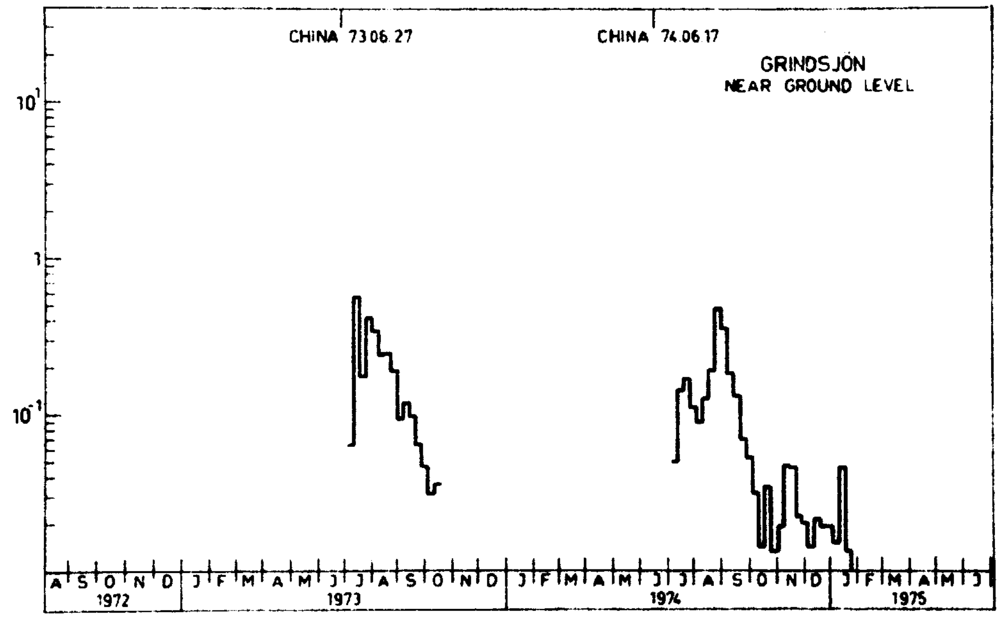

Fig. 30. ^{140}Ba (fCi/kg)

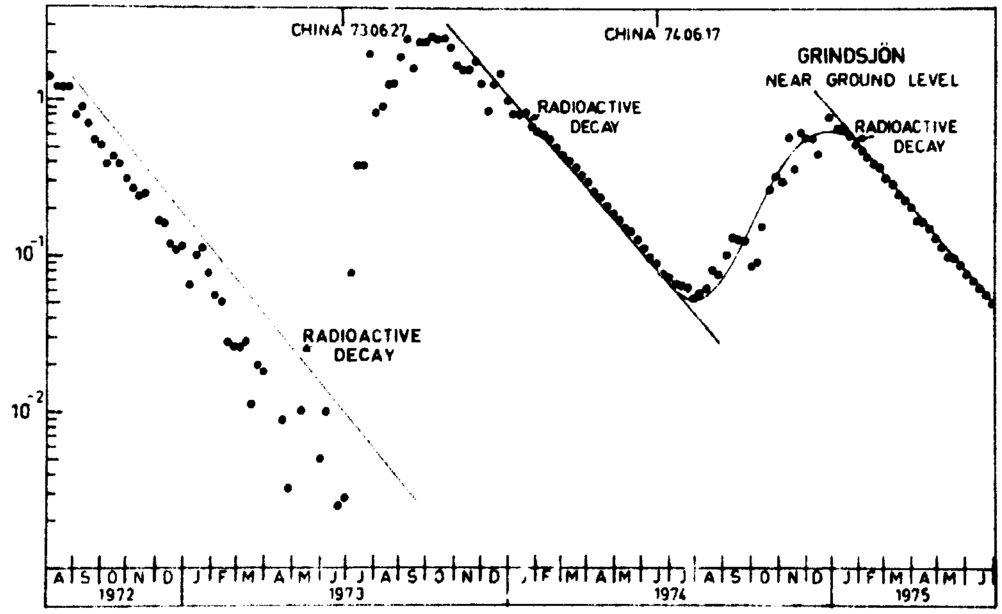

Fig. 31. $^{103}Ru/^{106}Ru$

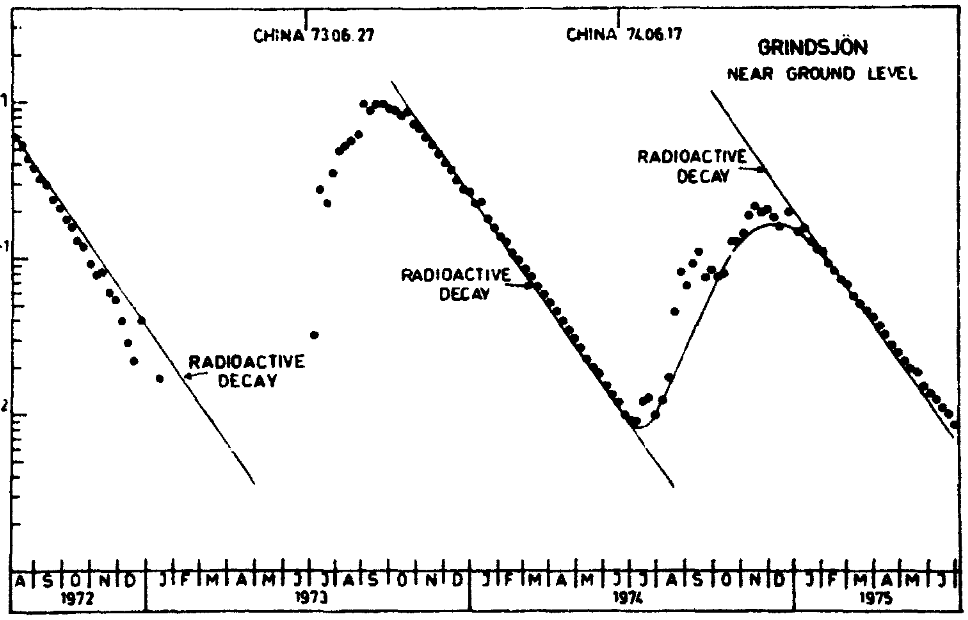

Fig. 32. $^{141}Ce/^{144}Ce$

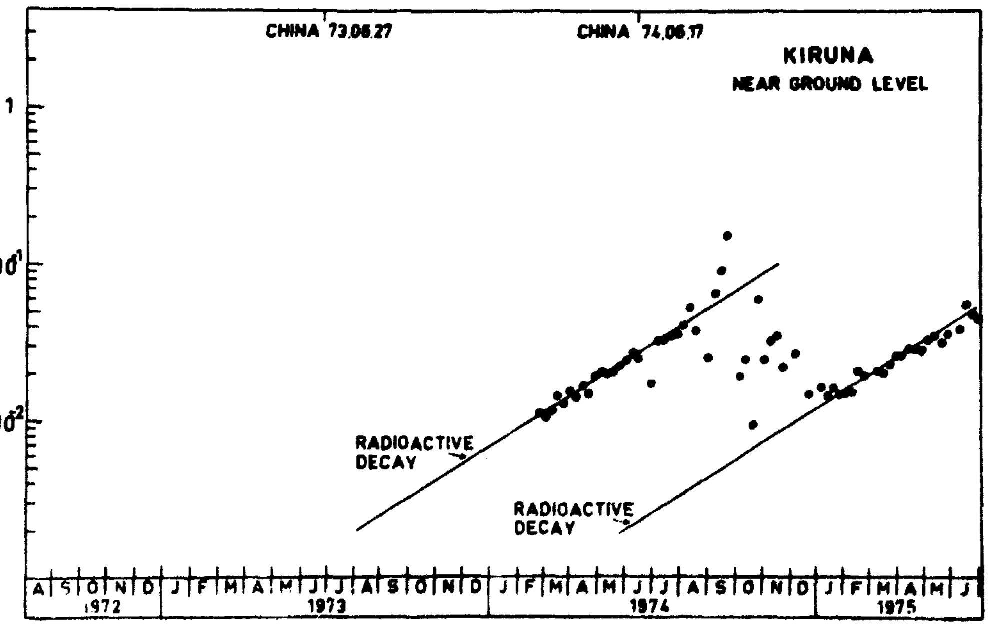

Fig. 33. $^{54}Mn/^{95}Zr$

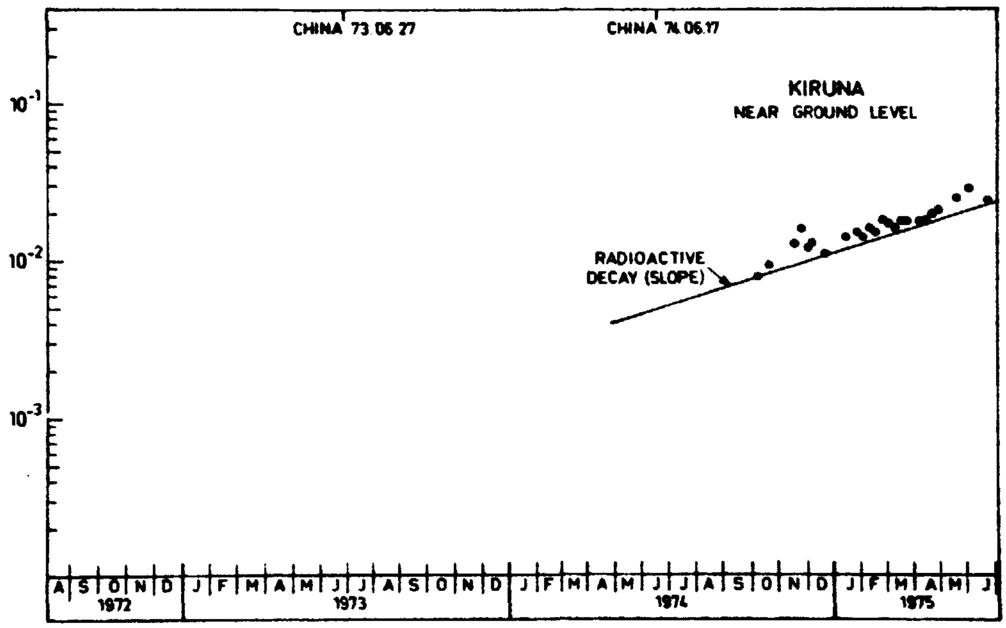

Fig. 34. $^{88}Y/^{95}Zr$

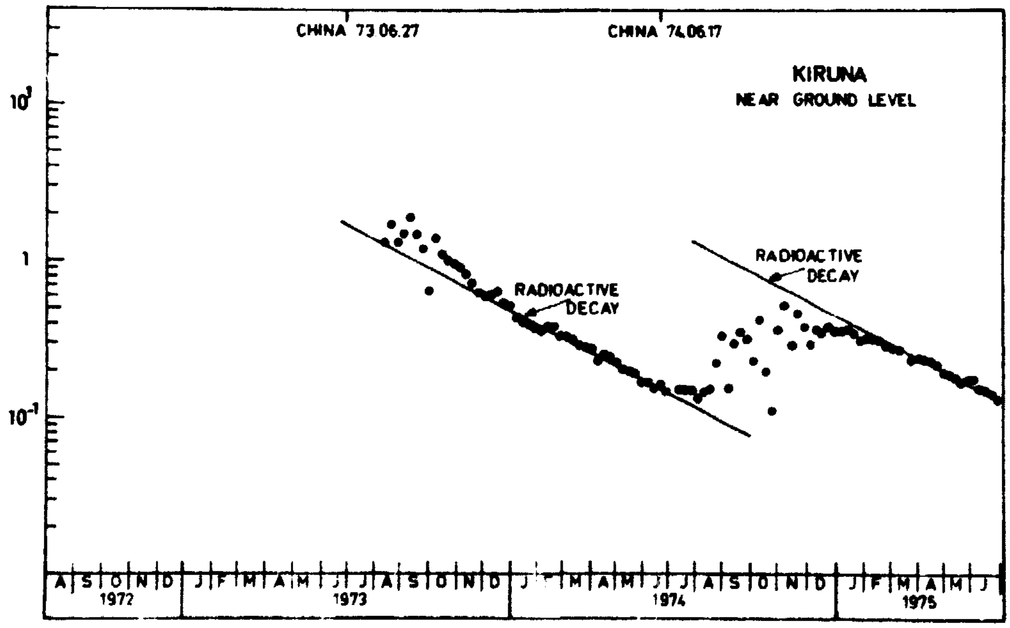

Fig. 35. $^{103}Ru/^{95}Zr$

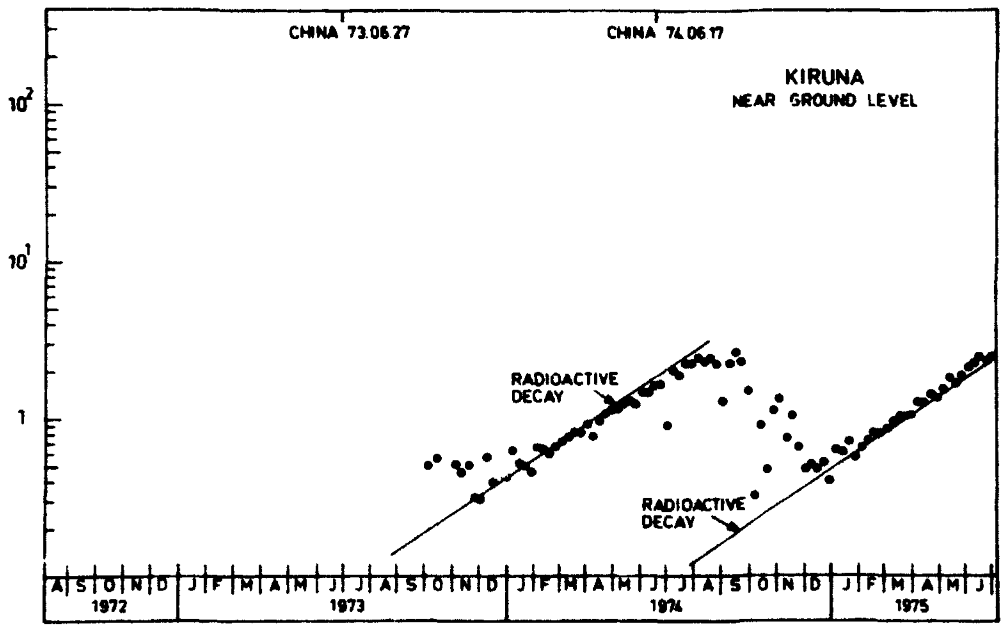

Fig. 36. $^{106}Ru/^{95}Zr$

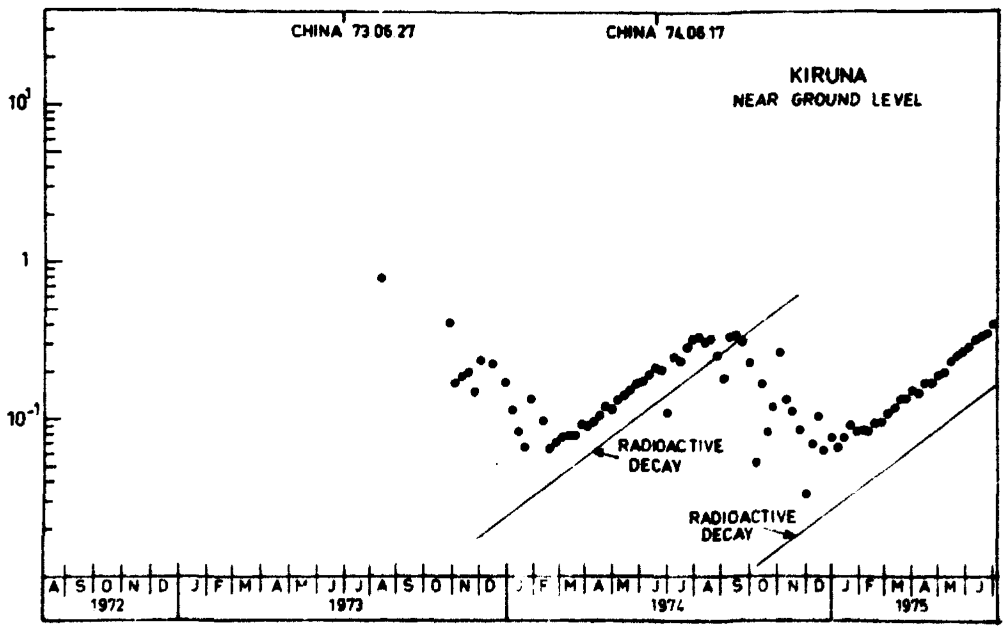

Fig. 37. $^{125}Sb/^{95}Zr$

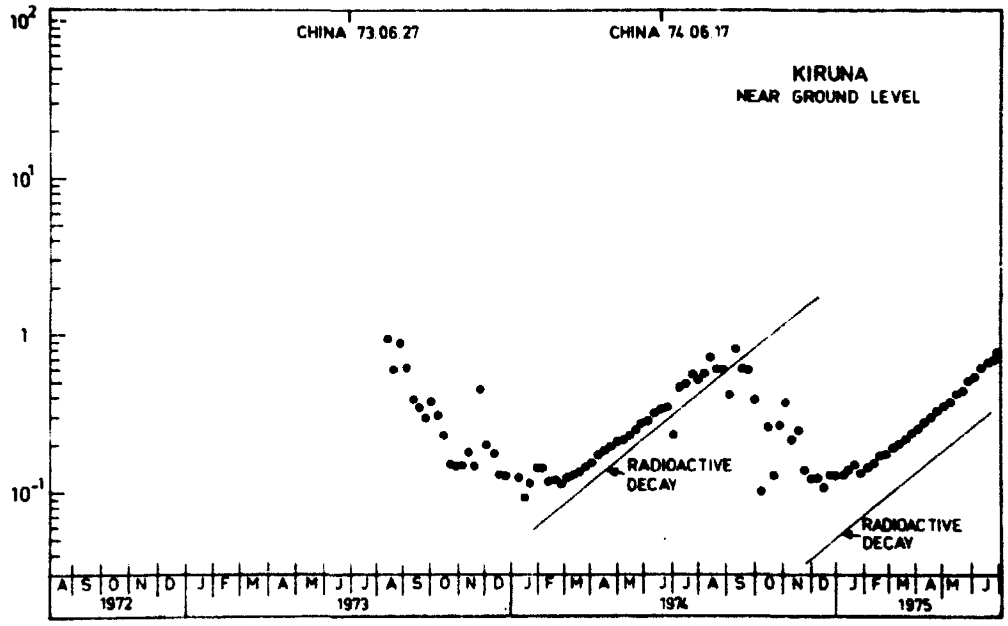

Fig. 38. $^{137}Cs/^{95}Zr$

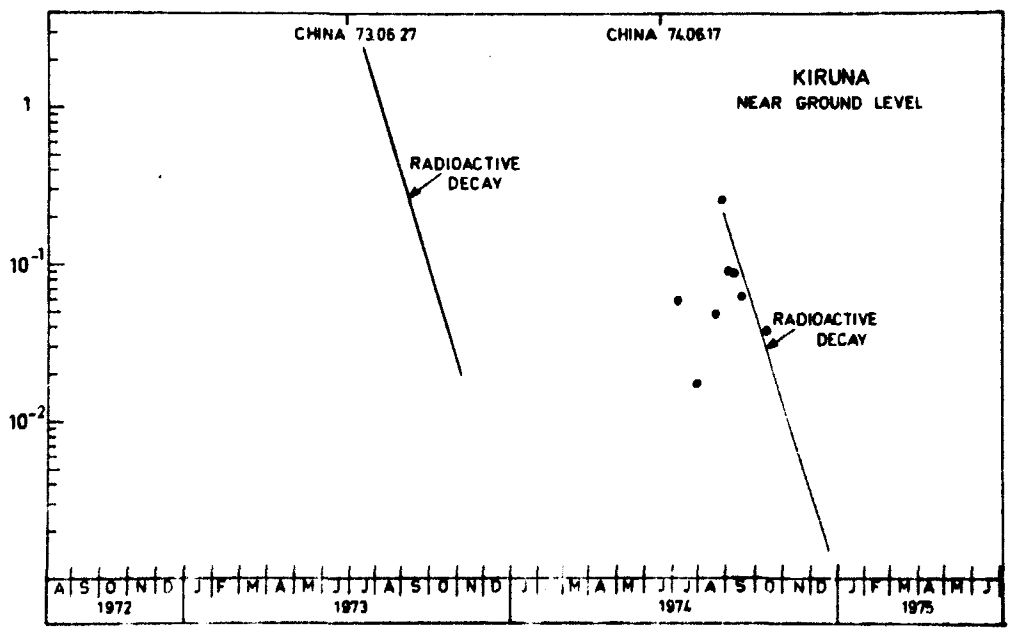

Fig. 3). $^{140}Ba/^{95}Zr$

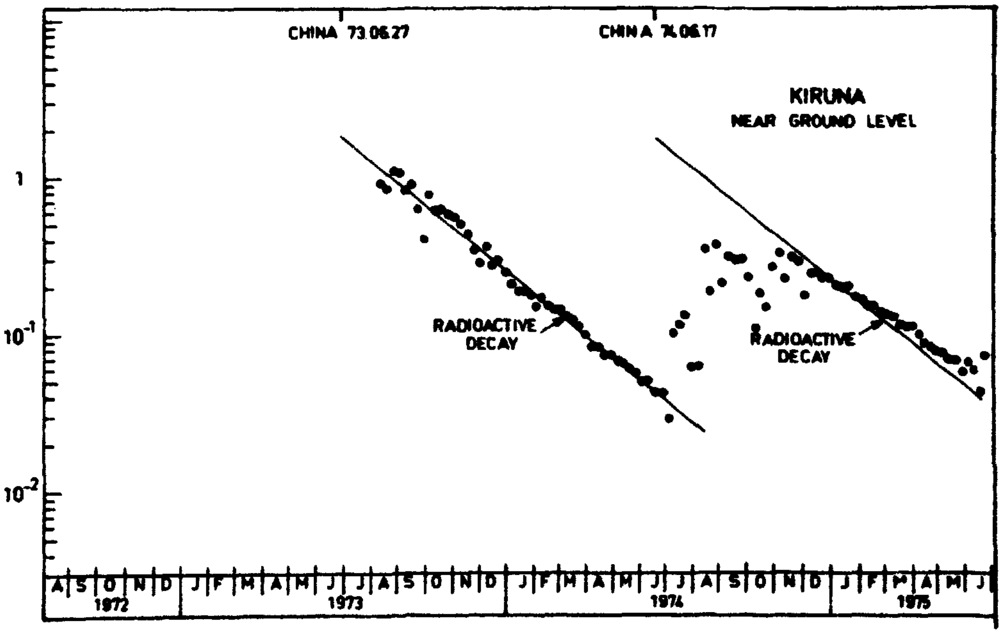

Fig. 40. $^{141}Ce/^{95}Zr$

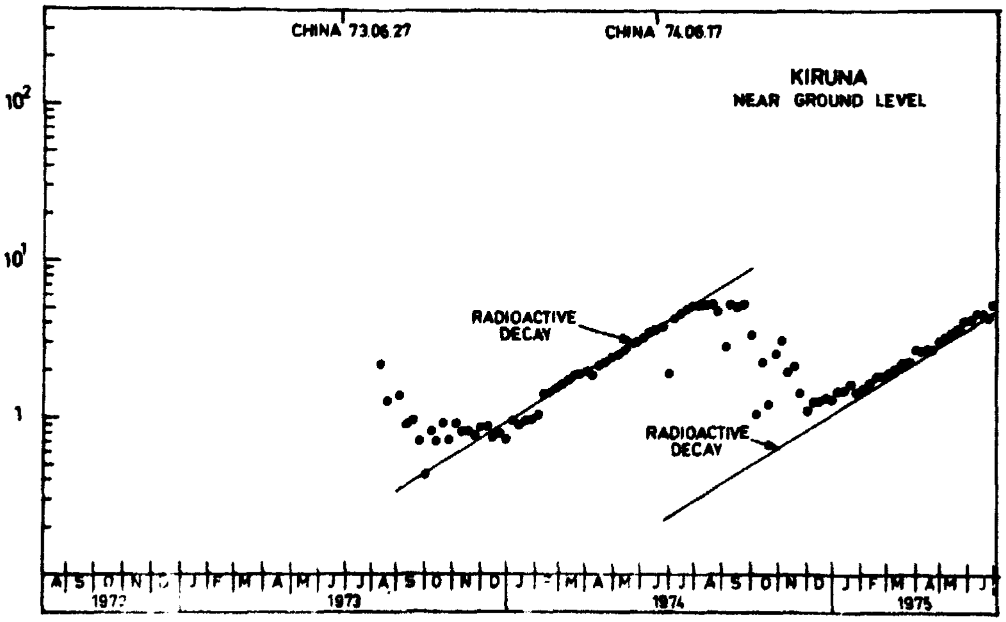

Fig. 41. $^{144}Ce/^{95}Zr$

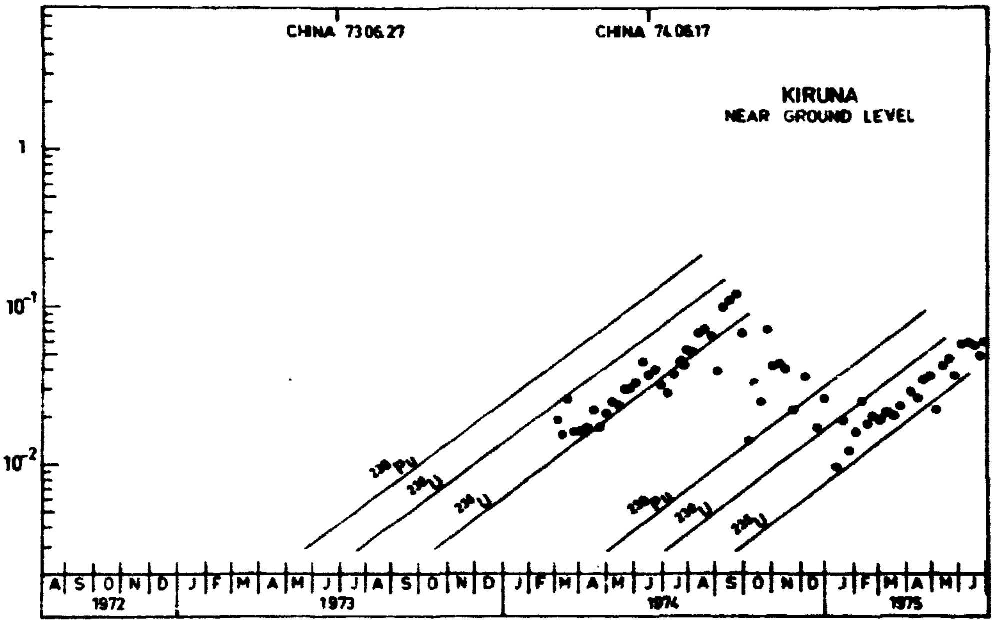

Fig. 42. $^{155}Eu/^{95}Zr$

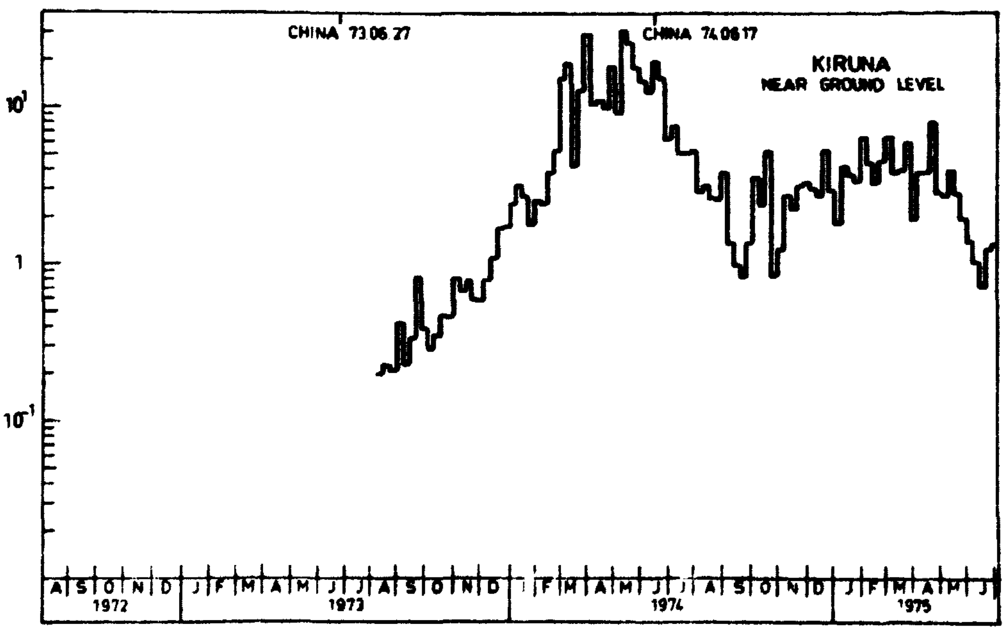

Fig. 43. ^{95}Zr (fCi/kg)

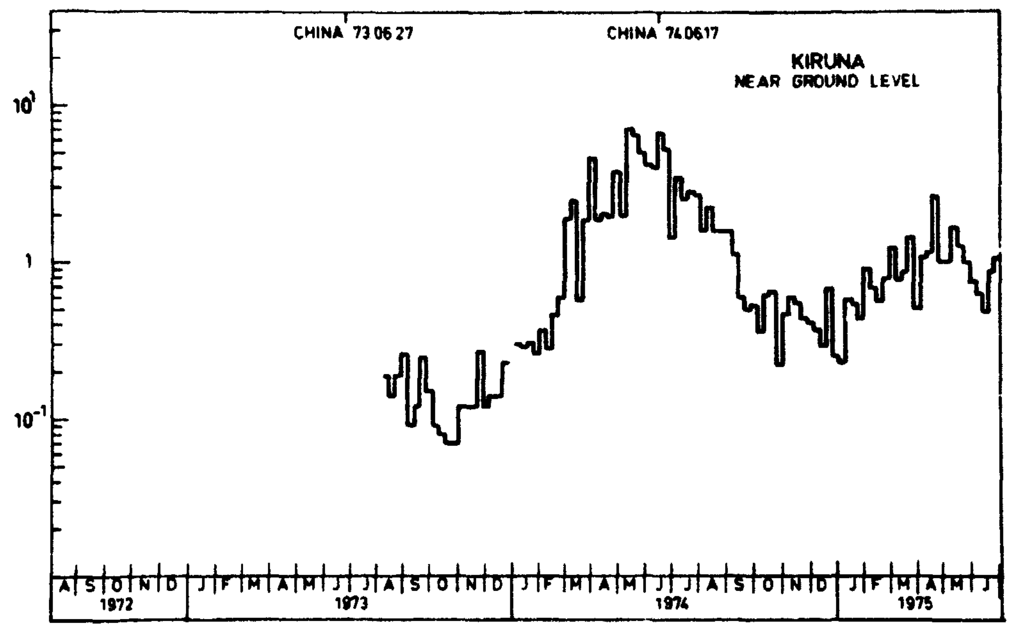

Fig. 44. ^{137}Cs (fCi/kg)

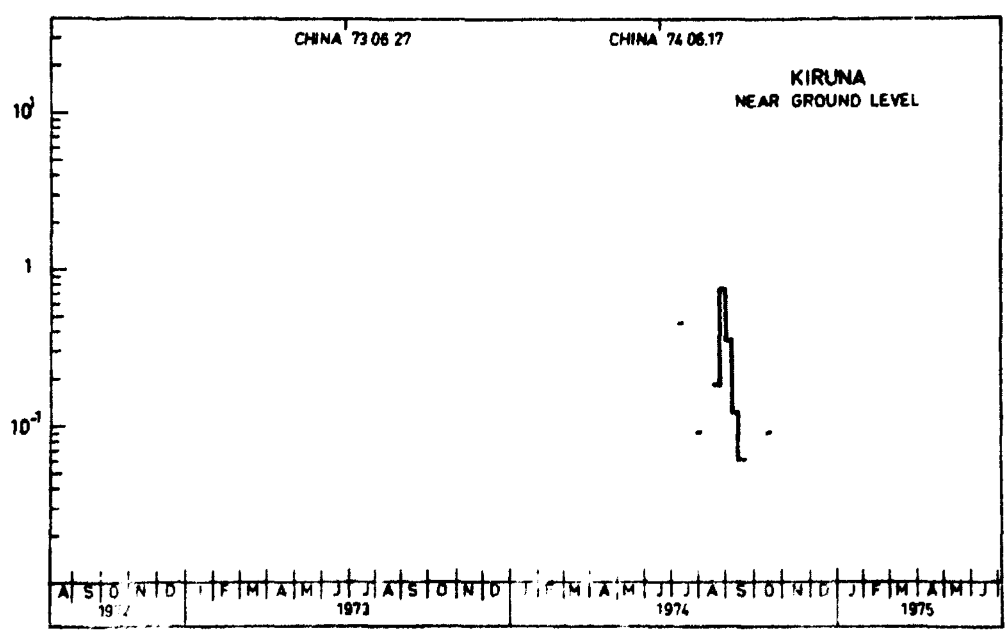

Fig. 45. ^{140}Ba (fCi/kg)

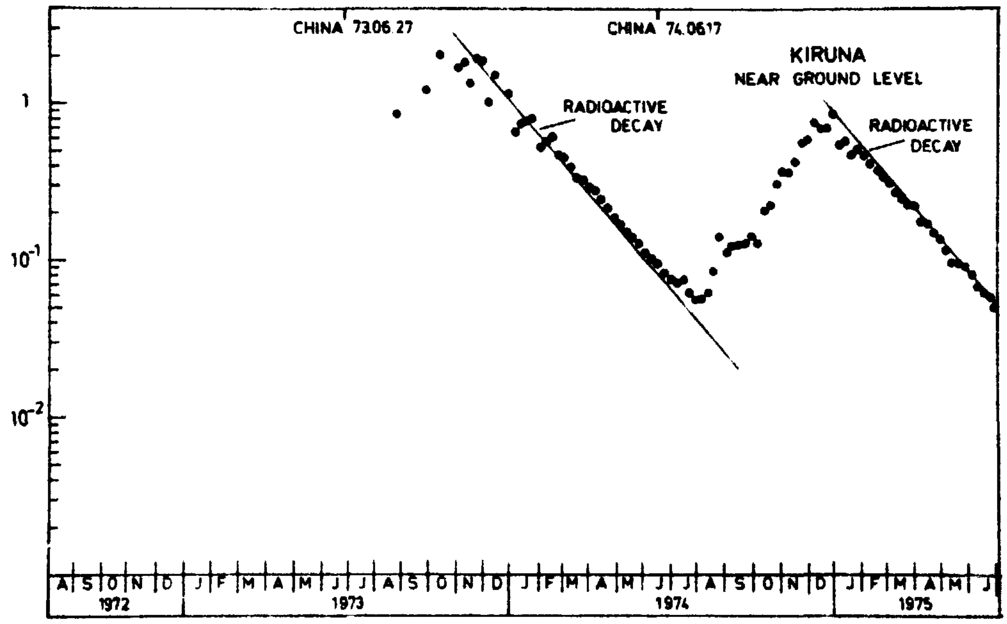

Fig. 46. ^{103}Ru/^{106}Ru

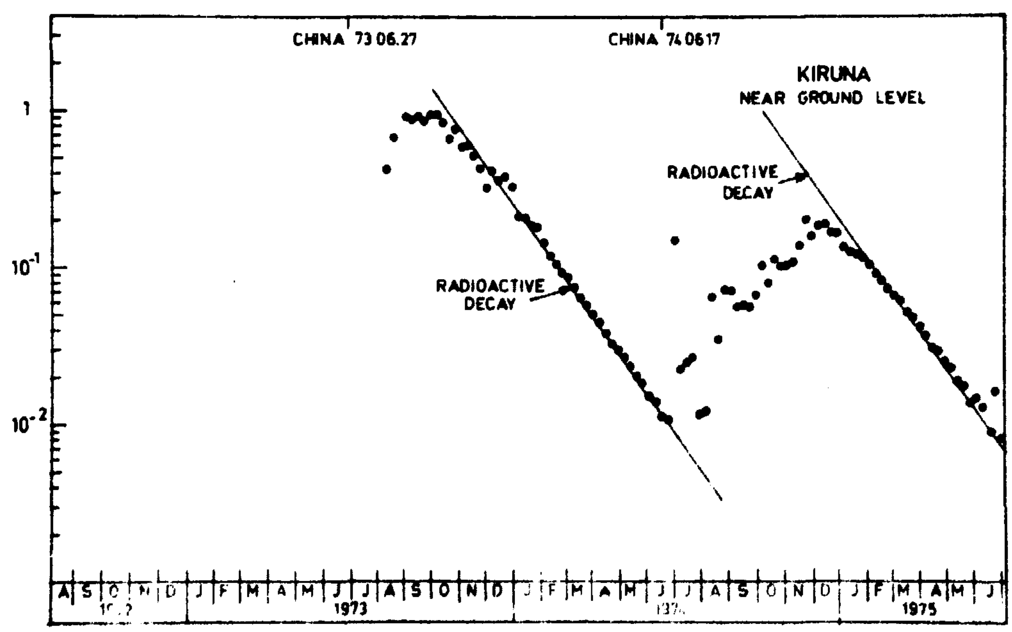

Fig. 47. ^{141}Ce/^{144}Ce

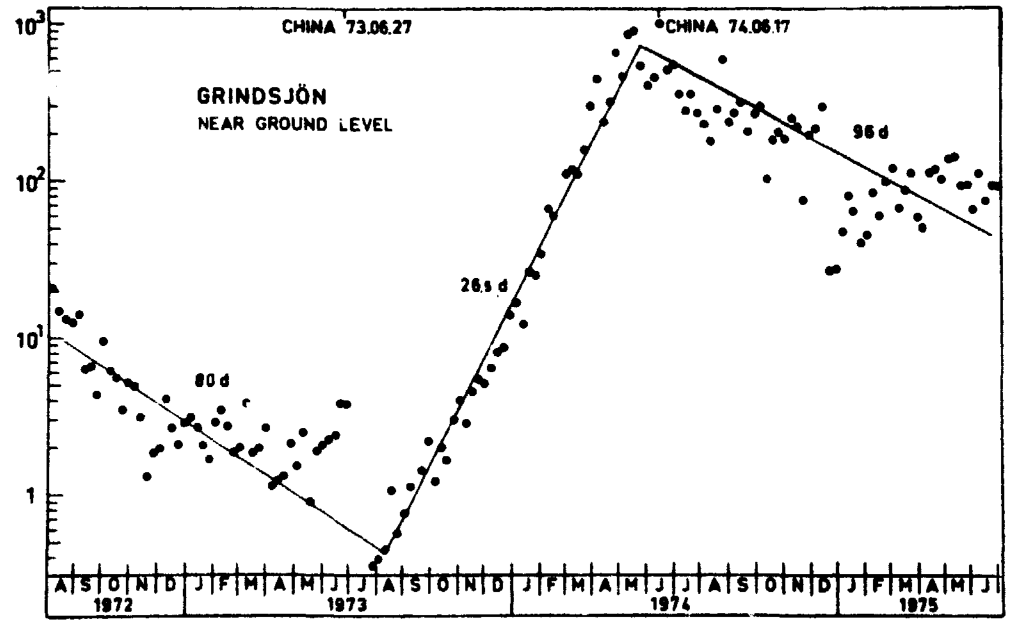

Fig. 48. Decay corrected ^{95}Zr (arbitrary units)

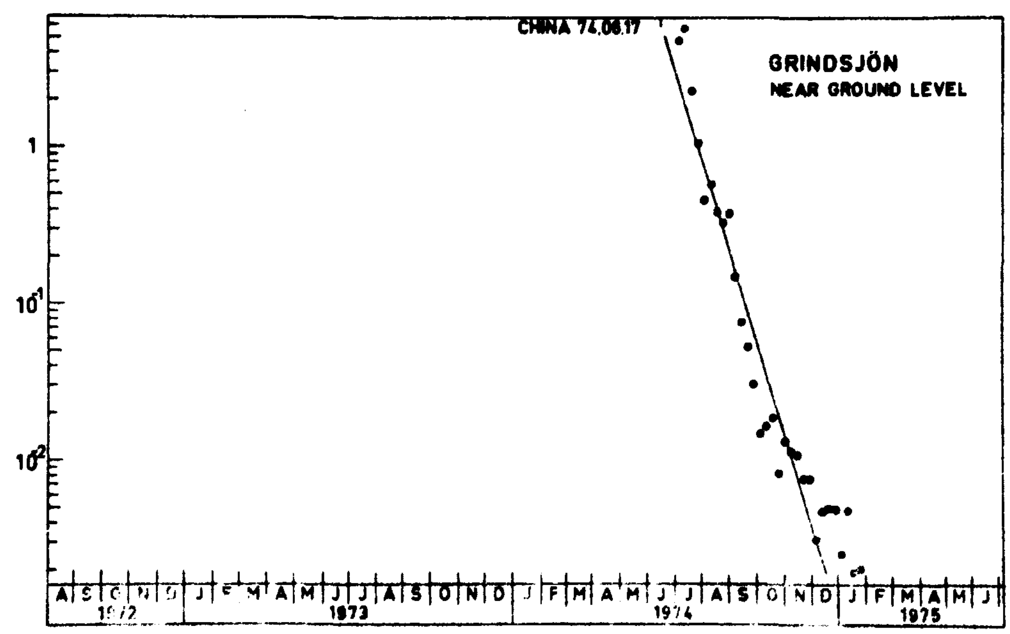

Fig. 49. $^{140}Ba/^{95}Zr_{new}$

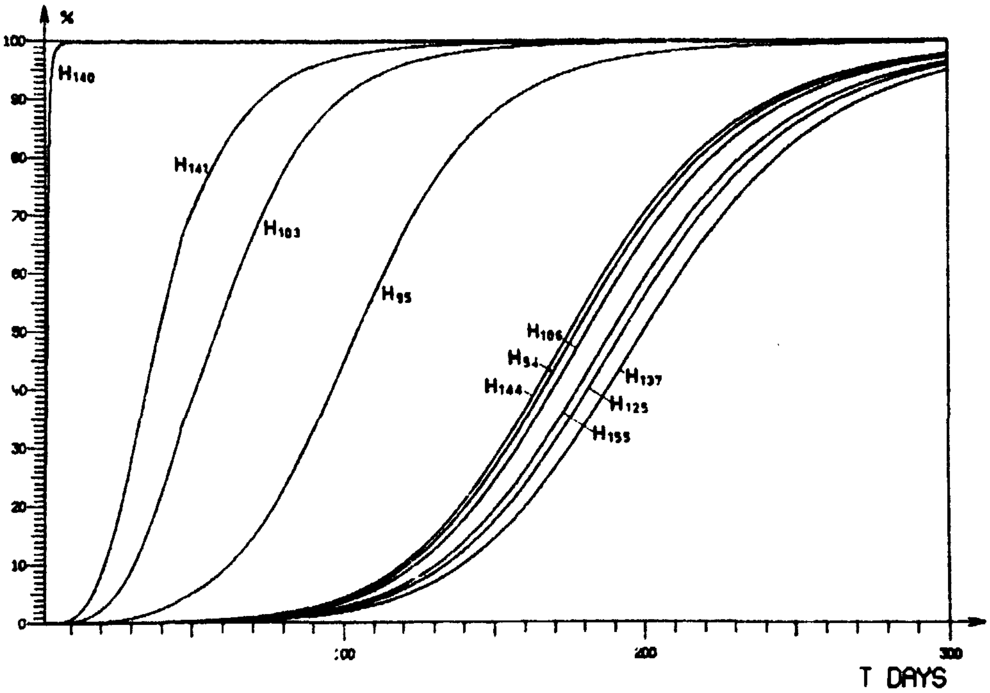

Fig. 50. New activity/New + old activity for some nuclides as functions of time after the Chinese 1974 explosion.