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## Quarterly report on measurements of radionuclides in ground level air in Sweden

Second quarter 2003



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**User report**

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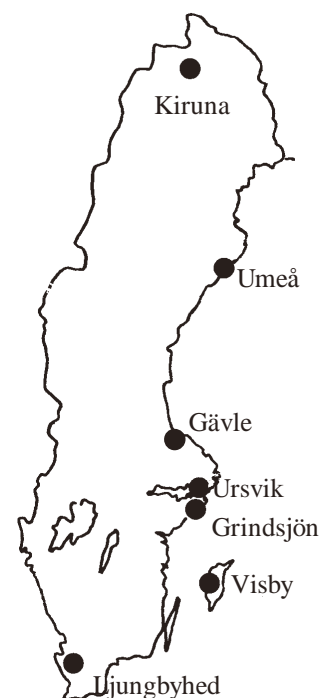
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<b>Report title</b> Quarterly report on measurements of radionuclides in ground level air in Sweden. Second quarter 2003.		
<b>Abstract (not more than 200 words)</b> Filtering of ground level air is performed weekly at seven different locations in Sweden: Kiruna, Umeå, Gävle, Ursvik, Grindsjön, Visby and Ljungbyhed. The filters are compressed and the contents of different radionuclides are measured by gamma spectroscopy. Precipitation is also collected at four of the stations: Kiruna, Gävle, Ursvik and Ljungbyhed, the samples are ashed and the contents of radionuclides measured. The levels of $^7\text{Be}$ and $^{137}\text{Cs}$ in air and deposition are presented for the different stations. Other anthropogenic radionuclides detected, if any, are also presented.		
<b>Keywords</b> Airborne radionuclides, deposition, $^7\text{Be}$ , $^{137}\text{Cs}$ , $^{82}\text{Br}$		
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<b>Rapportens titel (i översättning)</b> Radionuklider i markluft i Sverige. Kvartalsrapport, andra kvartalet 2003.			
<b>Sammanfattning (högst 200 ord)</b> Stationer för filtrering av markluft finns på sju olika ställen i Sverige: Kiruna, Umeå, Gävle, Ursvik, Grindsjön, Visby och Ljungbyhed. Filtren analyseras veckovis genom gammaspektroskopi med germaniumdetektor. Nederbörd samlas in på fyra av dessa stationer: Kiruna, Gävle, Ursvik och Ljungbyhed. Nederbördsproven askas in och mäts på samma sätt. Halterna i luft och deposition av <sup>7</sup> Be och <sup>137</sup> Cs presenteras för de olika stationerna. I de fall andra antropogena radionuklider detekterats presenteras även dessa.			
<b>Nyckelord</b> Luftburen radioaktivitet, deposition, <sup>7</sup> Be, <sup>137</sup> Cs, <sup>82</sup> Br			
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## Sampling and analysis procedures

Sampling of ground level air is performed at seven different locations in Sweden, as follows:

Kiruna:	67,84° N	20,42° O
Umeå:	63,85° N	20,34° O
Gävle:	60,40° N	17,14° O
Ursvik:	59,39° N	17,96° O
Grindsjön:	59,07° N	17,82° O
Visby:	57,63° N	18,32° O
Ljungbyhed:	56,08° N	13,23° O



At all stations except at Grindsjön, 1000 m<sup>3</sup>/h of air is filtered through a glass fibre filter (Camfil type CS 5.0). At Grindsjön 5500 m<sup>3</sup>/h of air is filtered through 5 filters. At each station the filters are changed twice a week (Monday and Thursday or Friday) and sent by mail to our laboratory for measurement and analysis.

Weekly samples are made from each station by taking 3/4 of each filter (1/4 of the filter is left for the archive) and compress them together into a small disc (diameter 60 mm, thickness 13 mm). These samples are measured, 3-4 days after the collection, on well shielded High Purity Germanium (HPGe) detectors. From the Grindsjön station, the 10 filters produced per week are assembled in a Marinelli like geometry by pressing them into one circular disc, placed on top of the detector, and into five rectangular bricks (77 mm by 48 mm by 13 mm) placed around the detector.

At four of the stations (Kiruna, Umeå, Ursvik and Ljungbyhed) a small part of the air flow (12m<sup>3</sup>/h) that has passed the filter is taken through a charcoal cartridge in order to collect gaseous iodine. The cartridges are changed weekly but only analysed if particulate iodine in greater amount has been detected in the filter.

The stations in Kiruna, Gävle, Ursvik and Ljungbyhed are each equipped with a big stainless steel funnel (1m radius) to collect the precipitation that is passed through a cartridge consisting of a filter part, an anion part and a cation part. The cartridges are changed weekly and sent by mail to our laboratory. Four samples are combined to a monthly sample by ashing. The samples are measured on our HPGe detectors. From these measurements the total deposition is calculated.

Radionuclides seen in the filters are normally only the naturally occurring radon daughters and <sup>7</sup>Be. Most of our stations also detect <sup>137</sup>Cs, which is due to the resuspension of the Chernobyl fallout. In tables I and II the concentrations of <sup>7</sup>Be and <sup>137</sup>Cs are presented. The depositions at the stations where we collect precipitation are presented in table III. Sometimes we also detect other anthropogenic radionuclides and in that case these are presented in Table IV.

Table I

***<sup>7</sup>Be concentrations in Sweden, second quarter 2003***

<i>Week starting</i>	<i>Kiruna</i>	<i>Umeå</i>	<i>Gävle</i>	<i>Ursvik</i>	<i>Grindsjön</i>	<i>Visby</i>	<i>Ljungbyhed</i>
31-mar	1210 (0.2)	1590 (0.2)	1850 (0.3)	1790 (0.3)	1890 (0.1)	1590 (0.3)	1920 (0.2)
7-apr	2250 (0.1)	2240 (0.1)	1810 <sup>(7)</sup> (0.2)	1740 (0.3)	1840 (0.1)	1720 (0.2)	2120 (0.3)
14-apr	3040 <sup>(1)</sup> (0.1)	2620 <sup>(1)</sup> (0.2)	3380 <sup>(8)</sup> (0.2)	3220 <sup>(11)</sup> (0.2)	3190 (0.1)	2890 <sup>(1)</sup> (0.1)	3650 (0.1)
21-apr	1610 <sup>(2)</sup> (0.1)	1980 <sup>(2)</sup> (0.2)	2470 <sup>(2)</sup> (0.4)	2430 <sup>(12)</sup> (0.2)	3010 (0.1)	3230 <sup>(2)</sup> (0.2)	3390 (0.1)
28-apr	2570 (0.2)	2150 <sup>(5)</sup> (0.2)	1380 (0.3)	1250 (0.2)	1490 <sup>(13)</sup> (0.1)	1380 (0.3)	1970 (0.2)
5-may	1650 (0.2)	2330 <sup>(6)</sup> (0.2)	2030 (0.2)	2190 (0.1)	2390 <sup>(14)</sup> (0.1)	2440 (0.2)	2690 (0.1)
12-may	2590 (0.2)	3040 (0.1)	2970 (0.2)	2740 (0.1)	2500 (0.1)	2320 (0.2)	2630 (0.2)
19-may	2480 (0.1)	1280 (0.2)	1910 (0.2)	2400 (0.2)	2260 (0.1)	2360 (0.2)	2030 (0.1)
26-may	1640 (0.2)	1720 (0.2)	2140 (0.3)	2350 (0.2)	2320 (0.1)	2550 (0.2)	2780 (0.1)
2-jun	2120 <sup>(3)</sup> (0.1)	2240 <sup>(3)</sup> (0.1)	2730 <sup>(9)</sup> (0.1)	3250 <sup>(3)</sup> (0.1)	2990 <sup>(3)</sup> (0.1)	2560 <sup>(3)</sup> (0.2)	2690 <sup>(3)</sup> (0.1)
9-jun	1550 <sup>(4)</sup> (0.2)	2270 <sup>(4)</sup> (0.2)	2290 <sup>(10)</sup> (0.3)	2350 <sup>(4)</sup> (0.1)	2550 <sup>(4)</sup> (0.1)	2400 <sup>(4)</sup> (0.2)	1870 <sup>(4)</sup> (0.2)
16-jun	3180 (0.1)	2740 (0.1)	2420 (0.2)	3050 (0.1)	3130 (0.1)	2800 (0.1)	1560 (0.2)
23-jun	3740 (0.1)	4160 (0.1)	3710 (0.1)	4460 (0.1)	4510 (0.1)	4150 (0.1)	3640 (0.1)

Values are given in  $\mu\text{Bq}/\text{m}^3$ .

Error estimates ( $1\sigma$  %) are given in brackets.

<sup>1)</sup> Eight days filter, 14 - 22/4

<sup>2)</sup> Six days filter, 22 - 28/4

<sup>3)</sup> Eight days filter, 2 - 10/6

<sup>4)</sup> Six days filter, 10 - 16/6

<sup>5)</sup> Eight days filter, 28/4 - 6/5

<sup>6)</sup> Six days filter, 6 - 12/5

<sup>7)</sup> Eight days filter, 7 - 15/4

<sup>8)</sup> Seven days filter, 15 - 22/4

<sup>9)</sup> Nine days filter, 2 - 11/6

<sup>10)</sup> Five days filter, 11 - 16/6

<sup>11)</sup> Nine days filter, 14 - 23/4

<sup>12)</sup> Five days filter, 23 - 28/4

<sup>13)</sup> Nine days filter, 28/4 - 7/5

<sup>14)</sup> Five days filter, 7 - 12/5

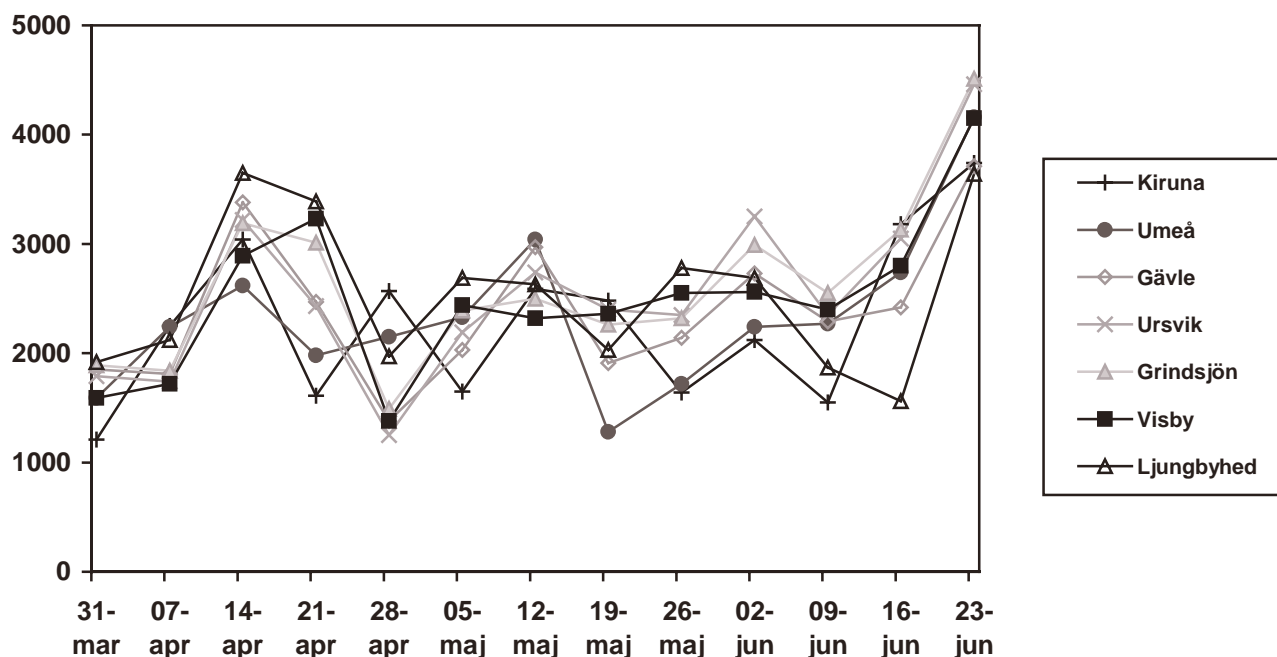


Table II

*<sup>137</sup>Cs concentrations in Sweden, second quarter 2003*

Week starting	Kiruna	Umeå	Gävle	Ursvik	Grindsjön	Visby	Ljungbyhed
31-mar	0.1 (30)	3.9 (2)	4.4 (5)	0.9 (11)	0.6 (5)	1.6 (7)	0.8 (8)
7-apr	0.2 (22)	3.1 (2)	4.7 <sup>(7)</sup> (4)	1.2 (9)	0.8 (3)	1.9 (7)	1.4 (11)
14-apr	0.4 <sup>(1)</sup> (10)	4.8 <sup>(1)</sup> (2)	6.3 <sup>(8)</sup> (3)	1.5 <sup>(11)</sup> (6)	1.0 (3)	1.5 <sup>(1)</sup> (4)	5.4 (2)
21-apr	0.2 <sup>(2)</sup> (20)	2.4 <sup>(2)</sup> (3)	6.2 <sup>(2)</sup> (4)	1.3 <sup>(12)</sup> (9)	0.9 (4)	1.8 <sup>(2)</sup> (5)	4.9 (1)
28-apr	0.2 (23)	2.4 <sup>(5)</sup> (3)	4.7 (4)	0.8 (8)	0.4 <sup>(13)</sup> (6)	0.5 (33)	0.4 (12)
5-may	0.2 (27)	3.4 <sup>(6)</sup> (2)	6.8 (3)	0.3 (12)	0.2 <sup>(14)</sup> (19)	0.5 (16)	0.5 (10)
12-may	0.5 (13)	5.5 (2)	10.0 (2)	0.6 (7)	0.3 (10)	0.4 (20)	0.6 (11)
19-may	0.2 (14)	5.7 (1)	4.9 (4)	0.7 (8)	0.4 (6)	1.3 (8)	0.6 (9)
26-may	0.1 (33)	7.8 (1)	5.7 (3)	0.9 (8)	0.5 (6)	1.2 (9)	0.5 (10)
2-jun	0.3 <sup>(3)</sup> (13)	5.9 <sup>(3)</sup> (1)	7.9 <sup>(9)</sup> (1)	0.8 <sup>(3)</sup> (7)	0.7 <sup>(3)</sup> (4)	1.3 <sup>(3)</sup> (5)	0.4 <sup>(3)</sup> (12)
9-jun	<0.1 <sup>(4)</sup>	3.6 <sup>(4)</sup> (2)	4.2 <sup>(10)</sup> (5)	0.6 <sup>(4)</sup> (9)	0.5 <sup>(4)</sup> (7)	0.5 <sup>(4)</sup> (11)	0.1 <sup>(4)</sup> (70)
16-jun	0.9 (7)	15.9 (1)	6.2 (2)	0.9 (6)	0.7 (4)	0.8 (7)	0.2 (20)
23-jun	0.5 (13)	8.3 (1)	5.2 (2)	1.1 (6)	0.8 (4)	0.9 (7)	0.5 (10)

Values are given in  $\mu\text{Bq}/\text{m}^3$ .

Error estimates ( $1\sigma$  %) are given in brackets.

<sup>1)</sup> Eight days filter, 14 - 22/4

<sup>2)</sup> Six days filter, 22 - 28/4

<sup>3)</sup> Eight days filter, 2 - 10/6

<sup>4)</sup> Six days filter, 10 - 16/6

<sup>5)</sup> Eight days filter, 28/4 - 6/5

<sup>6)</sup> Six days filter, 6 - 12/5

<sup>7)</sup> Eight days filter, 7 - 15/4

<sup>8)</sup> Seven days filter, 15 - 22/4

<sup>9)</sup> Nine days filter, 2 - 11/6

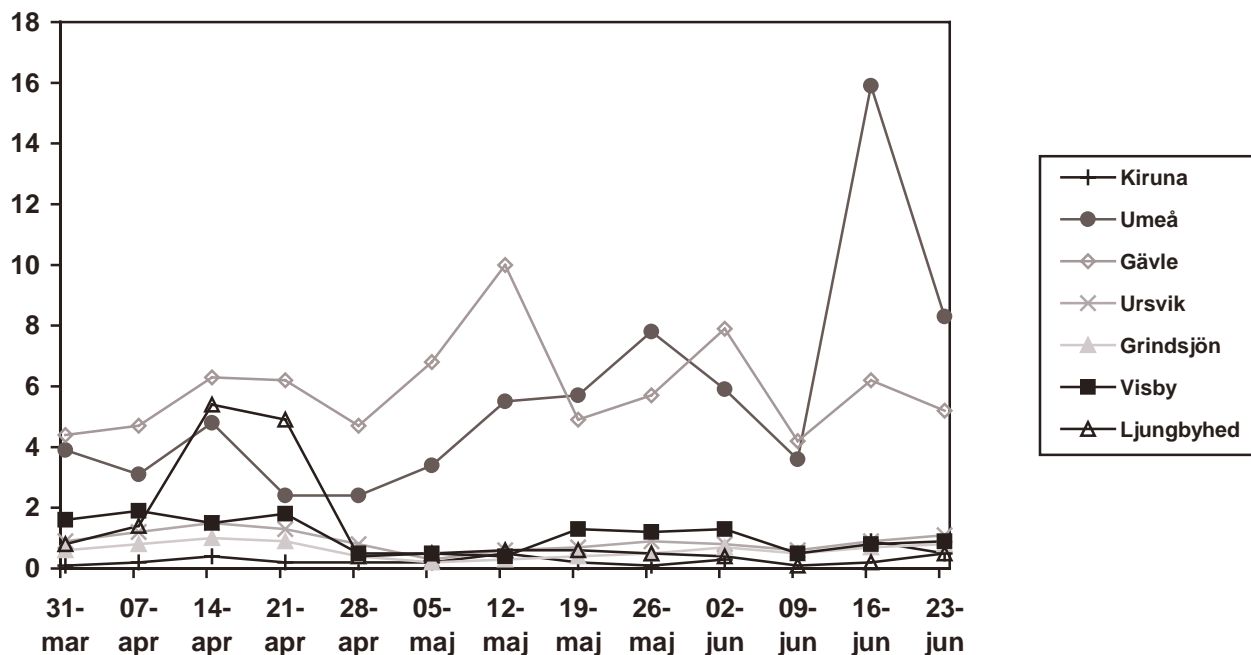
<sup>10)</sup> Five days filter, 11 - 16/6

<sup>11)</sup> Nine days filter, 14 - 23/4

<sup>12)</sup> Five days filter, 23 - 28/4

<sup>13)</sup> Nine days filter, 28/4 - 7/5

<sup>14)</sup> Five days filter, 7 - 12/5



*Table III**Deposition measurements, second quarter 2003**Kiruna*

<i>Weeks</i>	<i>Period</i>	<i><sup>7</sup>Be</i>	<i><sup>137</sup>Cs</i>	<i>Precipitation (mm)</i>
12 - 15	17/3 - 14/4	4600 (0.8)	<5	10.6
16 - 19	14/4 - 12/5	8800 (0.8)	7 (33)	13.4
20 - 23	12/5 - 10/6	22600 (0.4)	9 (25)	36.7

*Gävle*

<i>Weeks</i>	<i>Period</i>	<i><sup>7</sup>Be</i>	<i><sup>137</sup>Cs</i>	<i>Precipitation (mm)</i>
11 - 14	10/3 - 7/4	11400 (0.8)	65 (5)	14.6
15 - 18	7/4 - 5/5	33400 (0.3)	140 (3)	50.6
19 - 22	5/5 - 2/6	50300 (0.3)	240 (2)	38.8
23 - 26	2/6 - 30/6	159000 (0.1)	320 (2)	70.7

*Ursvik*

<i>Weeks</i>	<i>Period</i>	<i><sup>7</sup>Be</i>	<i><sup>137</sup>Cs</i>	<i>Precipitation (mm)</i>
14 - 17	31/3 - 28/4	12500 (0.6)	11 (28)	25.5
18 - 21	28/4 - 26/5	16400 (0.4)	14 (20)	43.7
22 - 25	26/5 - 23/6	105600 (0.2)	45 (6)	55.7

*Ljungbyhed*

<i>Weeks</i>	<i>Period</i>	<i><sup>7</sup>Be</i>	<i><sup>137</sup>Cs</i>	<i>Precipitation (mm)</i>
13 - 16	24/3 - 21/4	10800 (0.6)	15 (14)	17.5
17 - 20	21/4 - 19/5	68400 (0.2)	28 (10)	65.3
21 - 24	19/5 - 16/6	88900 (0.2)	23 (14)	73.5

Values are given in mBq/m<sup>2</sup>.

Error estimates (1σ %) are given in brackets.



*Table IV****Other anthropogenic radionuclides detected,  
second quarter 2003***

<i>Week starting</i>	<i>Station</i>	<i>Isotope</i>	<i>Concentration</i>
23-jun <sup>(1)</sup>	Gävle	<sup>82</sup> Br	16 (13)

Values are given in  $\mu\text{Bq}/\text{m}^3$ .

Error estimates ( $1\sigma$  %) are given in brackets.

- (1) On June 25 the isotope <sup>82</sup>Br ( $T_{1/2}=35\text{h}$ ) was used for gas flow measurements at Korsnäs AB in Gävle. Short tracer pulses of <sup>82</sup>Br in the form of ethyl bromide were injected into a closed system, a total of 5.55 GBq of <sup>82</sup>Br was injected. After each injection the dosing apparatus is pressure stabilized and small amounts of ethyl bromide can be released into the air.