

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the fourth quarter of the year 2004

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January 2005

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Keywords: Seismic network, Earthquakes.

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author and do not necessarily coincide with those of the client.

A pdf version of this document can be downloaded from www.skb.se

Abstract

According to an agreement with Swedish Nuclear Fuel and Waste Management Company (SKB) and Uppsala University, the Department of Earth Sciences has continued to carry out observation and additional construction of new seismic stations within the Swedish National Seismic Network (SNSN). This short report gives some information about the recorded seismicity during October through December 2004.

The Swedish National Seismic Network consists of 45 stations in operation and additional two under construction. During October through December, 1,880 events were located whereof 146 are estimated as real earthquakes, 1,440 are estimated as explosions and 294 events are still considered as uncertain but these are mainly outside the network.

The largest earthquake with magnitude $M_L = 2.3$ occurred on October 6th 19 km south of Storuman and additionally one with magnitude $M_L = 2.3$ in Jämtland, 21 km S-E of Östersund occurred on November 12th. Additionally one earthquake reached magnitude $M_L = 2.0$ during the period and was located 11 km east of Sala.

Sammanfattning

Enligt avtal mellan Svensk Kärnbränslehantering AB (SKB) och Uppsala Universitet, Institutionen för Geovetenskaper, fortsätter Uppsala Universitet att driva och bygga ut seismiska mätstationer i det svenska seismiska nätet (SNSN). Denna rapport ger information om registrerade händelser under tidsperioden oktober till december 2004.

Det seismiska nätet består av 45 stationer som nu är i drift. Ytterligare två stationer är under uppbyggnad, en i Oskarshamn och en i Forsmark. Under perioden oktober till december, 2004 var det 1 880 registrerade händelser varav 146 bedömdes som äkta jordskalv, 1 440 bedömdes vara förorsakade av explosioner eller sprängningar samt 294 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet.

Det största jordskalvet med en magnitud på 2,3 inträffade den 6 oktober 19 km söder om Storuman och ytterligare en med magnitud på 2,3 inträffade i Jämtland, 21 km sydost om Östersund den 12 november. Ytterligare ett skalv nådde magnitud 2,0 under perioden och det lokaliserades 11 km öster om Sala.

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1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the fourth quarter of the year 2004. The work was carried out in accordance with activity plan AP TD F73-01-013. In Table 1-1 controlling document for performing this activity is listed. The activity plan is an SKB internal controlling document.

At present 45 stations are in operation, Figure 1-1. Additional two stations are under construction in Oskarshamn and Forsmark. Additional 10 to 15 stations are planned to be constructed during the summer 2005.

The report includes fundamental information about the seismic events, including origin time and hypocenter location. Information about the source parameters is not included in the present report but is delivered as separate ASCII-text. This report is a preliminary report including only the automatic and the brief interactive analysis done on the routine bases at SNSN.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Drift av seismologiskt nät längs Östersjöns kust	AP TD F73-01-013	

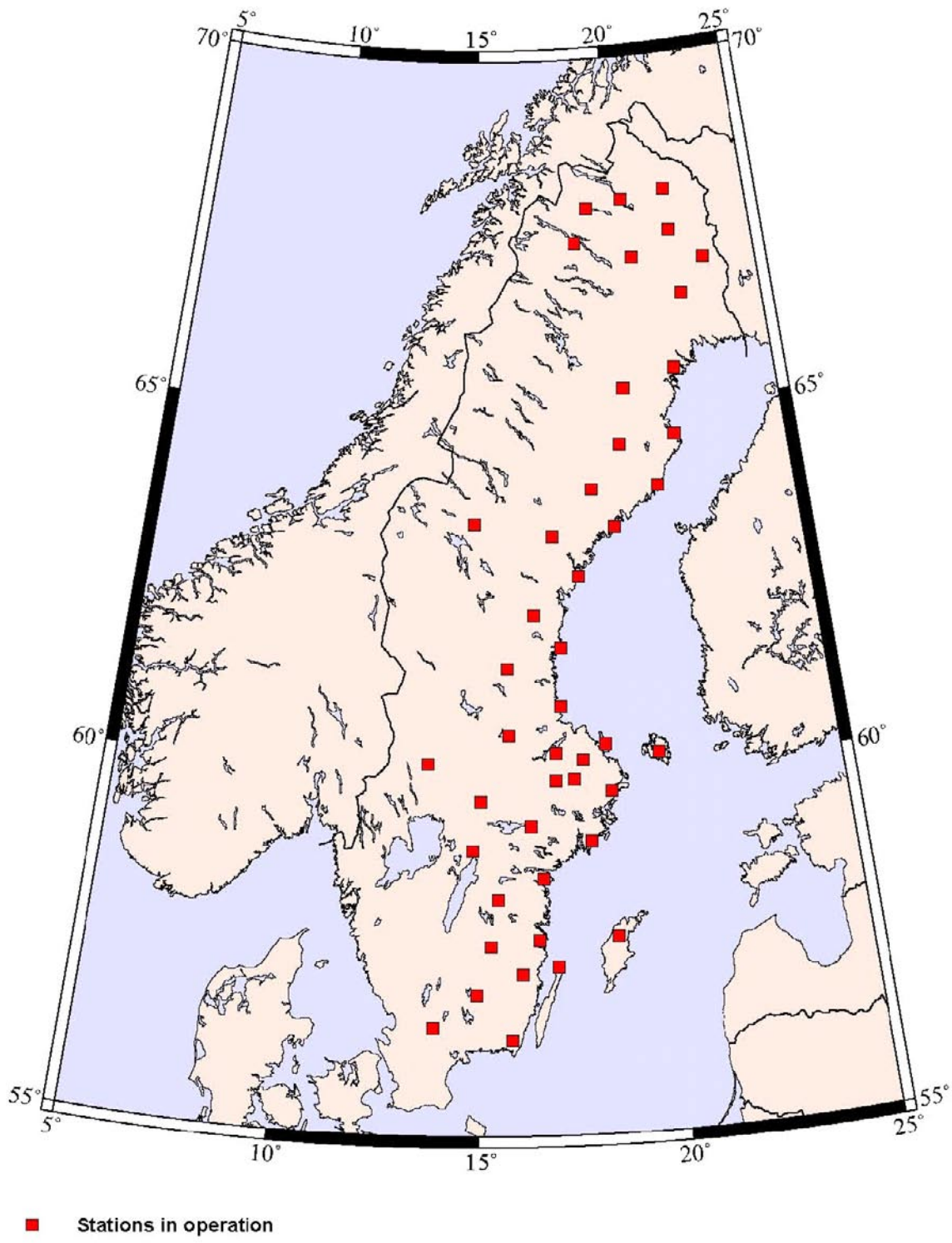


Figure 1-1. The present Swedish National Seismic Network (SNSN).

2 Objective and scope

According to an agreement with Swedish Nuclear Fuel and Waste Management Company (SKB) and Uppsala University, the Department of Earth Sciences continues to carry out observation and additional construction of new seismic stations within the Swedish National Seismic Network (SNSN).

The goal is to complement the existing regional seismic network to establish a local seismic network that also permits registration of small earthquakes in order to obtain relatively long time series and thereby gain a better understanding of the causes of seismic events in the site investigation areas.

Fundamental information about the seismic events, including origin time, hypocenter location and information about the source parameters will be given after every three month period.

The sensitivity of the network allows for complete recordings of all earthquakes down to a magnitude of lower than 0.5 within the network and down to magnitude 0.0 near the proposed nuclear waste deposit sites.

3 Recorded earthquakes during the fourth quarter of 2004

Figure 3-1 shows the recorded events in Sweden during October through December. During this period there were 1,880 events located whereof 146 are estimated as real earthquakes (which are shown in Figure 3-2). 1,440 are estimated as explosions and 294 events are still considered as uncertain but these are mainly outside the network.

The largest earthquake with magnitude $M_L=2.3$ occurred on October 6th 19 km south of Storuman and additionally one with magnitude $M_L=2.3$ in Jämtland, 21 km S-E of Östersund occurred on November 12th. Additionally one earthquake reached magnitude $M_L=2.0$ during the period and was located 11 km east of Sala.

Event lists for October through December 2004 are given in sections 3.1 through 3.3.

3.1 October

Event list for October is given in Table 3-1 with date, time (UTC), latitude, longitude, X (RT90 km), Y (RT90 km), depth and local magnitude (M_L). In October 57 events were located whereof one with magnitude 2.3 located 19 km south of Storuman and additional 5 above 1.0. The depth ranges of the events varies between 4.9 and 27.7 km.

3.2 November

Event list for November is given in Table 3-2 with date, time (UTC), latitude, longitude, X (RT90 km), Y (RT90 km), depth and local magnitude (M_L). In November 47 events were located whereof one with magnitude 2.3 in Jämtland, 21 km S-E of Östersund and additional 9 larger or equal to 1.0. The depth ranges of the events varies between 0.4 and 30.3 km.

3.3 December

Event list for December is given in Table 3-3 with date, time (UTC), latitude, longitude, X (RT90 km), Y (RT90 km), depth and local magnitude (M_L). In December 42 events were located whereof one with magnitude 2.0 located 11 km E of Sala. Additional 5 earthquakes had magnitudes above 1.0. The depth range was between 0.1 and 38.0 km.

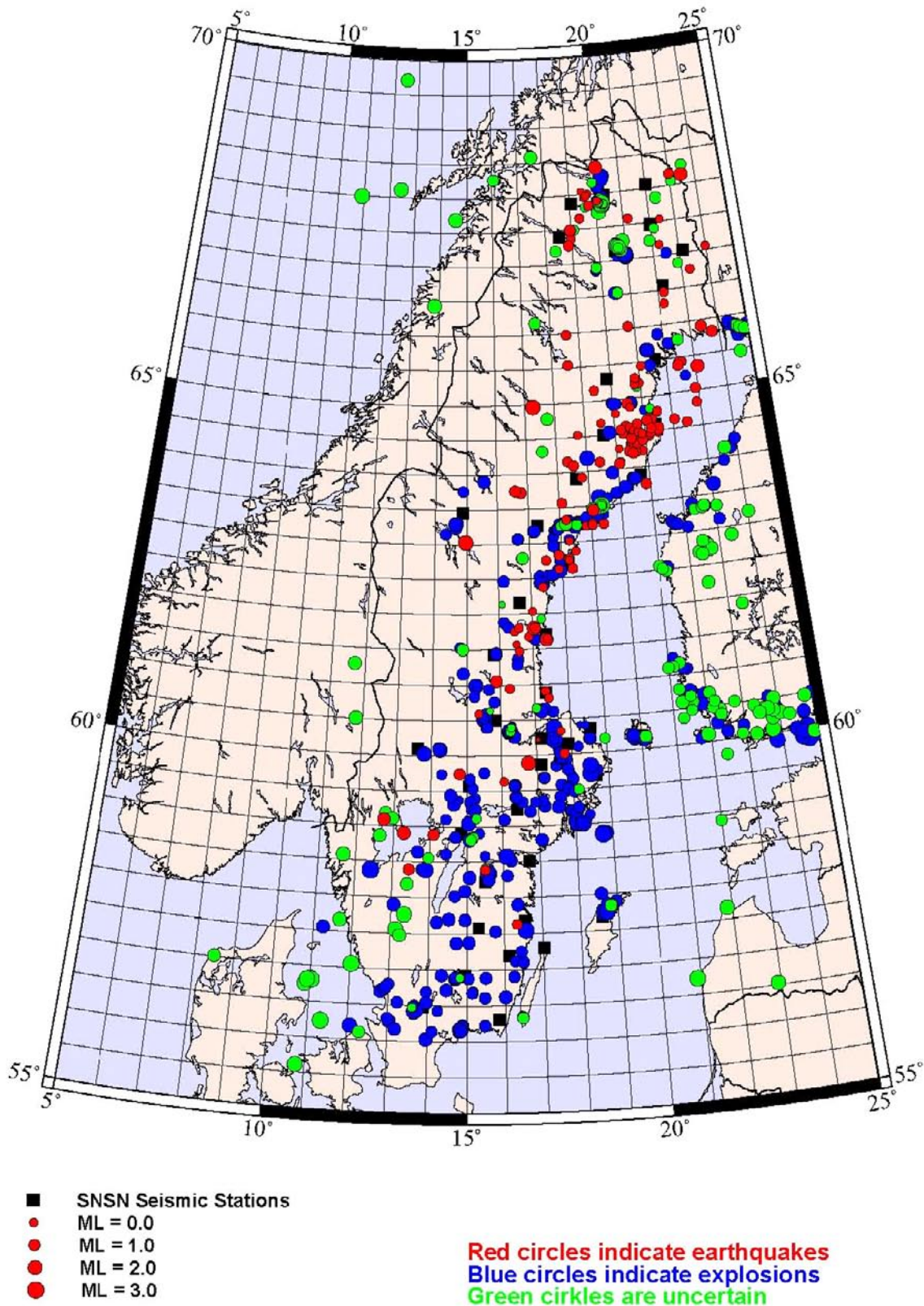


Figure 3-1. Recorded events including explosions in the SNSN network during the period October through December 2004.

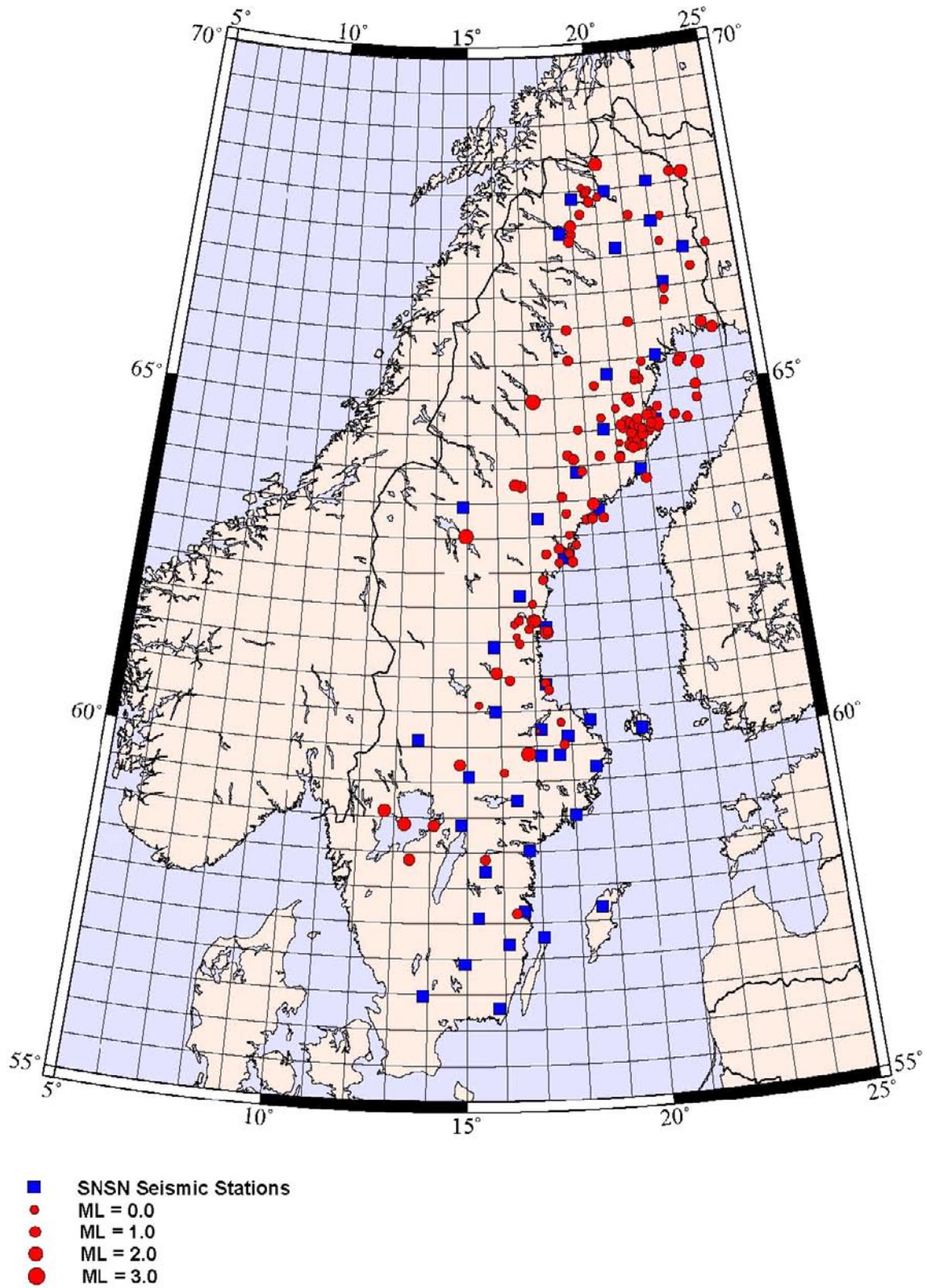


Figure 3-2. Earthquake activity in Sweden during October through December 2004.

Table 3-1. Date, time (UTC), latitude, longitude, X (RT90), Y (RT90), depth and local magnitude (M_L) of recorded earthquakes in October.

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M_L Local Magnitude
20041001	203742.2	58.384	13.435	6,475.9	1,361.2	9.5	1.1
20041001	233408.7	61.560	16.500	6,827.4	1,536.8	19.0	-0.4
20041002	113830.5	67.042	23.951	7,461.4	1,853.7	9.5	0.0
20041002	180452.2	60.943	16.266	6,758.5	1,524.8	19.3	0.4
20041003	141910.3	62.615	17.884	6,946.4	1,606.5	13.3	0.1
20041005	010312.5	64.417	21.104	7,156.3	1,755.0	9.9	0.1
20041005	020236.2	68.032	19.445	7,553.1	1,651.8	9.2	-0.5
20041005	105511.2	64.467	20.863	7,160.9	1,743.0	23.2	0.4
20041006	082639.8	65.800	23.722	7,322.6	1,861.3	15.0	1.1
20041006	204005.5	67.939	19.548	7,543.1	1,656.7	10.6	-0.2
20041006	224246.1	64.951	17.254	7,205.9	1,568.3	8.2	2.3
20041007	080105.4	65.185	20.925	7,240.9	1,739.5	19.2	0.4
20041007	194932.3	68.155	22.978	7,579.7	1,797.2	8.8	0.5
20041008	061454.8	64.518	18.720	7,160.1	1,639.8	24.4	0.1
20041009	035254.8	65.328	23.051	7,266.5	1,836.9	12.9	1.8
20041009	103405.1	64.090	20.080	7,116.1	1,708.2	19.1	-0.0
20041009	233233.1	64.283	20.527	7,139.1	1,728.4	22.5	-0.0
20041010	012805.4	63.428	19.067	7,039.5	1,662.6	8.4	1.2
20041010	014925.8	57.627	16.324	6,389.1	1,530.8	21.2	0.5
20041010	173656.6	60.894	17.308	6,753.9	1,581.4	11.9	0.2
20041011	044640.0	64.917	20.473	7,209.5	1,720.5	10.6	0.9
20041012	130448.7	60.319	17.696	6,690.5	1,604.3	8.5	-0.2
20041013	181142.3	64.352	20.562	7,146.9	1,729.5	15.0	0.1
20041014	172319.8	64.523	21.355	7,169.0	1,766.0	20.4	0.0
20041015	034545.0	65.234	20.800	7,245.9	1,733.2	20.4	0.3
20041015	050752.2	62.860	18.434	6,974.8	1,633.7	11.5	0.1
20041015	070816.2	63.742	20.847	7,080.1	1,748.6	20.7	0.8
20041016	000947.7	63.209	18.811	7,014.5	1,651.0	27.7	0.2
20041016	194908.8	61.461	16.581	6,816.4	1,541.2	19.9	0.1
20041018	002903.2	63.224	19.374	7,017.6	1,679.2	19.9	0.5
20041018	033155.3	64.278	20.072	7,137.0	1,706.4	21.8	-0.3
20041019	054356.5	64.689	21.169	7,186.7	1,755.6	9.3	0.3
20041019	061632.2	63.005	18.246	6,990.6	1,623.5	15.4	-0.1
20041019	191547.3	60.588	15.354	6,718.9	1,475.1	15.6	-0.1
20041021	002149.1	64.224	20.829	7,133.7	1,743.5	20.8	0.4
20041021	060233.8	64.522	20.686	7,166.3	1,734.0	20.3	0.6
20041021	103716.4	67.356	18.952	7,476.6	1,635.1	9.4	0.3
20041022	170925.8	64.487	20.534	7,161.9	1,727.0	19.2	1.3
20041022	192252.6	64.590	20.365	7,172.7	1,718.1	4.9	0.8
20041023	125028.4	64.298	20.632	7,141.2	1,733.3	18.8	0.1
20041024	180154.9	67.518	22.381	7,506.2	1,780.1	14.1	0.1
20041024	233900.4	64.861	20.553	7,203.6	1,724.8	20.2	0.0
20041025	012750.7	64.409	20.836	7,154.3	1,742.2	21.0	0.5
20041025	073916.1	63.552	18.073	7,051.2	1,612.6	21.3	0.5
20041025	084713.4	64.570	20.482	7,170.9	1,723.9	27.2	0.2

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M _L Local Magnitude
20041025	230040.9	65.895	23.365	7,331.0	1,843.8	16.0	1.0
20041025	232322.5	60.793	17.391	6,742.8	1,586.2	19.1	0.3
20041026	033729.4	64.379	20.771	7,150.7	1,739.3	15.2	-0.1
20041026	143002.9	64.457	20.763	7,159.4	1,738.2	19.6	0.4
20041027	014302.4	66.737	23.270	7,424.0	1,828.3	15.3	0.3
20041027	211236.2	64.317	20.519	7,142.9	1,727.7	18.6	0.1
20041028	005224.5	64.664	19.530	7,178.3	1,677.7	23.9	-0.0
20041028	013317.5	61.741	16.446	6,847.5	1,533.7	19.7	-0.1
20041029	134426.0	62.365	17.354	6,917.8	1,580.0	20.1	0.2
20041030	062327.8	66.017	20.756	7,332.9	1,724.3	18.9	0.5
20041031	010631.6	67.254	18.844	7,465.0	1,631.0	8.0	0.8
20041031	052026.5	61.669	16.876	6,839.8	1,556.5	15.1	0.1

Table 3-2. Date, time (UTC), latitude, longitude, X (RT90), Y (RT90), depth and local magnitude (M_L) of recorded earthquakes in November.

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M _L Local Magnitude
20041101	065156.7	62.024	17.005	6,879.5	1,562.7	5.0	-0.1
20041101	091946.1	61.792	16.579	6,853.3	1,540.7	17.5	0.2
20041101	155460.0	61.619	17.398	6,834.8	1,584.3	22.1	1.8
20041102	011030.2	67.478	18.935	7,490.2	1,633.7	5.2	1.0
20041102	101439.2	64.467	21.429	7,163.1	1,770.1	19.1	0.5
20041102	132200.3	64.535	20.718	7,167.9	1,735.4	22.9	0.3
20041102	175521.0	64.785	20.043	7,193.3	1,701.2	18.8	-0.2
20041102	221824.4	64.405	20.688	7,153.3	1,735.1	9.7	0.0
20041103	055001.5	62.742	17.482	6,960.1	1,585.5	13.9	0.4
20041103	224657.6	67.575	21.156	7,507.5	1,727.5	30.3	0.4
20041104	064229.5	61.630	17.427	6,836.0	1,585.8	23.4	0.3
20041104	074527.1	64.351	20.635	7,147.1	1,733.0	13.6	0.3
20041104	110738.9	64.348	20.633	7,146.7	1,732.9	18.7	-0.1
20041105	110813.3	64.326	20.493	7,143.7	1,726.4	17.3	0.2
20041106	185529.6	65.430	21.066	7,268.6	1,743.8	16.8	0.0
20041107	115055.1	64.209	20.612	7,131.2	1,733.1	29.8	0.5
20041108	114823.0	59.079	12.714	6,554.9	1,322.6	18.4	1.6
20041109	020421.6	64.828	22.860	7,210.1	1,834.2	10.0	0.4
20041109	122804.1	62.745	18.218	6,961.5	1,623.1	19.7	0.7
20041110	100154.0	67.987	19.675	7,548.7	1,661.7	17.9	-0.0
20041111	171446.2	64.624	22.041	7,183.3	1,797.8	24.5	0.6
20041112	233205.5	68.122	23.441	7,578.3	1,816.8	15.7	1.7
20041112	233329.3	63.018	14.948	6,990.0	1,456.5	8.8	2.3
20041113	084825.4	61.783	17.029	6,852.7	1,564.4	17.2	1.9
20041113	084929.4	61.785	17.074	6,852.9	1,566.8	17.2	0.9
20041114	134731.5	58.897	13.274	6,533.3	1,353.9	9.5	1.7
20041117	044854.5	64.377	20.695	7,150.2	1,735.7	20.7	0.7
20041118	032952.5	65.438	22.438	7,275.6	1,807.1	16.5	0.2

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M_L Local Magnitude
20041118	062615.7	64.657	21.246	7,183.5	1,759.5	4.3	0.4
20041118	212302.8	65.019	22.871	7,231.3	1,832.4	20.4	0.8
20041118	223956.8	63.719	16.761	7,068.1	1,547.1	12.6	0.7
20041118	230252.2	63.727	16.758	7,069.0	1,546.9	18.8	1.0
20041119	143042.6	64.238	20.431	7,133.8	1,724.1	5.8	1.2
20041119	163815.8	63.239	19.008	7,018.3	1,660.7	16.1	0.5
20041119	170416.0	63.216	19.013	7,015.8	1,661.1	16.6	0.4
20041120	034901.1	64.442	20.489	7,156.7	1,725.2	27.0	-0.1
20041120	115931.0	65.523	18.533	7,271.6	1,626.0	20.2	0.5
20041120	172703.6	65.424	22.529	7,274.5	1,811.5	20.3	0.3
20041121	092446.8	60.002	17.771	6,655.2	1,609.5	17.8	0.4
20041122	215305.3	64.491	20.239	7,161.2	1,712.9	18.5	0.3
20041125	002247.6	65.177	20.775	7,239.5	1,732.5	17.3	0.3
20041125	023944.8	64.378	20.857	7,150.9	1,743.5	27.3	0.9
20041125	180405.5	64.350	20.559	7,146.7	1,729.3	9.0	0.7
20041127	001822.7	67.875	20.045	7,537.2	1,678.0	0.4	-0.1
20041127	005943.9	64.520	20.637	7,165.8	1,731.7	19.4	0.7
20041128	004313.8	58.878	14.082	6,529.7	1,400.4	10.6	1.0
20041128	213634.4	64.395	20.710	7,152.3	1,736.3	19.7	0.9

Table 3-3. Date, time (UTC), latitude, longitude, X (RT90), Y (RT90), depth and local magnitude (M_L) of recorded earthquakes in December.

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M_L Local Magnitude
20041201	045821.8	64.764	21.468	7,196.3	1,769.0	9.1	0.5
20041201	141722.6	64.336	20.679	7,145.6	1,735.3	33.6	0.4
20041202	142221.5	59.736	14.787	6,624.4	1,442.6	9.8	1.1
20041204	184223.8	68.367	20.090	7,592.2	1,676.1	4.3	1.7
20041205	170715.6	64.502	20.780	7,164.4	1,738.7	26.9	0.4
20041207	122151.8	61.049	15.882	6,770.3	1,504.0	18.5	1.2
20041209	023259.8	65.960	18.539	7,320.3	1,624.1	23.2	0.6
20041209	070047.5	67.151	22.235	7,464.8	1,778.1	13.7	0.1
20041209	180546.6	65.262	20.805	7,249.0	1,733.2	10.3	0.2
20041209	192255.6	64.468	21.167	7,162.1	1,757.5	18.7	0.2
20041210	025508.0	64.560	22.446	7,178.2	1,817.8	17.7	0.5
20041211	170411.8	64.545	20.174	7,167.0	1,709.3	19.1	0.5
20041212	033539.5	65.137	19.372	7,230.6	1,667.2	14.4	0.3
20041213	033913.2	64.108	19.399	7,116.0	1,674.9	8.2	0.5
20041213	214132.1	64.065	20.040	7,113.2	1,706.4	3.8	0.7
20041215	121841.4	64.142	18.327	7,117.4	1,622.6	18.9	0.5
20041216	234821.2	64.375	20.877	7,150.7	1,744.4	17.4	0.5
20041219	103113.6	62.726	18.238	6,959.4	1,624.2	5.2	0.3
20041220	002843.6	63.310	18.184	7,024.4	1,619.1	17.5	0.3
20041220	133549.4	65.377	22.374	7,268.5	1,804.9	11.7	0.9
20041221	053121.4	60.207	17.038	6,677.1	1,568.2	2.2	-1.3

DATE	TIME (UTC)	LATITUDE	LONGITUDE	X RT90 km	Y RT90 km	DEPTH km	M_L Local Magnitude
20041222	102215.8	64.517	21.434	7,168.7	1,769.9	21.3	1.6
20041222	104557.3	64.649	21.082	7,181.9	1,751.8	10.2	0.7
20041222	194422.8	64.613	20.744	7,176.6	1,736.0	5.5	0.5
20041223	063252.4	67.816	19.699	7,529.7	1,663.9	0.1	0.6
20041224	221045.5	64.080	18.522	7,110.9	1,632.4	38.0	0.7
20041225	133557.1	67.960	19.616	7,545.6	1,659.4	6.4	-0.2
20041225	142512.8	64.465	20.868	7,160.6	1,743.2	20.7	0.1
20041226	031951.5	63.904	18.772	7,091.8	1,645.5	5.3	0.4
20041226	071509.0	63.749	16.573	7,071.3	1,537.8	6.9	1.0
20041227	013447.0	59.625	16.051	6,611.6	1,513.7	20.1	0.0
20041227	030729.8	62.734	18.207	6,960.3	1,622.6	5.6	-0.1
20041227	150859.1	62.813	17.897	6,968.6	1,606.5	18.6	0.6
20041230	083747.0	59.882	16.748	6,640.6	1,552.6	20.7	2.0
20041230	171531.4	58.387	15.502	6,473.8	1,482.1	15.3	0.5
20041230	203224.8	67.639	19.323	7,509.1	1,649.2	19.7	0.4
20041231	030808.3	66.289	22.149	7,368.7	1,784.2	36.0	0.2
20041231	031443.2	64.196	20.523	7,129.5	1,728.9	19.3	0.7
20041231	080840.2	64.411	20.505	7,153.3	1,726.3	22.8	0.6
20041231	095205.7	64.532	21.195	7,169.4	1,758.3	4.5	0.5
20041231	114101.2	66.455	22.198	7,387.4	1,784.5	19.3	0.4
20041231	162313.2	62.615	18.304	6,947.3	1,628.1	12.5	0.6

4 Recorded earthquakes during the year 2004

Figure 4-1 shows earthquake activity in Sweden during the year 2004. During 2004 there were 7,024 located events, Figure 4-2. Out of these 5,530 are explosions, 526 are true earthquakes and 968 are still uncertain.

The largest seismic event in our neighbourhood within 100 years occurred on September 21st in Kaliningrad only 260 km from Barshageudd in Gotland. The earthquake with a magnitude of $M_L=5.2$ was felt in large areas in southern Sweden. A foreshock with magnitude $M_L=4.7$ occurred before as well as an aftershock with magnitude $M_L=3.0$ occurred after the main earthquake.

On April 7th an earthquake occurred in Norway only 104 km NV of Arvika. This earthquake had a magnitude of $M_L=3.2$. One earthquake of magnitude $M_L=3.0$ was recorded in west Poland, 168 km SSE of Ystad . On April 8th an earthquake with a magnitude of $M_L=2.3$ occurred 8.5 km SE of Kiruna. Another earthquake with a magnitude of $M_L=2.3$ occurred on October 6th 19 km south of Storuman and additionally one with magnitude $M_L=2.3$ in Jämtland, 21 km S-E of Östersund occurred on November 12th. On September 29th an earthquake with a magnitude of $M_L=2.2$ occurred 9.3 km SE of Gällivare and two earthquakes with magnitude of $M_L=2.0$ occurred on April 2nd in Bottenviken and on December 30th 11 km east of Sala.

Of the recorded earthquakes, there were 524 located events whereof 2 with magnitude above or of 3.0, 11 with magnitude above or of 2.0 and additional 84 above or of 1.0. The range of the hypocentral depth varies between 0.1 and 43.2 km.

SNSN recorded earthquakes 2004

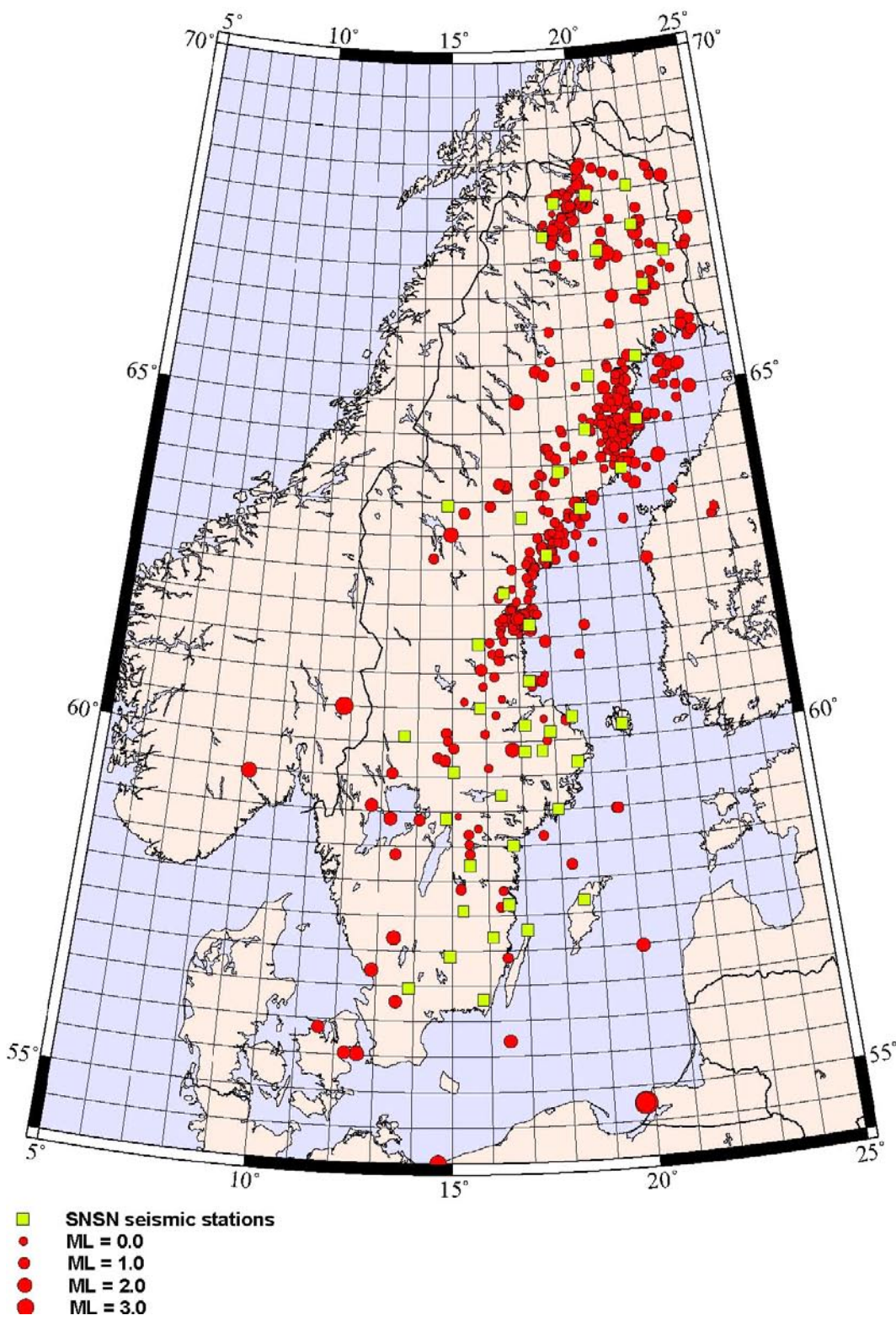


Figure 4-1. Earthquake activity in Sweden during the year 2004.

SNSN recorded events 2004

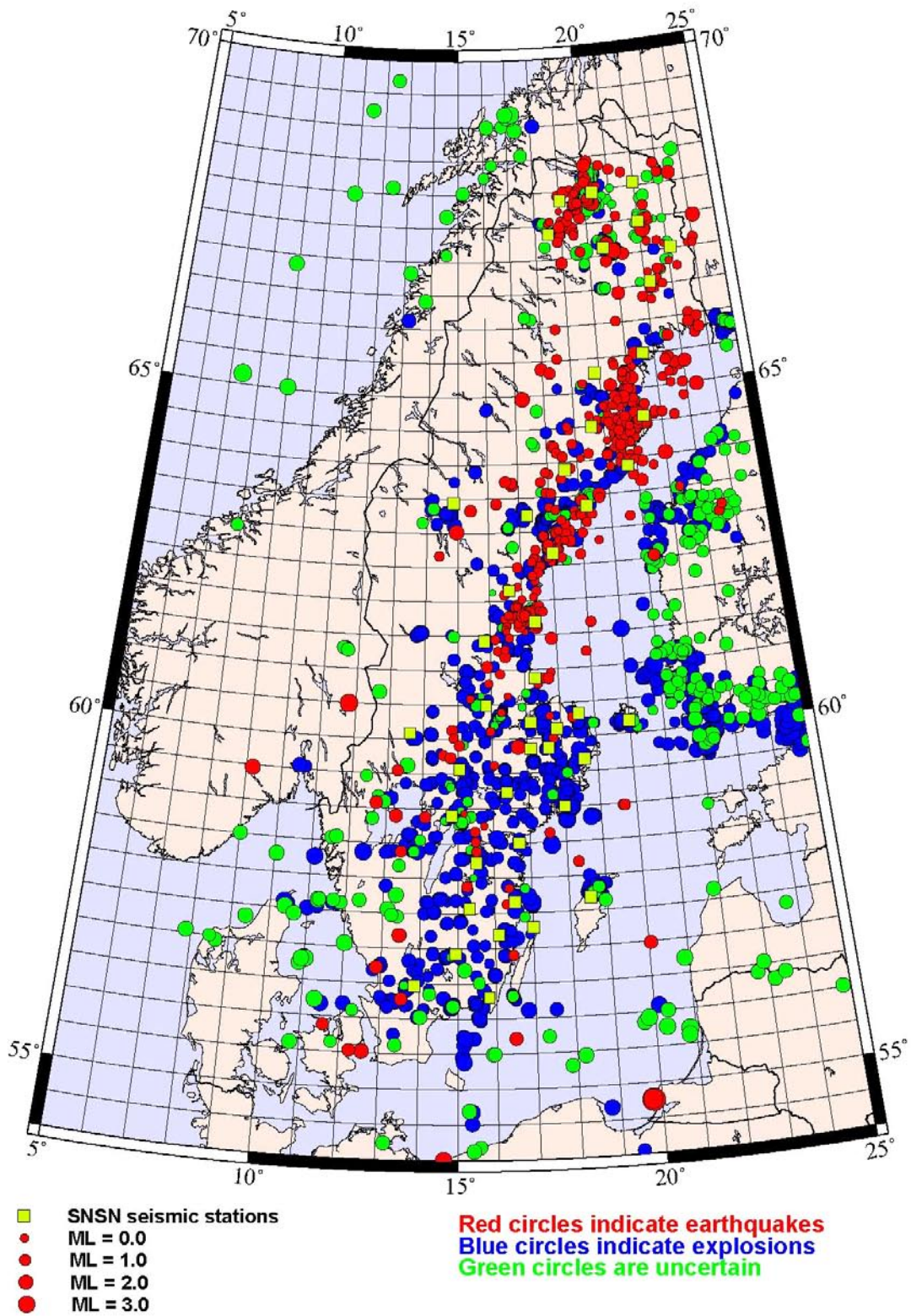


Figure 4-2. Recorded events including explosions in the SNSN network during the year 2004.