

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the second quarter of the year 2009

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July 2009

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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.

Data in SKB's database can be changed for different reasons. Minor changes in SKB's database will not necessarily result in a revised report. Data revisions may also be presented as supplements, available at www.skb.se.

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 observations of seismic events at 61 seismic stations within the Swedish National Seismic Network (SNSN). This short report gives brief information about the recorded seismicity during April through June 2009.

The Swedish National Seismic Network consists of 61 stations. During April through June, 1,328 events were located whereof 107 are estimated as real earthquakes, 882 are estimated as explosions, 156 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 183 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

Five earthquakes had magnitudes $M_L \geq 2.0$. In April one earthquake, with magnitude $M_L=2.8$, was located 13 km NW of Markaryd. One earthquake with magnitude $M_L=2.1$ was located 1 km north of Härnösand. In May two earthquakes with magnitudes $M_L=2.2$ and $M_L=1.9$ were located 63 km east of Umeå. In June an earthquake with magnitude $M_L=2.4$ was located 46 km east of Tranås and one with magnitude $M_L=2.0$ was located 10 km east of Umeå.

Sammanfattning

Enligt avtal mellan Svensk Kärnbränslehantering AB (SKB) och Uppsala Universitet, Institutionen för Geovetenskaper, fortsätter Uppsala Universitet att driva seismiska mätstationer i det Svenska Nationella Seismiska Nätet (SNSN). Denna rapport ger information om registrerade händelser under tidsperioden april till juni 2009.

Det seismiska nätet består av 61 stationer. Under perioden april till juni, 2009 var det 1 328 registrerade händelser varav 107 bedömdes som äkta jordskalv, 882 bedömdes vara förorsakade av explosioner eller sprängningar, 156 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 183 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Fem jordskalv hade magnitud $M_L \geq 2.0$. I april inträffade ett skalv nordväst om Markaryd med magnitud $M_L=2.8$, samt ett skalv med magnitud $M_L=2.1$ 1 km nord om Härnösand. I maj inträffade två skalv med magnitud $M_L=2.2$ och $M_L=1.9$ 63 km ost om Umeå. I juni inträffade ett skalv med magnitud $M_L=2.4$ 46 km ost om Tranås och ett skalv med magnitud $M_L=2.0$ lokaliserades 10 km ost om Umeå.

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1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the second quarter of the year 2009. The work was carried out in accordance with activity plan AP PU 400-06-004. In Table 1-1 controlling document for performing this activity is listed. The activity plan is an SKB internal controlling document.

At present 61 stations are in operation in the network, Figure 1-1.

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 i Sverige	AP PU 400-06-004	1.0

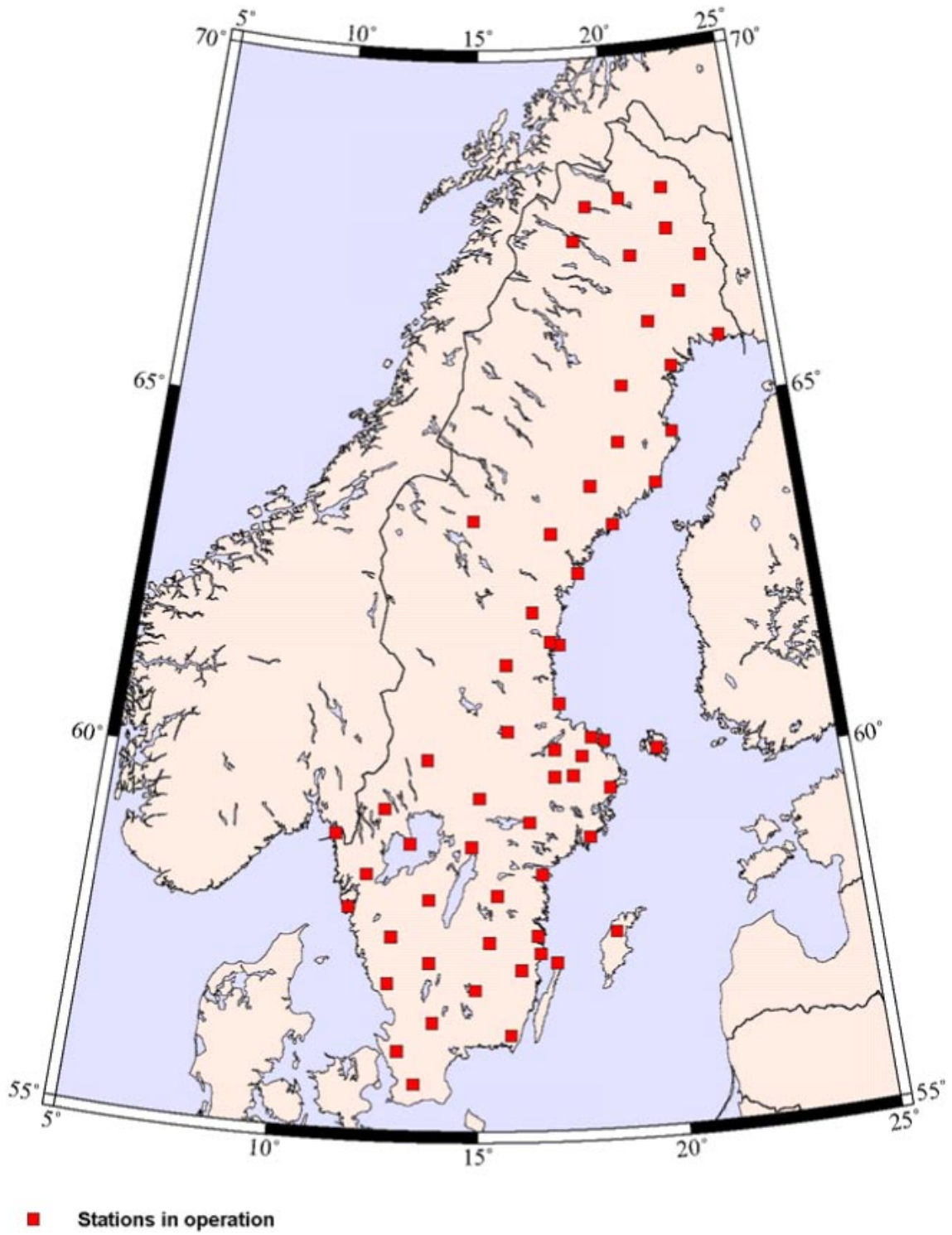


Figure 1-1. The present Swedish National Seismic Network (SNSN).

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 observations of seismic events at 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 recording 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 second quarter of 2009

Figure 3-1 shows the recorded events in Sweden during April through June. During the period 1,328 events were located whereof 107 are estimated as real earthquakes (which are shown in Figure 3-2). 882 are estimated as explosions and 183 are still considered as uncertain but are most probably explosions and are mainly located outside the network. Large amounts of induced seismicity around the mines in Kirunavaara, Malmberget and Aitik are observed and 156 events in the very vicinity of the mines have been excluded in the report.

Event lists for April through June 2009 are given in sections 3.1 through 3.3.

3.1 April

An event list for April is given in Table 3-1 with date, time (UTC), longitude, latitude, X (RT90 km), Y (RT90 km), depth and local magnitude (M_L). In April 53 events were located whereof one had magnitude $M_L=2.8$ located 13 km NW of Markaryd. One earthquake with magnitude $M_L=2.1$ was located 1 km north of Härnösand. Additional 6 earthquakes had magnitudes between $M_L=1.0$ and $M_L=1.5$. The depth range of the events varies between 1.1 and 36.3 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20090401	042745.4	65.470	22.256	7,278.2	1,798.4	13.5	0.4
20090401	182940.8	64.324	20.745	7,144.4	1,738.6	19.7	0.0
20090402	030731.0	62.639	17.993	6,949.3	1,612.0	1.5	2.1
20090403	124729.5	58.549	11.553	6,499.6	1,252.4	22.4	1.0
20090404	075802.9	61.922	17.154	6,868.3	1,570.7	8.0	-0.1
20090404	103729.6	67.765	19.489	7,523.5	1,655.4	14.1	-0.6
20090404	205450.9	64.167	20.651	7,126.7	1,735.3	5.0	-0.3
20090404	225608.8	65.014	20.837	7,221.5	1,736.9	18.6	0.4
20090406	031040.4	67.504	22.270	7,504.1	1,775.6	4.1	0.0
20090406	040526.4	58.321	12.131	6,472.3	1,284.6	16.9	0.3
20090406	142312.3	67.071	23.937	7,464.6	1,852.7	7.2	0.4
20090407	102418.5	56.083	12.147	6,223.2	1,272.1	13.1	0.9
20090408	151243.0	64.401	21.191	7,154.8	1,759.4	21.8	-0.2
20090409	073542.1	64.500	21.179	7,165.8	1,757.8	24.6	-0.3
20090409	111555.4	59.236	17.691	6,569.8	1,607.4	17.6	0.6
20090409	164718.4	64.481	21.923	7,166.8	1,793.7	6.7	-0.2
20090411	184406.1	64.349	20.922	7,147.9	1,746.9	23.7	-0.5
20090411	190304.0	66.178	21.889	7,355.3	1,773.8	17.0	0.3
20090411	234837.2	64.860	20.587	7,203.5	1,726.4	3.2	0.3
20090412	122021.4	64.856	20.754	7,203.7	1,734.3	18.4	0.8
20090413	150752.8	64.660	20.500	7,181.0	1,724.0	19.2	-0.2
20090413	172959.1	64.265	20.599	7,137.4	1,732.0	13.8	-0.2
20090414	001759.4	66.694	22.784	7,416.6	1,807.6	33.7	0.0
20090414	170031.9	64.392	20.912	7,152.7	1,746.0	20.9	-0.3
20090416	032938.4	64.303	20.510	7,141.3	1,727.4	3.0	0.2
20090416	095907.4	56.512	13.415	6,267.5	1,352.7	10.7	2.8
20090417	101145.9	66.182	21.883	7,355.6	1,773.5	17.0	0.7
20090417	104513.3	61.894	17.308	6,865.3	1,578.8	16.7	0.2
20090418	000841.4	64.463	20.705	7,159.8	1,735.4	19.0	-0.4
20090418	015438.6	65.202	23.045	7,252.6	1,838.2	4.9	0.3
20090418	025055.8	63.721	20.850	7,077.8	1,748.9	1.1	-0.7
20090418	044943.1	64.502	21.167	7,165.9	1,757.2	16.4	1.2
20090418	182001.1	62.263	15.549	6,905.6	1,486.5	9.8	1.2
20090419	020611.6	60.352	16.265	6,692.7	1,525.2	16.7	-0.3
20090420	200206.5	67.529	22.325	7,507.2	1,777.6	18.3	0.1
20090422	075703.2	65.321	20.729	7,255.3	1,729.1	24.0	0.3
20090423	044636.1	64.978	21.132	7,218.8	1,751.1	18.4	0.3
20090424	055508.2	65.002	21.032	7,221.0	1,746.2	6.0	1.3
20090424	065043.3	64.404	20.733	7,153.3	1,737.3	17.7	-0.2
20090424	135828.6	59.378	12.778	6,588.1	1,327.8	10.2	-0.5
20090424	183710.6	60.156	10.777	6,681.4	1,220.8	23.2	1.5
20090425	064020.3	63.957	19.551	7,099.7	1,683.3	35.8	0.8
20090425	082604.4	63.979	19.488	7,102.0	1,680.1	31.1	-0.2
20090425	213815.8	64.227	20.231	7,131.9	1,714.5	6.8	-0.6
20090426	190652.2	63.215	19.011	7,015.7	1,661.0	4.0	0.4
20090427	162853.7	64.372	20.724	7,149.7	1,737.1	19.8	-0.1
20090428	001205.9	64.241	20.619	7,134.8	1,733.2	3.0	-0.1
20090428	011622.0	67.809	22.199	7,537.6	1,769.1	18.1	0.1
20090428	090144.3	67.816	22.474	7,539.7	1,780.5	18.4	-0.6
20090428	110406.1	64.676	21.271	7,185.7	1,760.5	6.9	-0.7
20090428	113002.8	63.648	21.206	7,071.2	1,767.1	11.7	1.0
20090430	172749.1	64.106	20.448	7,119.1	1,726.0	20.7	-0.4
20090430	234324.0	65.921	23.011	7,332.1	1,827.4	36.3	-0.1

3.2 May

An event list for May is given in Table 3-2 with date, time (UTC), latitude, longitude, X (RT90km), Y (RT90 km), depth and local magnitude (M_L). In May 34 events were located whereof two earthquakes were located 33 km east of Holmön or 63 km east of Umeå with magnitudes $M_L=2.5$ and $M_L=1.9$. Additional seven events had magnitudes equal or above $M_L=1.0$. The depth range of the events varies between 0.1 and 30.7 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20090501	051211.0	63.793	21.018	7,086.5	1,756.6	5.1	1.5
20090501	072343.0	64.582	22.400	7,180.4	1,815.3	5.2	0.8
20090503	011917.6	64.442	20.837	7,158.0	1,742.0	19.0	-0.4
20090504	074230.1	62.800	18.053	6,967.4	1,614.5	20.5	0.7
20090504	113839.6	67.591	19.216	7,503.4	1,644.9	4.1	-0.1
20090504	224544.2	67.411	23.592	7,500.3	1,833.0	2.4	0.8
20090505	004356.7	55.631	13.642	6,169.0	1,363.6	7.2	0.3
20090505	053335.1	60.822	17.231	6,745.8	1,577.4	22.4	0.7
20090505	194447.0	68.163	20.037	7,569.3	1,675.5	3.4	-0.2
20090505	215529.0	63.681	21.480	7,076.0	1,780.4	15.5	2.5
20090506	140302.8	61.689	16.441	6,841.7	1,533.5	6.8	1.2
20090507	000140.6	63.311	19.144	7,026.6	1,667.2	0.4	0.6
20090509	005242.0	64.573	20.666	7,171.9	1,732.6	20.5	1.3
20090509	152848.1	63.691	21.416	7,076.8	1,777.1	8.8	1.9
20090511	040351.4	68.053	20.042	7,557.0	1,676.5	18.9	0.5
20090511	140936.2	58.023	13.246	6,436.1	1,348.6	11.9	1.1
20090511	165152.9	58.022	13.245	6,436.0	1,348.5	16.4	0.7
20090514	021956.1	60.318	16.229	6,688.9	1,523.2	3.0	-0.2
20090515	153146.4	59.400	14.333	6,587.5	1,416.2	19.5	-0.1
20090517	085144.0	60.105	16.022	6,665.1	1,511.9	9.6	0.5
20090519	061855.4	62.000	16.936	6,876.7	1,559.1	29.8	0.2
20090521	021325.1	61.676	17.188	6,840.8	1,573.0	21.0	-0.2
20090522	024719.9	62.734	18.005	6,960.0	1,612.3	9.4	1.3
20090522	123017.5	64.506	20.854	7,165.1	1,742.2	19.3	-0.1
20090522	130524.3	64.265	20.892	7,138.5	1,746.2	3.4	-0.3
20090522	153644.5	61.888	16.950	6,864.3	1,560.0	0.1	-0.6
20090522	185753.7	62.711	17.673	6,956.8	1,595.4	6.0	0.6
20090523	175328.4	63.070	14.993	6,995.7	1,458.8	2.2	1.2
20090523	200521.2	64.420	20.988	7,156.1	1,749.4	21.8	-0.7
20090524	021958.0	64.450	21.030	7,159.6	1,751.1	7.0	0.5
20090524	144622.9	64.322	18.454	7,137.7	1,627.9	30.7	-0.1
20090525	053709.3	57.124	12.358	6,338.3	1,291.1	14.4	0.4
20090527	232550.8	57.445	12.992	6,372.3	1,330.9	9.4	1.7
20090530	214001.6	68.182	20.387	7,572.4	1,689.8	10.1	0.2

3.3 June

An event list for June 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 June 20 events were located whereof one had magnitude $M_L=2.4$ located 8 km east of Kisa or 46 km east of Tranås. One earthquake with magnitude $M_L=2.0$ was located 10 km east of Umeå. Additional four earthquakes had magnitudes equal to or above $M_L=1.0$. The depth range of the events varies between 1.8 and 49.3 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20090603	124427.7	58.455	11.402	6489.7	1242.9	1.8	0.6
20090603	184025.5	57.997	15.779	6430.3	1498.3	14.5	2.4
20090604	084808.2	57.975	15.839	6427.8	1501.8	9.2	0.7
20090605	232119.2	66.238	22.105	7362.8	1782.8	3.4	0.0
20090607	070605.5	62.300	17.794	6911.2	1603.0	2.6	0.0
20090607	134901.6	57.300	13.344	6355.4	1351.5	5.0	0.1
20090607	223121.8	59.238	12.252	6573.9	1297.1	12.1	0.4
20090608	035402.5	57.431	10.503	6379.7	1181.5	16.0	1.4
20090610	144725.1	63.817	20.452	7087.0	1728.5	24.6	2.0
20090612	162243.7	66.727	21.616	7415.0	1755.8	6.3	-0.4
20090616	195520.4	64.475	20.900	7161.9	1744.7	3.0	0.9
20090618	212220.4	65.153	20.987	7237.6	1742.7	3.7	0.1
20090621	212933.1	62.167	17.804	6896.4	1604.0	9.5	1.2
20090623	150303.3	57.356	13.085	6362.1	1336.2	5.3	0.2
20090626	011510.7	64.340	20.507	7145.4	1726.9	19.5	-0.1
20090626	091855.6	63.251	15.950	7015.6	1507.1	28.8	0.2
20090626	185030.7	67.131	23.345	7468.0	1826.3	49.3	-0.1
20090627	095620.8	67.759	19.594	7523.1	1659.9	6.3	1.0
20090627	130144.1	64.584	20.969	7174.3	1747.0	24.9	0.0
20090629	054114.1	60.181	13.715	6675.3	1383.9	2.0	1.7

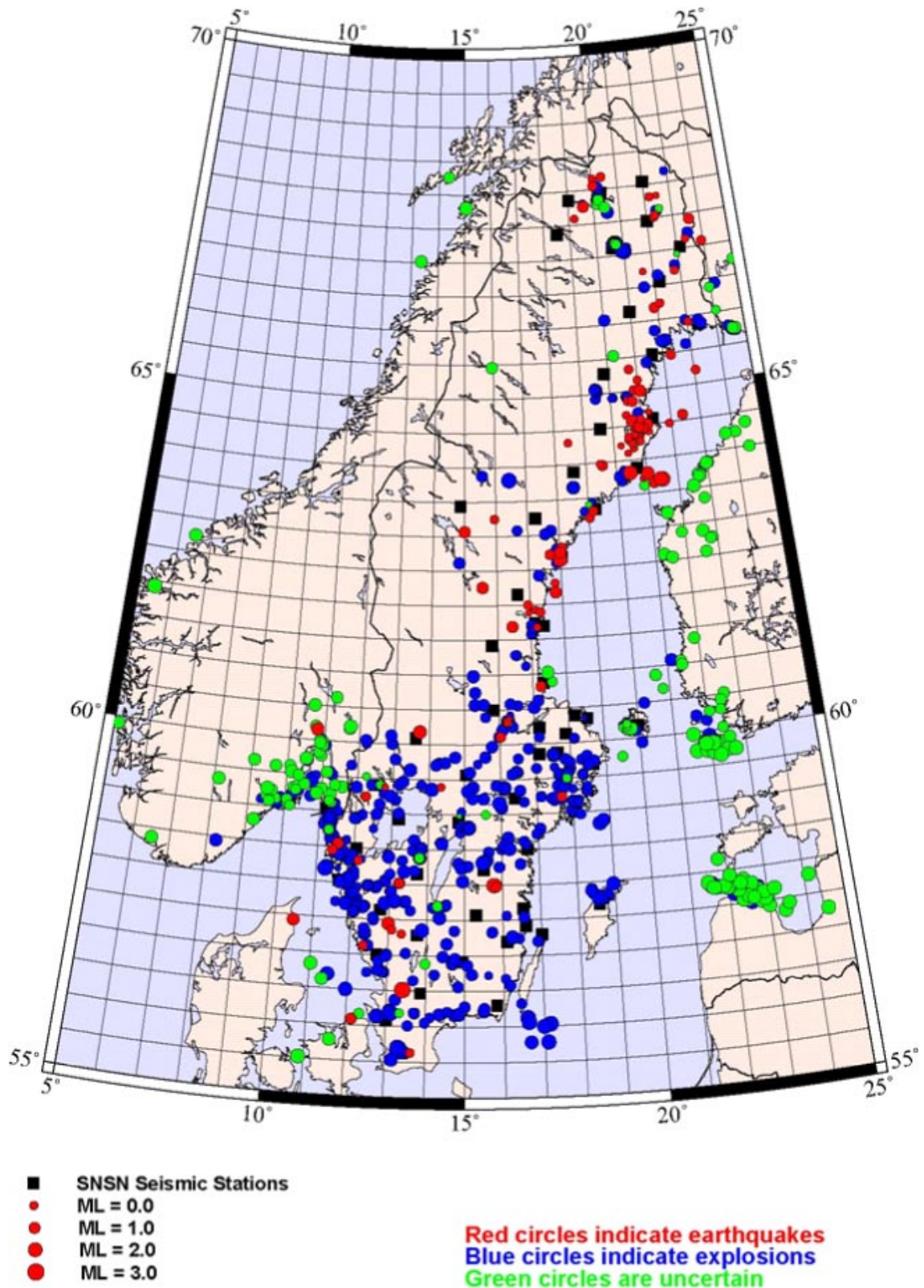


Figure 3-1. Recorded events including explosions in the SNSN network during the period April through June 2009.

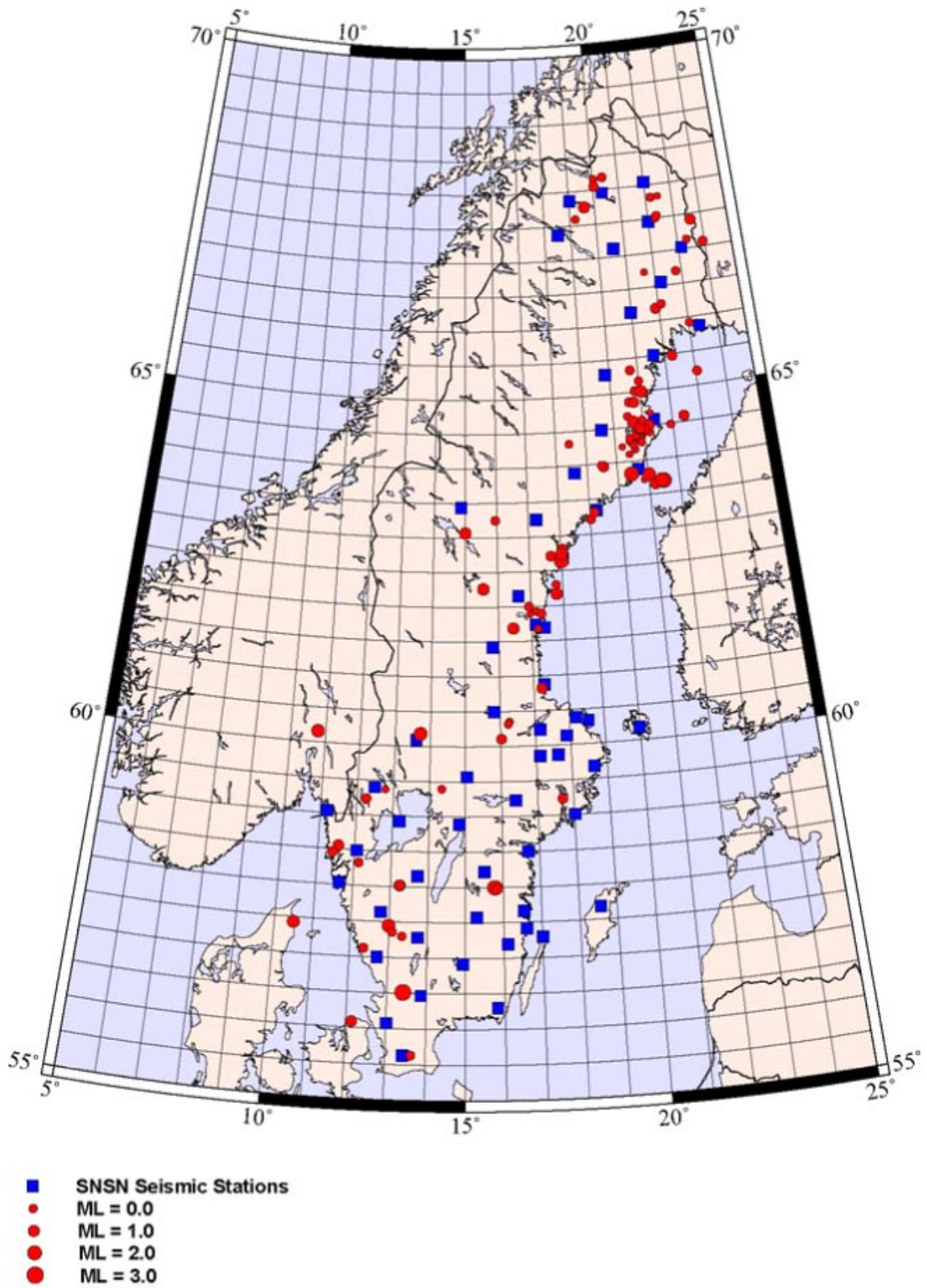


Figure 3-2. Earthquake activity in Sweden during April through June 2009.