

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the first quarter of the year 2006

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April 2006

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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.

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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 January through March 2006.

The Swedish National Seismic Network consists of 48 stations in operation and additional eleven are under construction. During January through March, 1,933 events were located whereof 130 are estimated as real earthquakes, 1,151 are estimated as explosions and 652 events are still considered as uncertain but these are most likely explosions and mainly located outside the network.

Large amount of induced seismicity with magnitudes between $M_L = 2.0$ and $M_L = 2.8$ were located close to the mines in Kirunavaara, Malmberget and Aitik. One earthquake with magnitude $M_L = 2.4$ was located 9 km east of Umeå.

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 januari till mars 2006.

Det seismiska nätet består av 48 stationer som nu är i drift. Ytterligare 11 stationer är under uppbyggnad. Under perioden januari till mars, 2006 var det 1 933 registrerade händelser varav 130 bedömdes som äkta jordskalv. 1 151 bedömdes vara förorsakade av explosioner eller sprängningar samt 652 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Flera inducerade skalv med magnituder mellan $M_L = 2,0$ och $M_L = 2,8$ lokaliserades nära gruvorna i Kirunavaara, Malmberget och Aitik. Ett skalv med magnitud $M_L = 2,4$ lokaliserades 9 km öster om Umeå.

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1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the first quarter of the year 2006. 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 48 stations are in operation, Figure 1-1. Additional eleven stations are under construction. 9 are located in SW part of Sweden and two in the North. Deliverance of instrumentation is however delayed, now by 7 months.

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	

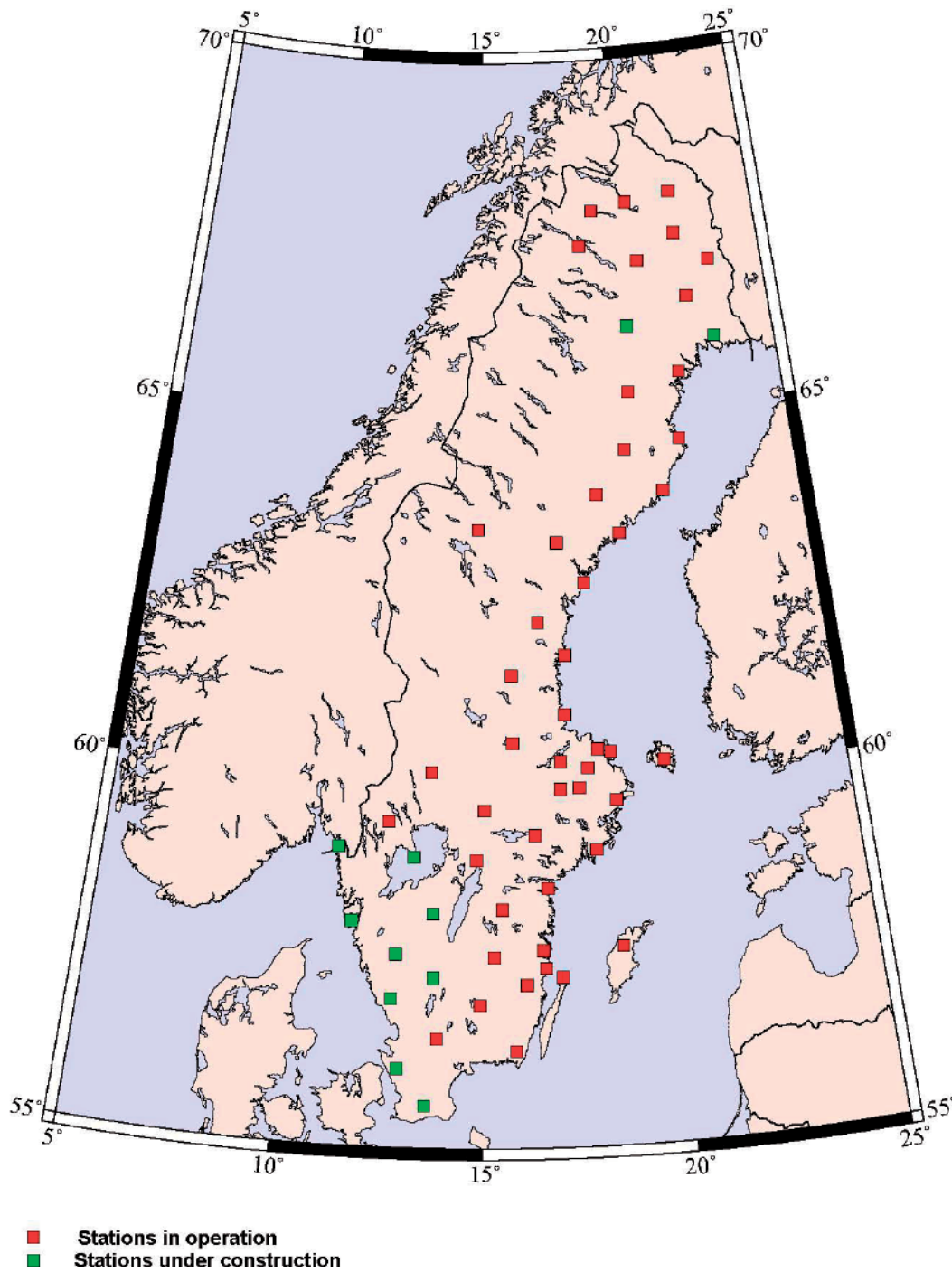


Figure 1-1. The present Swedish National Seismic Network (SNSN).

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 observations 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 are 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 first quarter of 2006

Figure 3-1 shows the recorded events in Sweden during January through March. During the period 1,933 events were located whereof 130 are estimated as real earthquakes (which are shown in Figure 3-2). 1,151 are estimated as explosions and 652 are still considered as uncertain but are most probably explosions and are mainly located outside the network.

Large amount of induced seismicity with magnitudes between $M_L = 2.0$ and $M_L = 2.8$ were located close to the mines in Kirunavaara, Malmberget and Aitik. Additional 258 events in the very vicinity of the mines have been excluded from the lists. One earthquake with magnitude $M_L = 2.4$ was located 9 km east of Umeå.

Event lists for January through March 2006 are given in Sections 3.1 through 3.3.

3.1 January

Event list for January is given in Table 3-1 with date, time longitude, latitude, X (RT90 km), Y (RT90 km), depth and local magnitude (M_L). In January 45 events were located whereof seven had magnitudes between $M_L = 2.0$ and $M_L = 2.8$. These were all induced events located close to the mines in Kirunavaara, Malmberget and Aitik. 14 earthquakes had magnitudes of or above 1.0. The depth range of the events varies between 0.0 and 27.4 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20060102	000153.7	67.236	19.882	7,465.7	1,675.8	2.8	0.4
20060102	191443.4	67.178	20.654	7,461.6	1,709.6	0.3	2.3
20060102	224835.0	64.011	20.688	7,109.5	1,738.5	0.1	0.3
20060103	001235.5	67.456	18.978	7,487.8	1,635.6	5.2	-0.0
20060103	104738.9	66.917	23.551	7,445.3	1,838.1	12.9	-0.1
20060103	134700.9	57.458	17.185	6,371.1	1,582.6	5.1	0.6
20060103	134945.0	59.587	12.906	6,611.0	1,336.1	27.4	0.8
20060103	185922.0	67.075	20.961	7,451.2	1,723.8	0.0	2.0
20060104	002454.4	67.824	20.199	7,532.0	1,684.9	0.1	1.2
20060104	002715.0	67.826	20.198	7,532.2	1,684.8	0.3	1.7
20060104	052123.7	64.350	20.705	7,147.2	1,736.4	9.5	0.2
20060104	125449.8	67.187	20.665	7,462.6	1,710.0	5.6	1.1
20060104	140109.7	60.372	17.476	6,695.9	1,592.0	1.1	1.5
20060105	095628.6	64.446	20.810	7,158.3	1,740.6	17.8	0.9
20060107	060830.4	64.340	20.746	7,146.2	1,738.4	16.4	-0.0
20060108	030226.9	60.337	16.250	6,691.0	1,524.4	3.2	0.5
20060109	001711.4	67.818	20.202	7,531.4	1,685.0	0.1	2.4

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M _L Local Magnitude
20060109	001955.4	67.827	20.189	7,532.4	1,684.4	0.1	1.8
20060109	002115.0	67.838	20.190	7,533.5	1,684.4	0.1	2.6
20060109	040601.3	61.794	17.038	6,853.9	1,564.9	1.3	0.1
20060109	230827.9	67.175	20.652	7,461.3	1,709.6	4.6	1.7
20060111	145201.3	57.111	16.897	6,332.2	1,565.9	0.1	0.8
20060112	144942.4	67.190	20.636	7,462.8	1,708.7	7.4	2.8
20060115	004844.7	61.579	16.740	6,829.6	1,549.5	17.7	0.2
20060115	033325.3	67.718	20.240	7,520.4	1,687.5	0.1	0.7
20060117	154953.9	66.863	22.790	7,435.4	1,805.7	9.9	-0.1
20060119	065245.8	64.602	20.570	7,174.8	1,727.8	2.6	0.8
20060119	180344.5	64.086	20.619	7,117.6	1,734.5	5.3	-0.2
20060124	124204.9	67.901	20.008	7,540.1	1,676.3	0.1	-0.3
20060127	002116.6	67.827	20.199	7,532.3	1,684.9	0.1	1.5
20060127	004438.4	67.820	20.197	7,531.6	1,684.8	0.1	1.0
20060127	012429.4	67.843	20.202	7,534.1	1,684.8	8.8	2.4
20060127	041044.8	67.166	20.643	7,460.2	1,709.3	7.3	0.5
20060127	063400.4	67.195	20.540	7,463.1	1,704.6	4.4	0.8
20060127	111126.5	67.840	20.201	7,533.8	1,684.8	4.0	1.1
20060127	170829.8	67.185	20.691	7,462.5	1,711.2	3.9	1.7
20060127	201801.4	67.854	20.100	7,535.0	1,680.5	1.5	-0.2
20060127	232036.3	67.833	20.204	7,533.1	1,685.0	2.7	0.6
20060127	234330.3	67.190	20.674	7,463.0	1,710.4	2.9	1.8
20060129	002412.2	67.845	20.205	7,534.4	1,684.9	0.5	2.4
20060129	002654.3	67.862	20.184	7,536.2	1,683.9	0.1	1.1
20060129	030632.4	60.324	16.239	6,689.5	1,523.8	3.0	0.0
20060129	074252.5	63.917	19.984	7,096.5	1,704.8	16.9	0.2
20060129	123903.7	61.882	16.920	6,863.5	1,558.4	12.1	1.0
20060129	225921.8	67.170	20.656	7,460.7	1,709.8	7.9	1.2

3.2 February

Event list for February 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 February 34 events were located whereof one with magnitude of 2.4 located 9 km east of Umeå. Four earthquakes with magnitudes between $M_L = 2.0$ and $M_L = 2.4$ were located close to the mines in Lappland. One earthquake with magnitude 2.0 was located in Norway. 10 events had magnitudes above of or above 1.0. The depth range of the events varies between 0.1 and 29.2 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20060205	114232.0	64.379	20.509	7,149.8	1,726.7	5.7	0.6
20060207	011738.9	64.496	20.975	7,164.4	1,748.1	1.8	1.6
20060207	031630.9	64.683	21.461	7,187.3	1,769.5	3.8	0.1
20060211	051459.5	68.016	22.875	7,563.8	1,794.8	8.6	0.4
20060211	153712.4	64.490	21.228	7,164.8	1,760.3	19.9	0.3
20060217	103939.0	64.496	21.443	7,166.4	1,770.5	17.3	0.9
20060222	200720.5	67.857	19.619	7,534.1	1,660.2	0.2	-0.2
20060224	130027.2	67.987	22.233	7,557.6	1,768.4	29.2	1.0
20060224	231431.4	67.068	13.978	7,442.3	1,420.4	0.1	2.0
20060225	075730.1	66.378	22.208	7,378.8	1,785.8	5.5	1.4
20060225	162354.6	67.322	18.977	7,473.0	1,636.3	0.1	0.6
20060225	232215.6	67.830	20.188	7,532.6	1,684.3	19.0	0.6
20060226	023740.0	67.787	20.282	7,528.2	1,688.7	0.1	0.4
20060226	043407.5	59.991	15.160	6,652.5	1,463.8	19.3	0.8
20060226	150839.7	60.314	16.220	6,688.4	1,522.7	3.0	0.3
20060226	211131.8	66.423	22.486	7,385.1	1,797.7	15.2	0.1
20060227	014204.6	67.816	20.202	7,531.1	1,685.1	4.5	1.0
20060227	042656.8	67.106	20.570	7,453.3	1,706.6	7.0	1.1
20060227	050148.0	67.186	20.669	7,462.6	1,710.2	5.6	2.3
20060227	053250.0	67.187	20.667	7,462.6	1,710.1	3.3	1.8
20060227	063731.0	67.177	20.664	7,461.5	1,710.1	7.6	1.7
20060227	065617.2	67.156	20.633	7,459.1	1,708.9	7.6	0.7
20060227	074045.0	67.162	20.633	7,459.7	1,708.9	7.5	0.9
20060227	084238.4	63.808	20.455	7,086.0	1,728.7	1.4	2.4
20060227	131157.8	67.188	20.698	7,462.8	1,711.4	5.5	2.5
20060227	135920.9	67.154	20.613	7,458.8	1,708.0	8.0	0.4
20060227	145919.1	67.817	20.213	7,531.3	1,685.5	1.5	2.4
20060227	205657.6	67.181	20.651	7,461.9	1,709.5	9.4	2.0
20060227	225343.6	67.835	20.197	7,533.2	1,684.7	13.3	1.7
20060227	232609.9	67.204	20.658	7,464.5	1,709.6	3.1	1.6
20060227	233246.5	67.158	20.694	7,459.5	1,711.5	5.4	0.9
20060227	233611.3	67.160	20.691	7,459.8	1,711.4	0.1	0.6
20060227	235432.4	67.178	20.652	7,461.6	1,709.5	2.8	1.4
20060228	060954.5	67.853	20.203	7,535.2	1,684.8	0.1	0.3

3.3 March

Event list for March 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 March 51 events were located whereof two with magnitude 1.9, one located 27 km SE of Nikkaluokta and the other 7 km NW of Stora Sjöfallet. 12 earthquakes had magnitudes of or above 1.0. The depth range of the events varies between 0.0 and 35.8 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20060301	011523.1	64.457	20.871	7,159.7	1,743.5	21.9	1.4
20060301	021359.4	67.932	22.603	7,553.2	1,784.5	0.0	0.5
20060301	063931.4	67.790	19.570	7,526.5	1,658.6	3.0	0.3
20060301	065446.4	67.714	19.523	7,517.9	1,657.2	0.1	1.9
20060303	212041.2	67.903	19.982	7,540.2	1,675.1	16.9	-0.3
20060305	002807.7	67.309	19.488	7,472.8	1,658.4	26.6	1.2
20060305	212519.8	63.167	18.732	7,009.6	1,647.3	3.3	0.4
20060307	000543.4	64.447	21.106	7,159.6	1,754.8	19.0	-0.0
20060307	215942.1	61.678	16.760	6,840.7	1,550.4	12.7	0.0
20060309	123805.2	64.165	20.834	7,127.1	1,744.2	18.2	0.1
20060311	071052.2	67.538	18.164	7,495.5	1,600.4	35.8	1.9
20060312	005303.9	67.359	24.538	7,500.0	1,874.1	0.1	0.4
20060313	020703.0	64.401	20.609	7,152.5	1,731.3	12.6	0.3
20060313	043558.0	64.050	20.770	7,114.1	1,742.1	0.0	0.3
20060314	151256.5	67.580	18.823	7,501.3	1,628.3	0.1	0.2
20060317	164934.2	66.823	22.893	7,431.5	1,810.7	17.6	0.3
20060317	191753.0	57.969	14.916	6,427.5	1,447.2	19.8	0.9
20060318	104231.8	67.769	19.564	7,524.2	1,658.5	0.1	1.0
20060318	160231.4	65.134	22.046	7,239.9	1,792.4	15.3	0.3
20060319	134947.6	66.692	22.417	7,414.7	1,791.4	10.3	1.3
20060319	140751.8	66.743	22.214	7,419.5	1,781.9	1.6	0.4
20060320	130335.4	67.148	18.891	7,453.3	1,633.6	0.1	0.2
20060320	135539.7	61.515	16.548	6,822.3	1,539.4	12.0	0.2
20060320	212953.4	64.660	20.724	7,181.8	1,734.6	25.3	0.7
20060320	213248.7	64.657	20.705	7,181.4	1,733.8	22.0	0.3
20060321	094926.1	64.505	21.157	7,166.3	1,756.7	0.1	0.3
20060321	135610.6	64.500	21.232	7,166.0	1,760.3	16.4	1.6
20060321	185808.6	64.384	20.804	7,151.4	1,740.9	11.1	0.7
20060322	000141.8	67.646	19.391	7,510.0	1,652.0	0.1	1.0
20060322	000517.3	64.439	20.655	7,156.9	1,733.2	0.0	0.6
20060322	022622.5	61.675	16.935	6,840.6	1,559.7	1.1	0.3
20060322	212051.9	64.710	21.340	7,189.7	1,763.5	2.1	0.4
20060322	225327.4	63.974	20.519	7,104.7	1,730.5	16.3	0.1
20060323	024723.2	64.510	20.397	7,163.9	1,720.3	22.2	0.9
20060323	163313.1	66.948	23.535	7,448.7	1,837.0	5.2	-0.6
20060324	121012.3	61.938	17.318	6,870.2	1,579.2	18.4	1.0
20060324	202634.5	62.340	17.209	6,914.9	1,572.6	0.8	0.6

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M _L Local Magnitude
20060325	042801.5	67.887	19.705	7,537.7	1,663.6	10.8	0.5
20060326	010456.7	66.915	22.468	7,439.7	1,791.0	10.5	-0.0
20060326	074724.7	64.448	21.739	7,162.4	1,785.2	4.0	0.4
20060326	213820.6	61.637	17.028	6,836.3	1,564.6	0.1	-0.1
20060328	015132.5	66.679	23.165	7,416.9	1,824.5	4.5	0.9
20060328	154733.0	61.342	16.243	6,802.9	1,523.3	7.1	0.3
20060328	190915.3	63.197	15.173	7,009.8	1,468.0	6.7	1.0
20060328	193735.9	68.009	23.394	7,565.6	1,816.4	14.2	1.7
20060328	194608.6	63.182	15.156	7,008.1	1,467.1	4.6	1.3
20060329	113428.1	59.922	14.944	6,645.0	1,451.7	19.7	1.1
20060330	104604.8	67.827	20.173	7,532.2	1,683.8	5.4	-0.2
20060330	142737.9	67.429	19.983	7,487.5	1,678.8	1.1	0.7
20060330	223405.0	67.708	19.503	7,517.2	1,656.4	1.8	1.3
20060331	171259.9	65.103	22.035	7,236.5	1,792.2	4.9	0.9

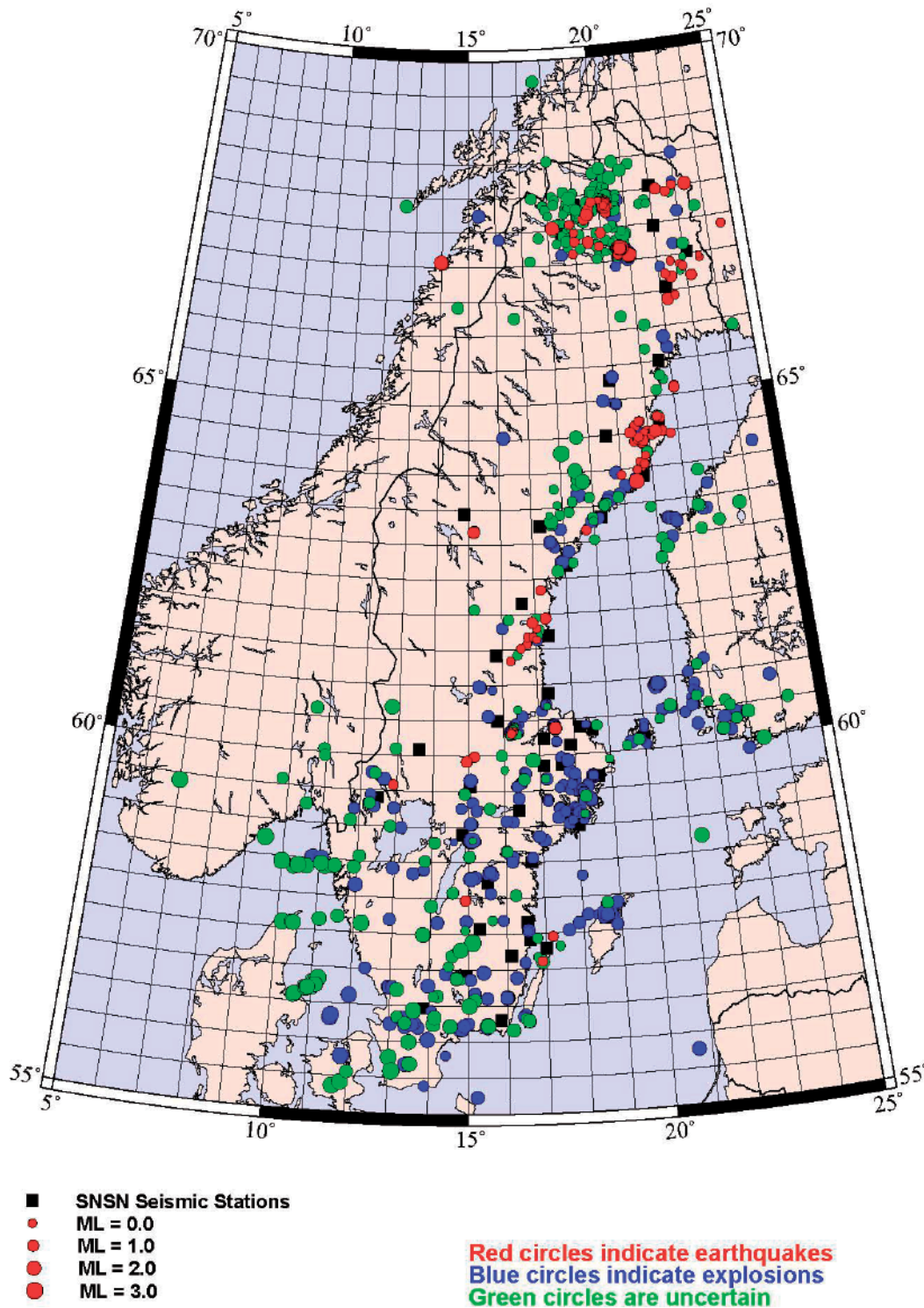


Figure 3-1. Recorded events including explosions in the SNSN network during the period January through March 2006.

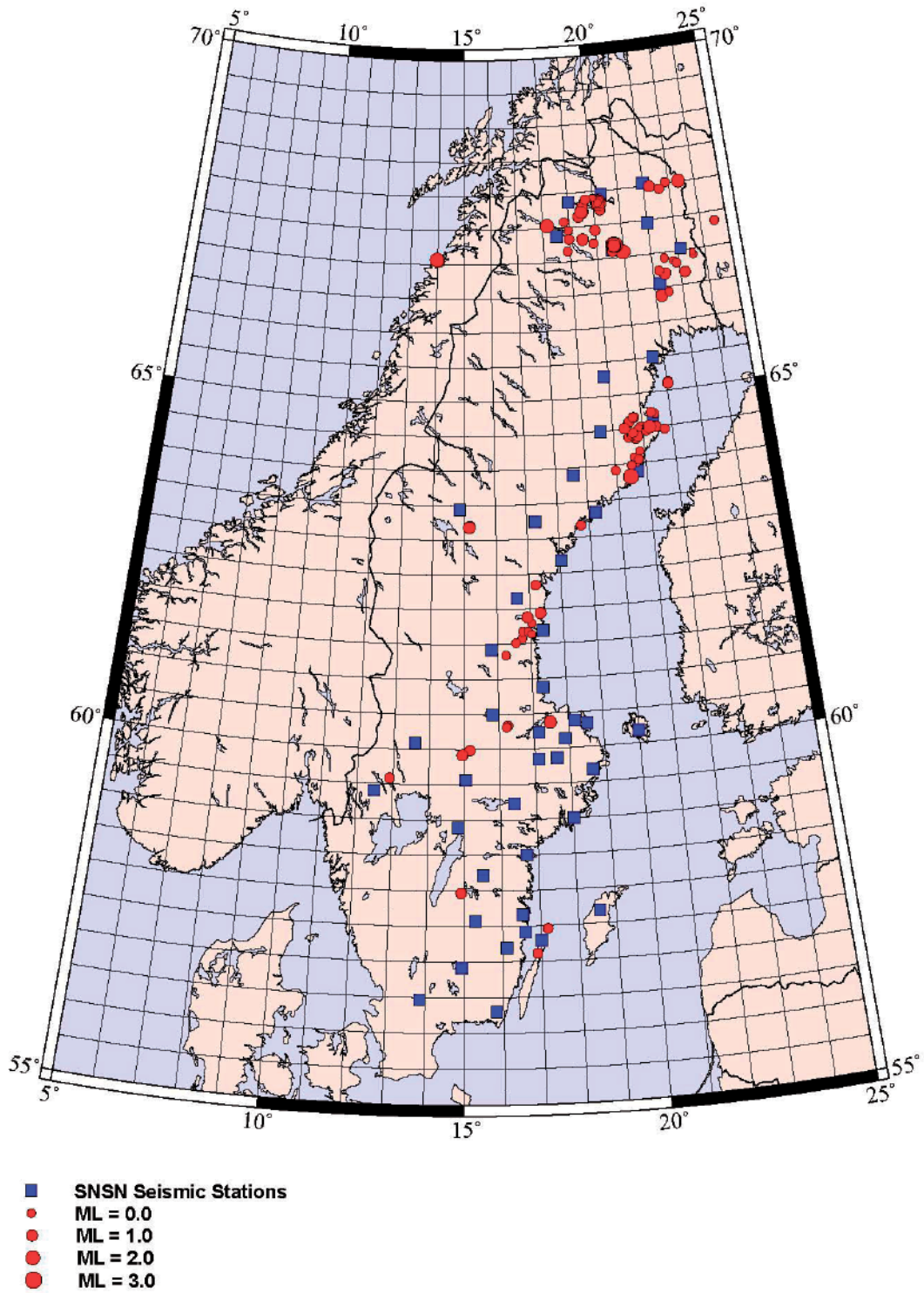


Figure 3-2. Earthquake activity in Sweden during January through March 2006.