

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the fourth quarter of the year 2008

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January 2009

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the authors 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 and additional construction of new seismic stations within the Swedish National Seismic Network (SNSN). This short report gives a brief information about the recorded seismicity during October through December 2008.

The Swedish National Seismic Network consists of 61 stations. During October through December, 1,173 events were located whereof 51 are estimated as real earthquakes, 788 are estimated as explosions, 256 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 78 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

An earthquake with magnitude $M_L = 4.4$ occurred on December 16th in Skåne. This is the largest earthquake in Sweden since 1986 when an earthquake with similar magnitude occurred in Skövde. Additional four earthquakes had magnitudes above $M_L = 2.0$ during the period.

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 Nationella Seismiska Nätet (SNSN). Denna rapport ger information om registrerade händelser under tidsperioden oktober till december 2008.

Det seismiska nätet består av 61 stationer. Under perioden oktober till december 2008 var det 1 173 registrerade händelser varav 51 bedömdes som äkta jordskalv, 788 bedömdes vara förorsakade av explosioner eller sprängningar, 256 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 78 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Det största jordskalvet under perioden inträffade den 16 december i Skåne och hade magnitud $M_L = 4.4$. Detta är det största skalv som har inträffat i Sverige sedan skalvet i Skövde 1986, som var ungefär lika stort. Ytterligare fyra skalv hade magnitud över $M_L = 2.0$.

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1 Introduction

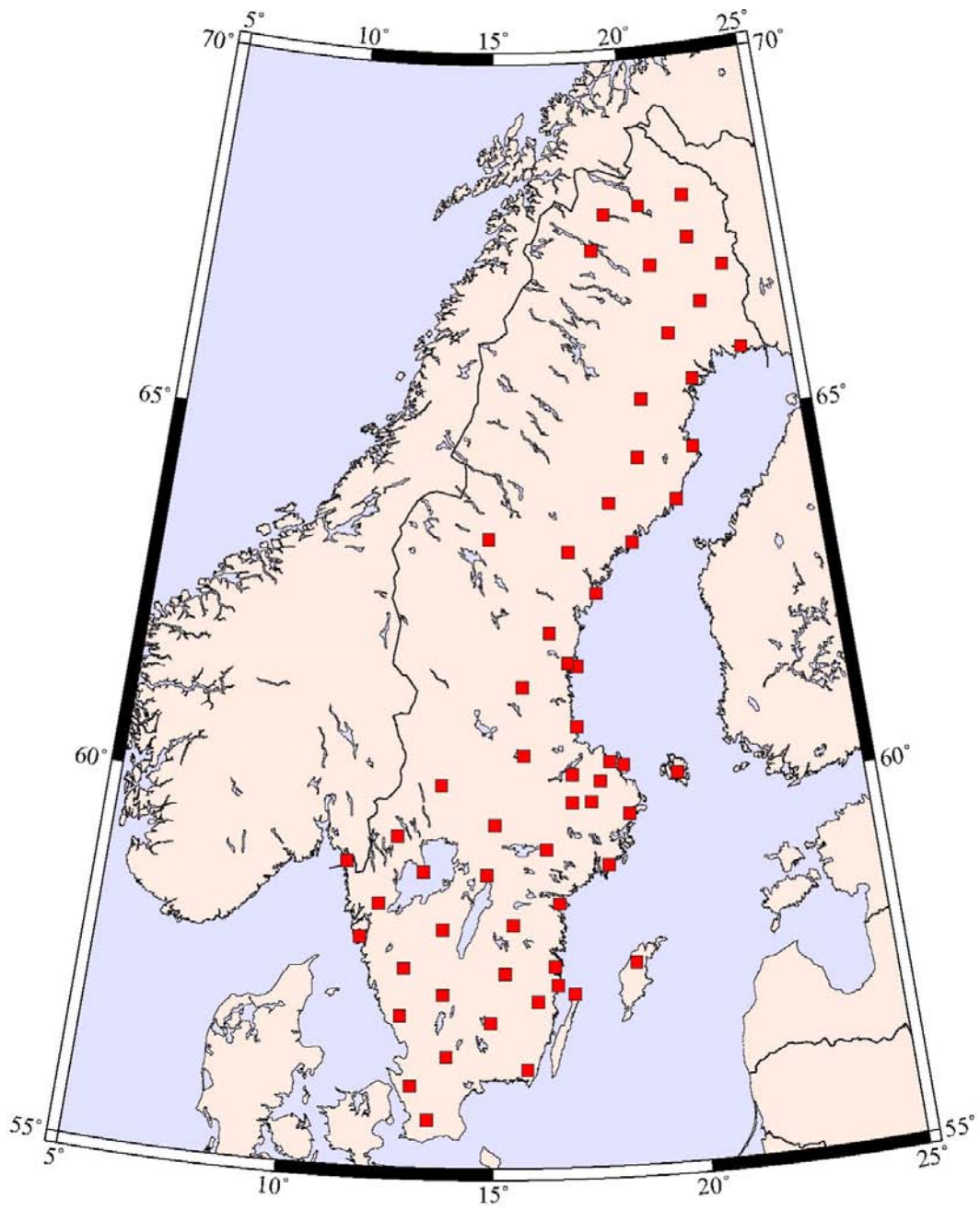
This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the fourth quarter of the year 2008. The work was carried out in accordance with activity plan AP PU 400-06-004. In Table 1-1 controlling document for performing this activity is listed. The activity 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



■ Stations in operation

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 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 fourth quarter of 2008

Figure 3-1 shows the recorded events in Sweden during October through December. During the period 1,173 events were located whereof 51 are estimated as real earthquakes (which are shown in Figure 3-2). 788 are estimated as explosions and 78 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 256 events in the very vicinity of the mines have been excluded in the report.

Event lists for October through December 2008 are given in sections 3.1 through 3.3.

3.1 October

An event list for October 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 October 16 events were located whereof one had magnitude $M_L = 2.3$ located 20 km W of Arvidsjaur and another with magnitude $M_L = 2.2$ located 25 km NW of Robertsfors. Additionally one earthquake had magnitude equal to $M_L = 1.0$. The depth range of the events varies between 0.1 and 36.6 km.

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
20081002	154118.8	61.808	16.974	6,855.4	1,561.4	18.2	0.1
20081004	025703.7	64.064	19.825	7,112.4	1,696.0	36.6	-0.0
20081004	232222.2	67.847	20.162	7,534.5	1,683.1	0.1	0.0
20081005	180757.3	67.093	22.940	7,461.7	1,809.3	4.8	0.5
20081007	091619.7	66.866	18.284	7,420.8	1,608.6	21.6	0.3
20081010	220731.0	67.407	22.170	7,493.0	1,772.4	11.6	-0.6
20081011	140339.1	67.907	22.033	7,547.9	1,761.0	5.1	-0.3
20081013	063008.3	64.841	20.527	7,201.2	1,723.7	8.5	0.7
20081013	164505.8	67.279	22.463	7,480.1	1,786.4	17.5	-0.2
20081013	194047.2	68.120	22.817	7,575.0	1,791.0	13.3	0.3
20081016	053124.2	59.264	10.512	6,583.4	1,198.1	2.1	1.0
20081016	170209.3	60.235	15.605	6,679.6	1,488.7	2.9	-0.3
20081016	193158.4	64.373	20.542	7,149.2	1,728.3	4.3	2.2
20081023	184109.2	67.655	22.114	7,520.3	1,767.2	8.7	0.8
20081024	014106.4	63.174	18.981	7,010.9	1,659.7	4.4	0.5
20081026	114133.3	65.624	18.753	7,283.4	1,635.6	7.2	2.3

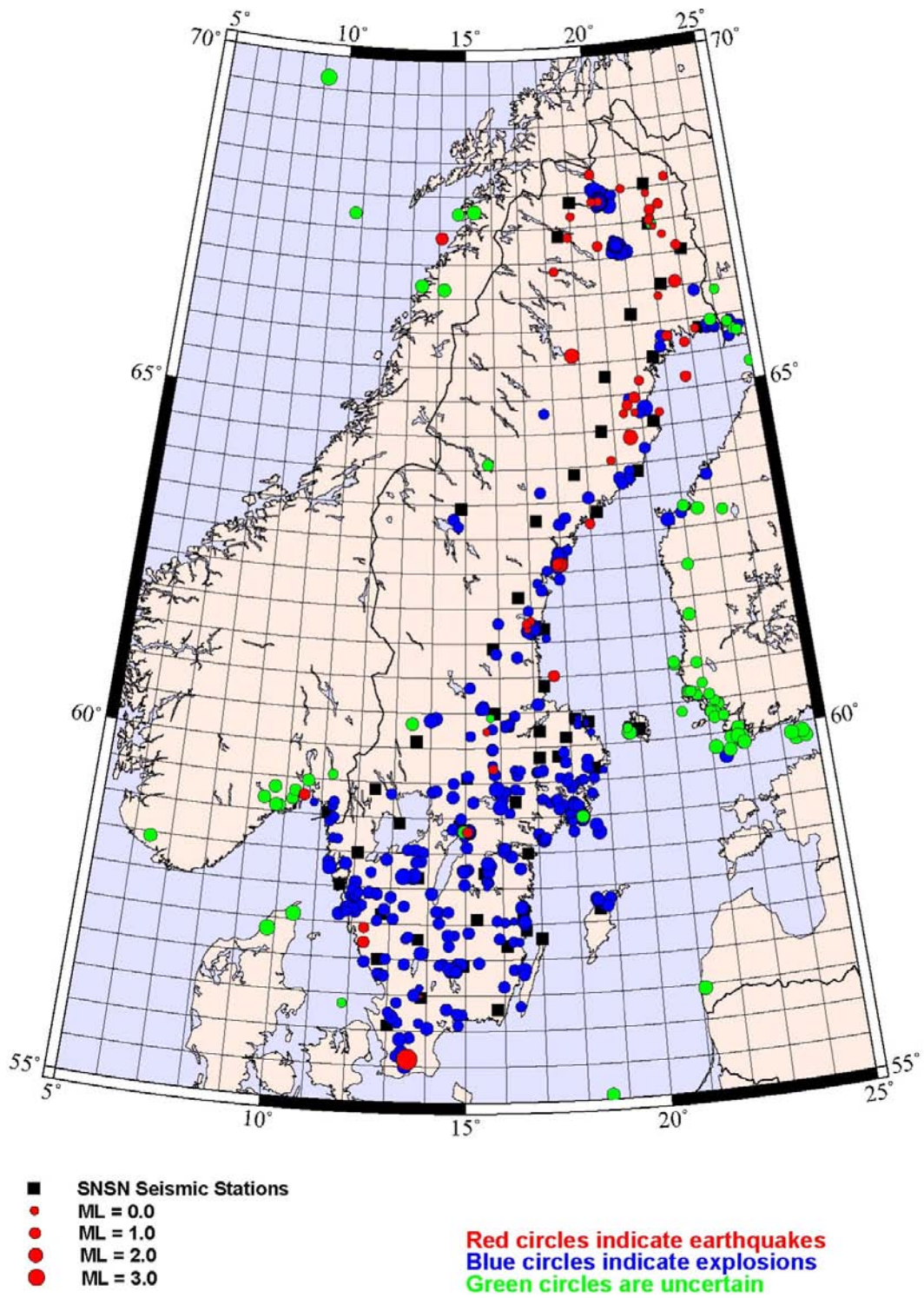


Figure 3-1. Recorded events including explosions in the SNSN network during the period October through December 2008.

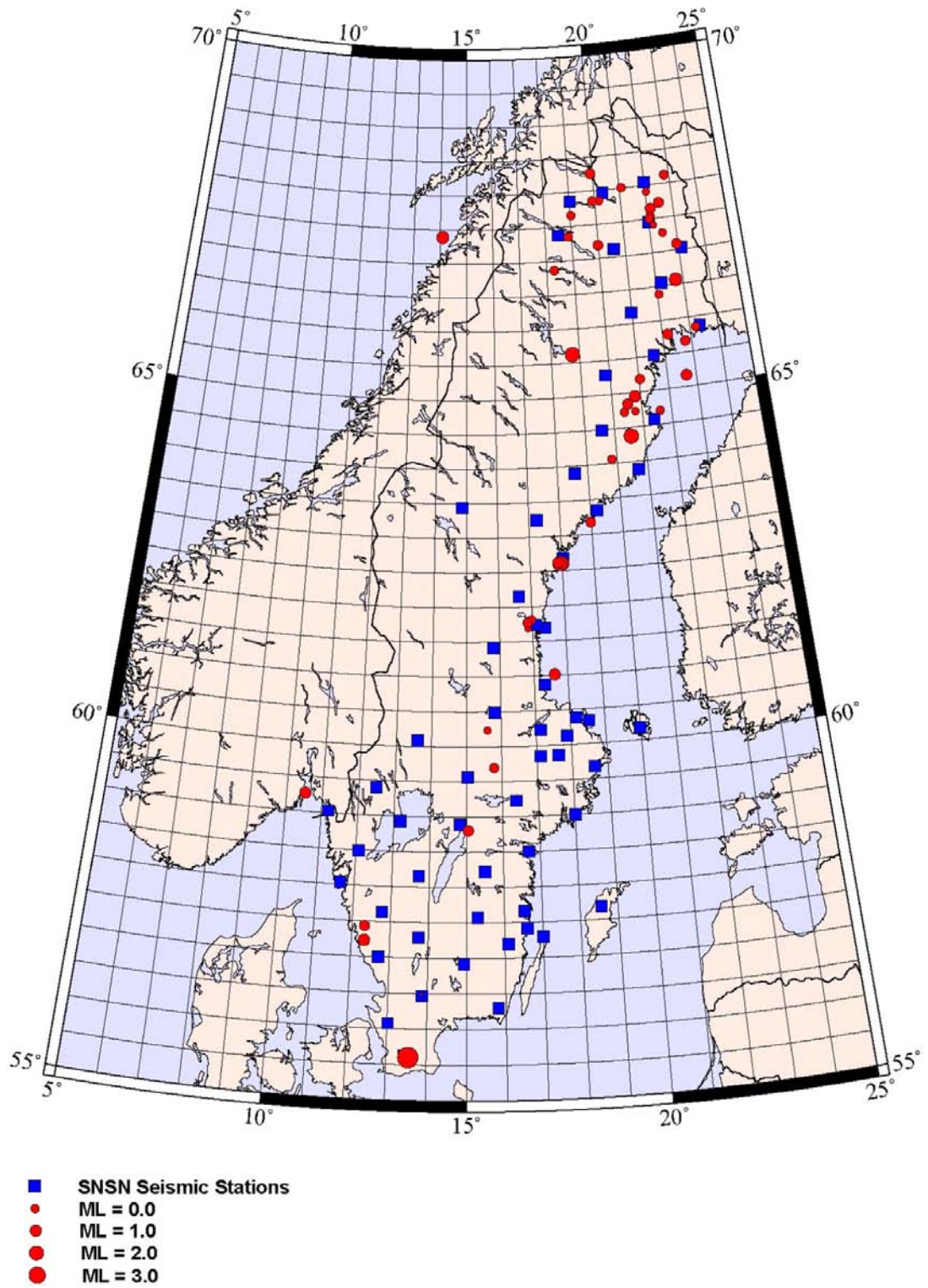


Figure 3-2. Earthquake activity in Sweden during October through December 2008.

3.2 November

An 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 15 events were located whereof one with magnitude $M_L = 2.3$, located 4.5 km SW of Härnösand and another in the same area, with magnitude $M_L = 2.1$ located 3 km south of Härnösand. Additionally 3 earthquakes had magnitudes equal to or above $M_L = 1.0$. The depth range of the events varies between 1.1 and 17.5 km.

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
20081101	044624.7	57.233	12.334	6,350.5	1,290.3	2.9	1.3
20081104	224924.1	59.703	15.778	6,620.3	1,498.3	17.5	0.4
20081106	164421.4	67.531	22.080	7,506.3	1,767.2	8.5	0.2
20081106	183023.8	67.658	19.039	7,510.5	1,637.0	8.6	-0.0
20081108	121230.4	58.807	15.054	6,520.7	1,456.4	1.1	0.8
20081109	170041.6	66.571	22.723	7,402.8	1,806.4	12.7	1.5
20081111	023722.8	68.004	21.076	7,554.9	1,720.0	13.2	0.1
20081113	022136.9	57.437	12.325	6,373.3	1,290.9	1.9	0.7
20081115	185224.6	66.387	22.044	7,379.1	1,778.4	12.2	-0.2
20081117	004441.6	67.385	14.096	7,477.5	1,426.5	7.7	1.4
20081119	192848.0	62.607	17.997	6,945.7	1,612.4	2.7	2.1
20081119	222133.6	64.724	20.384	7,187.7	1,717.9	4.9	0.1
20081120	011840.1	62.607	17.933	6,945.6	1,609.1	1.9	2.3
20081120	072427.9	62.613	17.878	6,946.3	1,606.2	4.6	0.2
20081125	051944.5	62.608	17.886	6,945.6	1,606.7	4.3	0.5

3.3 December

An 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 20 events were located whereof one with magnitude $M_L = 4.4$, located 20 km east of Staffanstorp in Skåne. This is the largest earthquake in Sweden since a similar sized earthquake occurred in Skövde in 1986. Additionally 2 earthquakes had magnitudes equal to or above $M_L = 1.0$. The depth range of the events varies between 0.1 and 23.2 km.

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
20081201	181327.9	68.254	19.911	7,579.0	1,669.6	6.8	0.6
20081201	230334.7	67.726	22.463	7,529.6	1,781.1	11.5	0.6
20081202	200037.8	65.187	21.029	7,241.5	1,744.3	4.6	0.4
20081206	013904.4	67.848	19.887	7,533.8	1,671.6	0.7	0.1
20081208	023250.7	64.727	20.764	7,189.4	1,735.9	17.1	-0.3
20081208	055404.6	62.619	17.881	6,946.9	1,606.4	8.6	0.9
20081209	212019.5	64.701	21.611	7,189.9	1,776.5	2.3	0.1
20081211	010644.5	61.016	17.610	6,767.9	1,597.4	5.3	1.1
20081211	062332.8	65.849	23.201	7,325.1	1,837.0	23.2	0.1
20081214	041004.9	65.167	22.656	7,246.6	1,820.5	17.8	0.9
20081214	174638.3	67.192	19.982	7,461.0	1,680.5	11.6	0.5
20081215	112133.2	65.666	22.776	7,302.5	1,819.9	2.9	0.6
20081216	052002.7	55.604	13.548	6,166.1	1,357.6	18.1	4.4
20081219	063708.4	61.690	16.869	6,842.1	1,556.1	16.4	-0.5
20081219	122841.8	67.505	22.036	7,503.2	1,765.6	0.1	0.1
20081224	002253.7	61.768	16.852	6,850.8	1,555.1	7.3	0.3
20081226	041740.5	64.944	20.806	7,213.7	1,736.0	3.0	1.1
20081226	205945.7	67.350	18.880	7,475.8	1,632.0	1.4	0.2
20081229	101233.0	65.792	22.185	7,313.7	1,791.5	19.8	0.7
20081231	230355.7	56.488	13.861	6,264.0	1,380.1	1.5	-1.8

4 Recorded earthquakes during the year 2008

Figure 4-1 shows the earthquake activity in Sweden during the year 2008. During 2008 there were 4,617 located events, Figure 4-2. Out of these 3,261 are explosions, 315 are true earthquakes and 389 events, mainly located outside the network, are still uncertain. Additionally 652 induced earthquakes in the vicinity of the mines in Kiruna, Malmberget and Aitik were located. These are not shown in the figure.

The largest earthquake located during 2008 was the $M_L = 4.4$ earthquake that occurred on December 16th, located 20 km east of Staffanstorp in Skåne. This is the largest earthquake in Sweden since a similar sized earthquake occurred in Skövde in 1986. In 2008 additionally 11 earthquakes had magnitude over $M_L = 2.0$, the largest with magnitude $M_L = 2.4$ was located 21 km SE of Luleå.

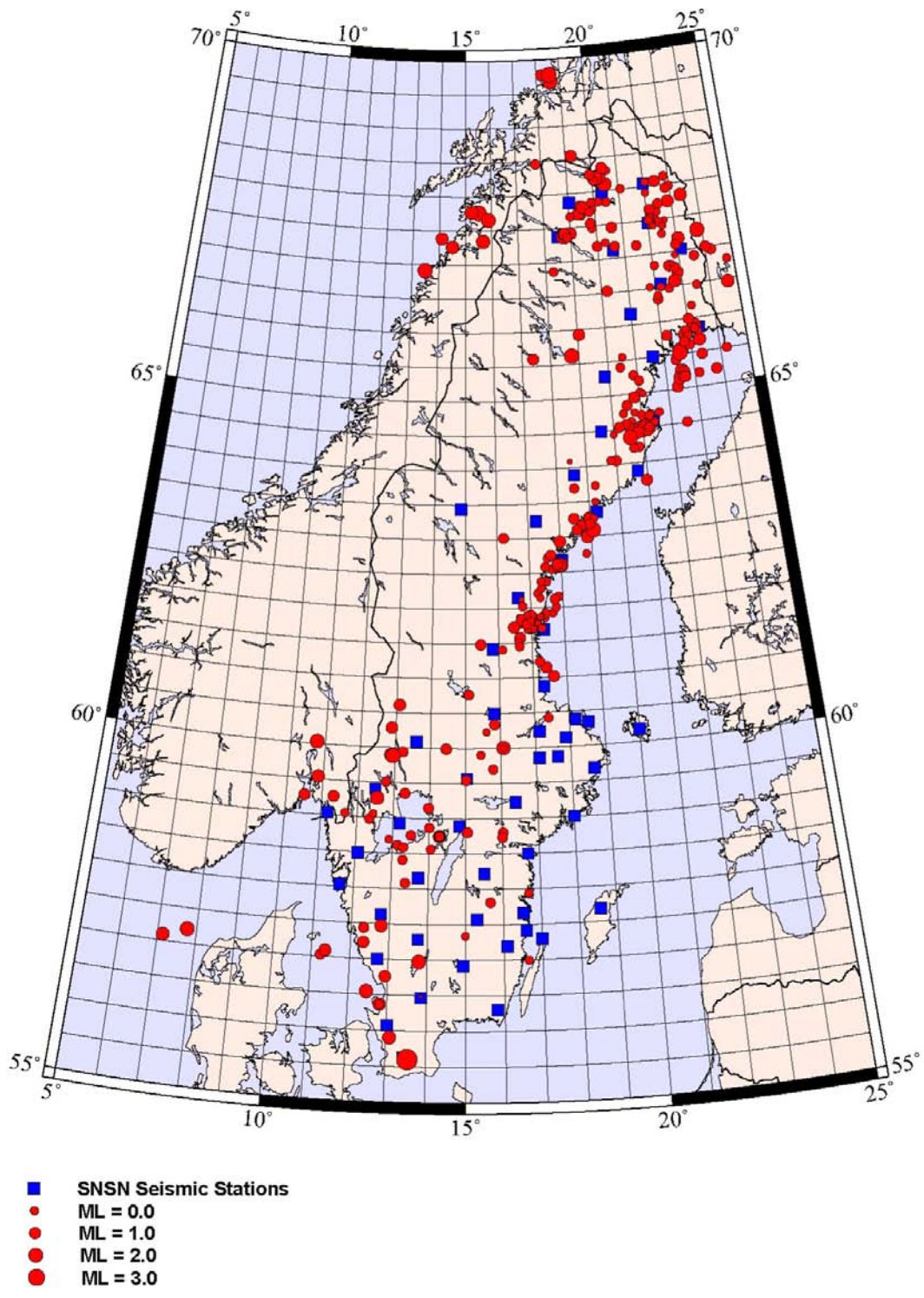


Figure 4-1. Recorded earthquakes during the year 2008.

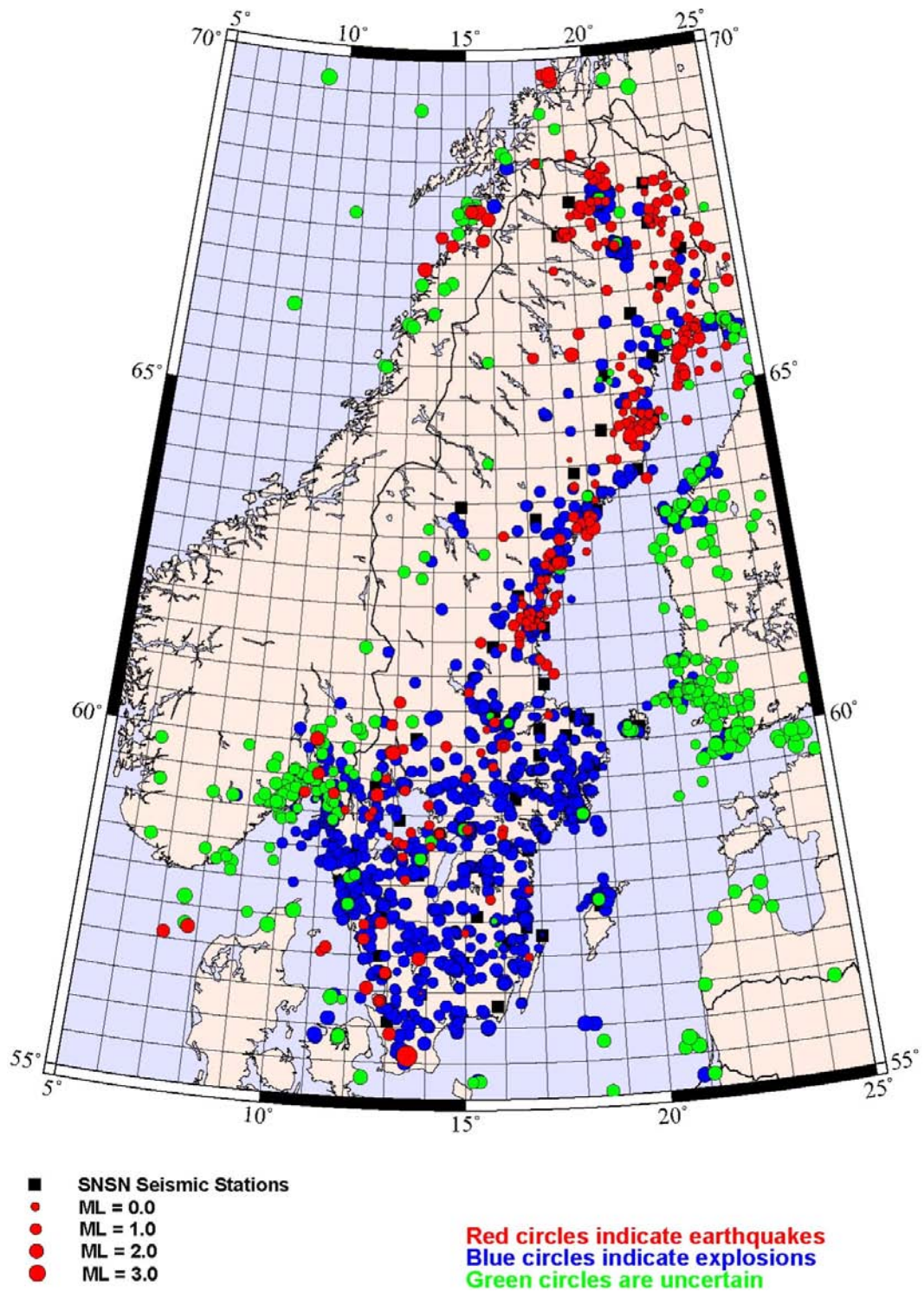


Figure 4-2. Recorded events including explosions in the SNSN during the year 2008.