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Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the first quarter of the year 2007

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April 2007

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Keywords: Seismic network, Earthquakes.

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 2007.

The Swedish National Seismic Network consists of 59 stations in operation and additional two under construction. During January through March, 1,563 events were located whereof 150 are estimated as real earthquakes, 1,354 are estimated as explosions and 59 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

The three largest earthquakes recorded by the network during the period were all located in Norway. The largest earthquake located in Sweden was the $M_L = 2.7$ earthquake that occurred on February 28th, 12 km south of Skara. Additionally 16 earthquakes had magnitudes equal to or above $M_L = 2.0$.

Large amount of induced seismicity around the mines in Kirunavaara, Malmberget and Aitik are observed and 325 events in the very vicinity of the mines have been excluded from the analysis.

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 2007.

Det seismiska nätet består av 59 stationer som är nu i drift. Ytterligare två stationer är under uppbyggnad. Under perioden januari till mars, 2007 var det 1 563 registrerade händelser varav 150 bedömdes som äkta jordskalv, 1 354 bedömdes vara förorsakade av explosioner eller sprängningar samt 59 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt explosioner.

De tre största jordskalven som registrerades av nätverket var alla lokaliserade i Norge. Det största skalvet i Sverige under perioden inträffade den 28 februari, 12 km söder om Skara och hade en magnitud på 2,7. Ytterligare 16 skalv hade magnitud lika med eller större än 2,0.

Ett stort antal inducerade skalv har registreras i närheten av gruvorna i Kirunavaara, Malmberget och Aitik. Dessa är inte medtagna i denna rapport.

Contents

1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the first quarter of the year 2007. 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 59 stations are in operation, Figure 1-1. Additional two stations are under construction in Skåne.

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

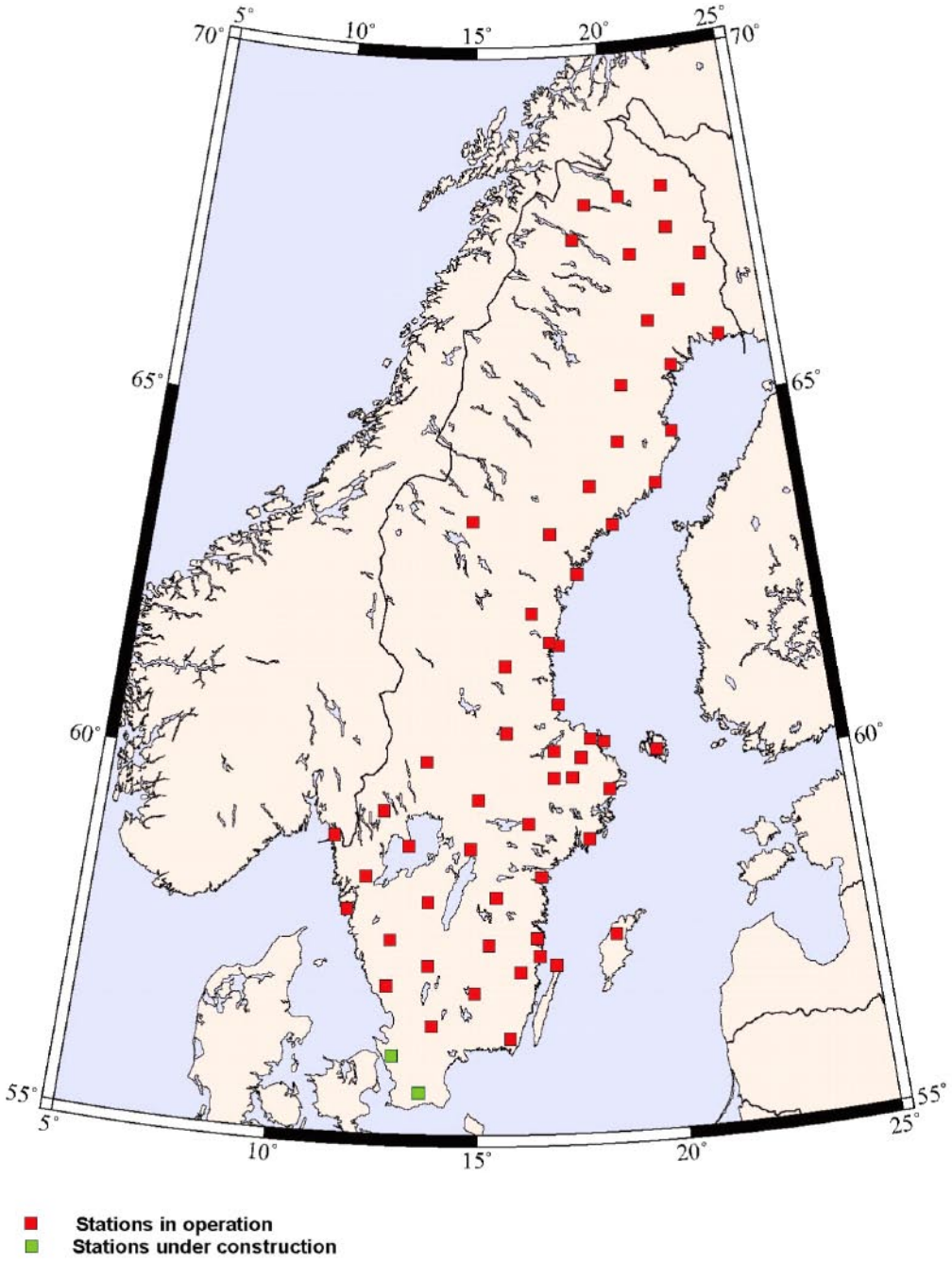

Figure 1-1. *The present Swedish National Seismic Network (SNSN).*

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 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 first quarter of 2007

Figure 3-1 shows the recorded events in Sweden during January through March. During the period 1,563 events were located whereof 150 are estimated as real earthquakes (which are shown in Figure 3-2). 1,354 are estimated as explosions and 59 are still considered as uncertain but are most probably explosions and are mainly located outside the network. Large amount of induced seismicity around the mines in Kirunavaara, Malmberget and Aitik are observed and 325 events in the very vicinity of the mines have been excluded in the report.

Event lists for January through March 2007 are given in sections 3.1 through 3.3.

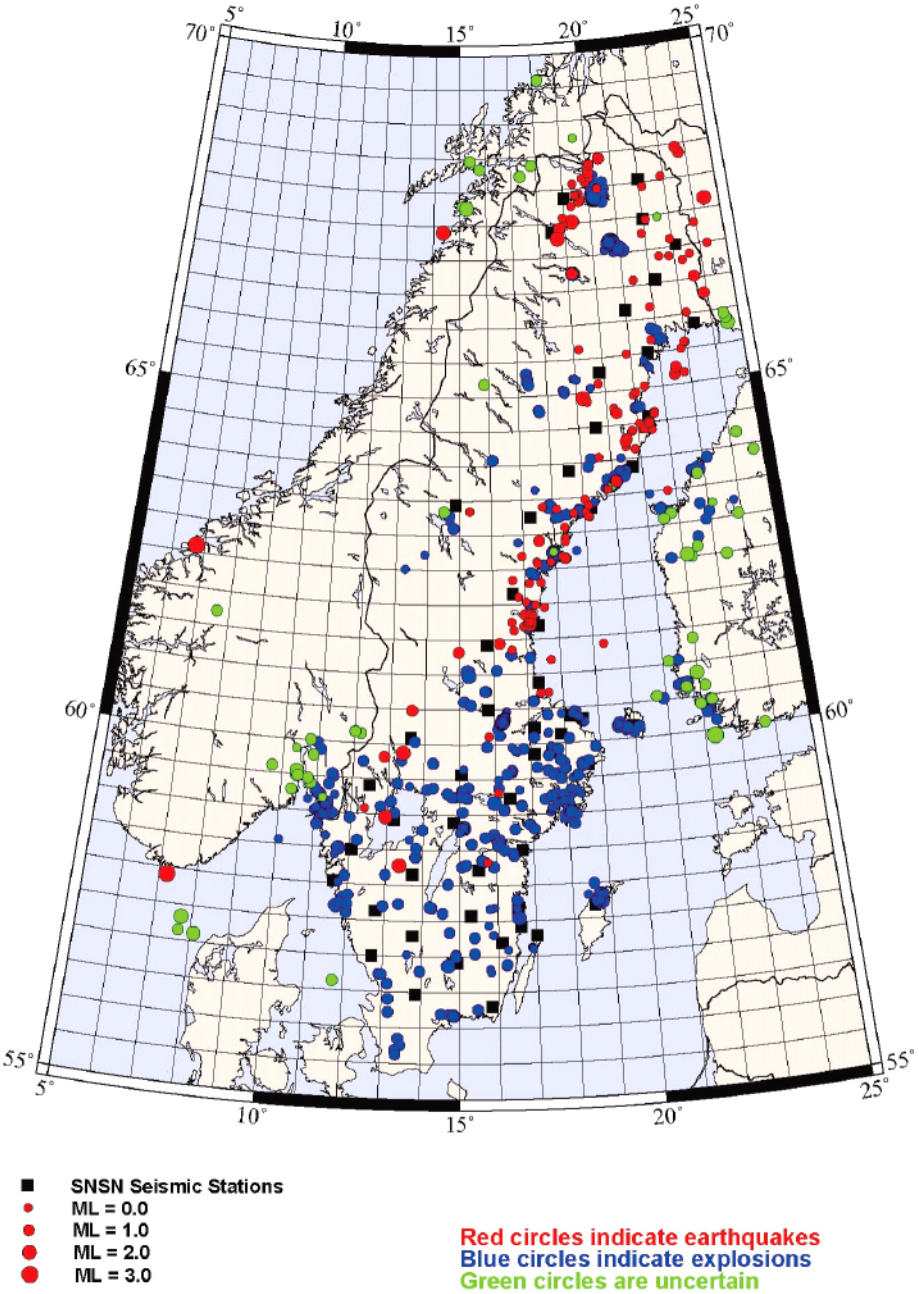

Figure 3-1. *Recorded events including explosions in the SNSN network during the period January through March 2007.*

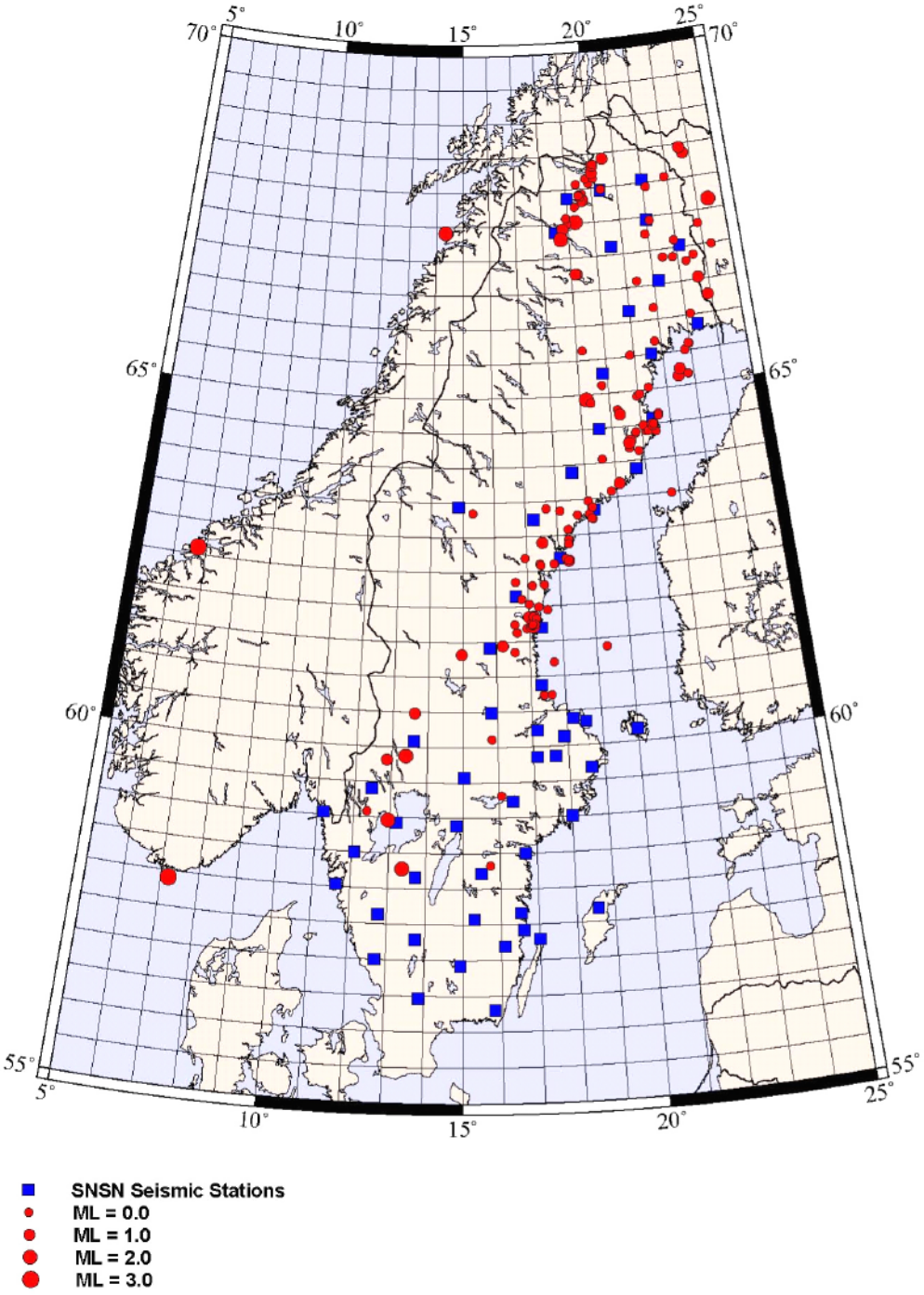

Figure 3-2. *Earthquake activity in Sweden during January through March 2007.*

3.1 January

An 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 51 events were located whereof one had magnitude M_L = 3.3 and one had a magnitude of M_L = 3.1. Both these events were located in Norway, far from the Swedish border. Four earthquakes had magnitudes above M_L = 2.0. One with magnitude M_L = 2.7 was located in Norway, 215 km NW of Arjeplog, and one with magnitude M_L = 2.4 was located 75 km south of Arjeplog. Another with the same magnitude was located 34 km north of Keino. One earthquake with magnitude M_L = 2.3 was located 10 km NW of Munkfors. Additional 8 earthquakes had magnitudes between M_L = 1.0 and 1.5. The depth range of the events varies between 0.0 and 37.2 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
20070101	083138.4	66.269	23.880	7,375.5	1,861.8	1.1	1.1
20070101	112146.6	63.083	18.349	6,999.5	1,628.4	13.1	0.5
20070101	214405.5	63.346	15.320	7,026.3	1,475.5	18.5	0.0
20070102	011647.0	61.349	16.553	6,803.9	1,539.8	20.5	0.3
20070102	034216.3	64.917	20.951	7,211.2	1,743.1	15.9	0.3
20070102	070632.9	61.382	19.303	6,812.4	1,686.7	15.5	0.9
20070105	235806.3	63.473	19.037	7,044.4	1,660.9	12.3	–0.7
20070106	062051.2	59.815	12.862	6,636.4	1,334.8	3.6	1.5
20070106	093431.4	59.875	13.391	6,642.0	1,364.7	0.8	2.3
20070106	105348.6	61.946	17.575	6,871.4	1,592.7	24.2	0.7
20070106	170857.8	63.355	18.112	7,029.3	1,615.3	19.7	–0.1
20070107	193839.1	62.640	18.290	6,950.0	1,627.2	10.8	0.7
20070109	042956.9	58.328	15.746	6,467.1	1,496.4	11.4	0.2
20070109	093109.7	62.636	18.309	6,949.6	1,628.3	0.9	1.3
20070110	152753.4	64.646	21.612	7,183.8	1,777.1	20.9	0.3
20070111	030734.2	67.515	19.289	7,495.2	1,648.5	14.6	2.4
20070112	060900.1	64.415	21.114	7,156.1	1,755.5	1.0	0.0
20070113	065605.5	64.930	19.217	7,207.1	1,661.2	1.1	2.4
20070115	061550.1	68.049	22.886	7,567.4	1,794.8	0.6	0.6
20070116	014526.5	61.196	17.705	6,788.1	1,602.0	1.0	0.8
20070116	055234.0	61.747	16.574	6,848.3	1,540.4	0.0	0.5
20070116	191543.2	68.364	23.731	7,606.7	1,825.3	15.9	1.4
20070117	080801.2	64.427	21.184	7,157.7	1,758.8	14.4	0.2
20070118	000828.7	62.935	18.342	6,983.0	1,628.6	4.6	0.6
20070119	023754.6	62.032	17.025	6,880.3	1,563.7	1.6	0.2
20070119	043117.5	66.864	23.570	7,439.6	1,839.7	1.3	0.2
20070119	115912.4	62.298	17.141	6,910.1	1,569.1	0.9	0.8
20070119	124747.9	67.918	19.627	7,540.9	1,660.2	0.1	0.2
20070119	182322.0	60.728	17.601	6,735.8	1,597.8	1.0	0.7
20070119	192909.9	63.393	17.667	7,032.8	1,592.9	16.4	–0.2
20070120	133847.1	67.250	21.880	7,474.3	1,761.8	37.2	0.6
20070120	154913.4	63.591	19.816	7,059.7	1,698.9	13.9	–0.2
20070120	163059.0	62.906	17.506	6,978.3	1,586.3	13.7	1.4
20070121	134523.3	62.599	6.732	6,975.8	1,035.0	1.1	3.3

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local magnitude
20070124	053057.6	61.442	16.190	6,814.1	1,520.4	1.0	1.0
20070124	223851.1	63.214	19.162	7,015.9	1,668.6	19.4	0.1
20070125	142242.5	64.492	21.059	7,164.4	1,752.1	0.0	0.5
20070126	214232.5	65.261	22.542	7,256.5	1,814.1	10.5	0.9
20070126	224141.2	67.412	14.352	7,480.2	1,437.6	1.1	2.7
20070127	024655.2	68.071	19.905	7,558.7	1,670.7	19.0	0.9
20070127	061810.8	65.641	19.193	7,286.2	1,655.7	3.4	0.9
20070127	185958.5	65.686	21.773	7,300.0	1,773.8	0.0	0.4
20070128	015621.7	65.255	22.505	7,255.7	1,812.4	9.1	0.7
20070128	051618.7	64.388	20.771	7,151.7	1,739.3	1.0	0.7
20070128	103058.7	57.902	7.204	6,452.2	990.7	1.8	3.1
20070129	025025.6	62.670	18.219	6,953.2	1,623.5	1.2	1.1
20070129	150200.3	63.286	19.053	7,023.7	1,662.7	27.5	0.2
20070129	195051.0	66.790	23.280	7,429.9	1,828.1	16.4	0.3
20070130	003056.5	60.484	13.619	6,709.3	1,379.7	1.2	1.1
20070131	003554.3	63.380	19.169	7,034.4	1,668.0	25.8	0.3
20070131	232743.1	61.685	16.932	6,841.6	1,559.5	15.6	–0.1

3.2 February

An 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 55 events were located whereof one with magnitude $M_L = 2.7$, located 12 km south of Skara. One earthquake with magnitude $M_L = 2.1$ was located less than one km east of Hudiksvall. Two earthquakes with magnitude $M_L = 2.0$ were located, one was located 17 km SE of Åmål and the other was located 67 km NE of Pajala. Additional 9 events had magnitudes equal to or above $M_L = 1.0$. The depth range of the events varies between 0.0 and 33.0 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
20070202	052919.5	64.056	19.605	7,110.9	1,685.3	33.0	0.2
20070202	103439.8	64.947	21.048	7,214.9	1,747.4	25.5	0.5
20070204	071816.5	63.486	21.739	7,055.5	1,795.2	20.6	0.4
20070204	114053.5	65.145	22.451	7,243.2	1,811.2	17.0	1.4
20070204	152952.7	64.406	21.207	7,155.4	1,760.1	24.7	0.3
20070204	203229.4	63.223	19.125	7,016.8	1,666.7	3.0	0.5
20070205	073750.4	65.252	22.526	7,255.3	1,813.4	3.1	1.6
20070205	131252.4	68.140	19.798	7,566.1	1,665.7	18.1	0.0
20070205	142356.9	67.114	22.921	7,464.0	1,808.2	1.2	0.8
20070206	031201.6	59.078	12.367	6,555.8	1,302.7	18.6	0.1
20070206	050105.6	65.251	22.526	7,255.2	1,813.4	3.5	1.6

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local magnitude
20070206	141430.7	62.603	17.407	6,944.4	1,582.1	1.0	0.4
20070206	155853.9	67.493	18.968	7,492.0	1,635.0	15.6	–0.1
20070206	211154.2	62.641	18.310	6,950.1	1,628.3	7.7	0.8
20070207	000239.2	65.162	22.801	7,246.8	1,827.3	18.4	0.8
20070207	000239.2	65.165	22.791	7,247.1	1,826.8	18.6	0.7
20070207	105216.1	58.964	12.952	6,541.5	1,335.7	19.1	2.0
20070208	005241.7	61.990	17.310	6,876.0	1,578.7	28.2	0.2
20070209	032655.5	61.628	16.637	6,835.0	1,543.9	5.2	0.9
20070209	143447.7	67.826	19.632	7,530.6	1,661.0	8.7	1.3
20070209	185336.4	66.887	22.428	7,436.4	1,789.6	1.0	–0.0
20070210	205604.9	61.850	17.010	6,860.1	1,563.3	1.2	1.1
20070212	000645.9	67.388	18.781	7,479.9	1,627.5	1.0	–0.1
20070212	001311.4	67.425	18.785	7,484.0	1,627.5	7.8	1.9
20070212	174749.8	61.880	17.146	6,863.6	1,570.3	15.7	–0.0
20070213	172718.0	63.282	18.666	7,022.3	1,643.4	1.0	0.1
20070214	061627.6	68.413	20.522	7,598.5	1,693.4	0.1	1.1
20070215	101136.5	67.311	23.911	7,491.0	1,848.0	1.1	0.4
20070215	131056.7	62.354	16.630	6,915.9	1,542.5	16.7	0.9
20070215	140946.9	61.734	17.136	6,847.3	1,570.2	1.0	–0.5
20070216	142827.0	65.520	20.856	7,277.9	1,733.3	1.8	0.7
20070216	193216.9	61.869	17.186	6,862.4	1,572.5	1.1	–0.0
20070220	025612.4	67.898	19.475	7,538.3	1,653.9	17.6	0.2
20070220	025758.4	67.902	19.477	7,538.7	1,654.0	16.9	0.6
20070220	030757.6	67.875	19.491	7,535.8	1,654.7	2.2	0.8
20070220	032712.0	67.901	19.473	7,538.7	1,653.8	16.7	–0.1
20070220	040814.1	67.739	19.295	7,520.1	1,647.4	1.1	–0.1
20070220	065554.9	67.798	19.598	7,527.5	1,659.8	16.2	0.1
20070221	081903.1	62.304	17.513	6,911.3	1,588.4	16.7	0.6
20070221	082010.0	67.915	19.474	7,540.1	1,653.8	1.8	–0.1
20070221	094127.0	67.642	24.447	7,530.7	1,865.8	3.2	2.0
20070221	151829.6	62.599	17.845	6,944.6	1,604.6	16.5	0.4
20070222	042904.4	67.969	20.369	7,548.7	1,690.8	23.5	0.1
20070222	092645.9	66.757	19.198	7,410.5	1,649.2	7.9	1.3
20070222	134551.5	61.719	17.120	6,845.6	1,569.3	1.2	2.1
20070222	191426.1	61.853	17.136	6,860.5	1,569.9	1.6	–0.0
20070222	202434.6	67.901	19.472	7,538.6	1,653.8	17.7	0.1
20070223	062056.1	67.902	19.473	7,538.7	1,653.8	16.9	0.4
20070225	000855.7	68.445	23.615	7,615.0	1,819.4	0.0	1.1
20070225	050811.8	65.508	22.783	7,285.1	1,822.2	17.0	0.3
20070225	060645.2	60.110	15.830	6,665.7	1,501.2	17.7	0.5
20070226	004134.5	62.105	16.802	6,888.3	1,551.9	18.5	0.1
20070228	032344.2	64.181	20.532	7,127.8	1,729.5	27.4	–0.0
20070228	132811.2	58.279	13.364	6,464.2	1,356.6	1.0	2.7
20070228	133537.5	61.725	17.095	6,846.2	1,568.0	1.1	0.4

3.3 March

An 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 44 events were located whereof one with magnitude M_L = 2.2 was located 87 km west of Gällivare. One earthquake with magnitude M_L = 1.9 was located 18 km west of Robertsfors. Additional 10 earthquakes had magnitudes equal to or above 1.0. The depth range was between 0.1 and 29.9 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
20070301	111414.2	59.311	16.071	6,576.6	1,515.0	0.1	0.6
20070302	124004.1	66.583	21.374	7,398.0	1,746.6	1.1	0.2
20070302	193754.6	66.987	24.288	7,457.4	1,869.1	1.2	0.3
20070304	024431.9	62.691	16.943	6,953.8	1,558.1	20.4	0.9
20070304	034419.8	67.578	18.930	7,501.4	1,632.8	1.1	–0.0
20070304	163650.3	68.140	20.098	7,566.9	1,678.2	17.2	0.5
20070307	143751.3	66.872	22.804	7,436.5	1,806.2	12.1	–0.2
20070308	014143.4	67.445	22.100	7,496.9	1,769.0	10.9	0.8
20070309	030654.8	61.826	17.232	6,857.6	1,575.0	16.6	–0.4
20070309	120652.5	67.884	19.532	7,536.9	1,656.4	12.0	–0.4
20070310	014238.7	61.742	17.197	6,848.2	1,573.4	7.4	–0.7
20070310	033201.2	64.287	20.578	7,139.7	1,730.8	10.7	1.3
20070311	064039.8	68.220	20.062	7,575.7	1,676.1	8.0	1.2
20070311	233056.8	61.321	14.967	6,800.9	1,455.0	1.5	1.0
20070311	233831.7	62.876	18.339	6,976.3	1,628.8	1.1	0.7
20070312	071010.2	66.532	23.622	7,403.1	1,846.6	7.0	1.6
20070312	084219.4	64.393	21.461	7,155.1	1,772.4	20.4	–0.0
20070312	195352.6	63.694	20.096	7,072.1	1,711.9	1.6	1.2
20070313	032650.7	65.594	22.964	7,295.5	1,829.5	16.7	0.7
20070313	032856.8	65.603	22.929	7,296.3	1,827.7	12.9	0.6
20070314	160726.0	68.070	19.413	7,557.3	1,650.2	1.1	0.6
20070314	175331.0	64.134	20.832	7,123.7	1,744.4	16.2	–0.1
20070315	083746.9	64.875	19.357	7,201.3	1,668.1	19.9	0.7
20070316	060035.2	66.170	21.874	7,354.3	1,773.2	18.6	0.1
20070316	083904.7	68.329	20.106	7,587.9	1,677.0	3.0	1.1
20070316	133106.3	68.344	20.129	7,589.7	1,677.9	1.0	0.6
20070320	004648.2	64.254	20.531	7,135.9	1,728.8	8.8	1.9
20070320	024205.3	67.936	22.123	7,551.4	1,764.4	20.5	0.7
20070320	111740.3	61.723	17.082	6,846.0	1,567.4	1.0	0.9
20070320	205903.6	67.278	18.695	7,467.4	1,624.4	1.0	2.2
20070321	090347.9	61.742	17.111	6,848.2	1,568.8	1.1	0.2
20070321	165427.3	66.759	19.156	7,410.7	1,647.4	7.4	1.4
20070321	215945.3	60.726	17.375	6,735.3	1,585.5	17.1	0.3
20070322	055907.9	64.406	20.792	7,153.7	1,740.1	23.0	0.9
20070324	143957.4	67.902	19.474	7,538.7	1,653.9	16.7	0.2
20070325	051109.8	64.750	20.247	7,190.1	1,711.2	29.9	0.6

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local magnitude
20070325	054440.7	64.616	21.604	7,180.4	1,777.0	19.0	0.3
20070325	070236.9	62.580	17.432	6,941.8	1,583.5	20.5	0.3
20070327	114540.2	64.494	21.389	7,166.0	1,767.9	20.3	1.5
20070327	122037.0	64.495	21.409	7,166.2	1,768.9	20.9	0.4
20070328	012753.0	65.119	19.788	7,229.7	1,686.8	16.1	–0.4
20070329	103721.9	64.676	20.320	7,182.1	1,715.2	9.5	1.2
20070331	030034.4	65.027	21.365	7,225.1	1,761.6	1.1	0.5
20070331	102232.0	66.021	23.154	7,343.9	1,832.6	27.3	0.4