P-10-14

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the first quarter of the year 2010

Reynir Böðvarsson
Uppsala University, Department of Earth Sciences

April 2010

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co

Box 250, SE-101 24 Stockholm
Phone +46 8 459 84 00

ISSN 1651-4416
SKB P-10-14

Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the first quarter of the year 2010

Reynir Böðvarsson
Uppsala University, Department of Earth Sciences

April 2010

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

The Swedish National Seismic Network consists of 61 stations. During January through March, 1,929 events were located whereof 136 are estimated as real earthquakes, 1,314 are estimated as explosions, 366 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 113 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

Four earthquakes had magnitudes above M_L=2.0. In January an earthquake with magnitude M_L=2.3 was located 18 km SE of Kramfors, one with magnitude M_L=2.2 was located 10 km SE of Falköping and one with magnitude M_L=2.1 was located in the Norwegian Sea. In February an earthquake with magnitude M_L=2.0 was located 12 km east of Härnösand.

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 januari till mars 2010.

Det seismiska nätet består av 61 stationer. Under perioden januari till mars, 2010 var det 1 929 registrerade händelser varav 136 bedömdes som äkta jordskalv, 1 314 bedömdes vara förorsakade av explosioner eller sprängningar, 366 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 113 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Fyra jordskalv hade magnitud över M_L=2.0. I januari inträffade ett skalv 18 km sydost om Kramfors med magnitud M_L=2.0, samt ett skalv med magnitud M_L=2.2, 10 km sydost om Falköping. Ett skalv med magnitud M_L=2.1 inträffade i Norska havet. I februari inträffade ett skalv med magnitud M_L=2.0, 12 km öster om Härnösand.

Contents

1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the first quarter of the year 2010. 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

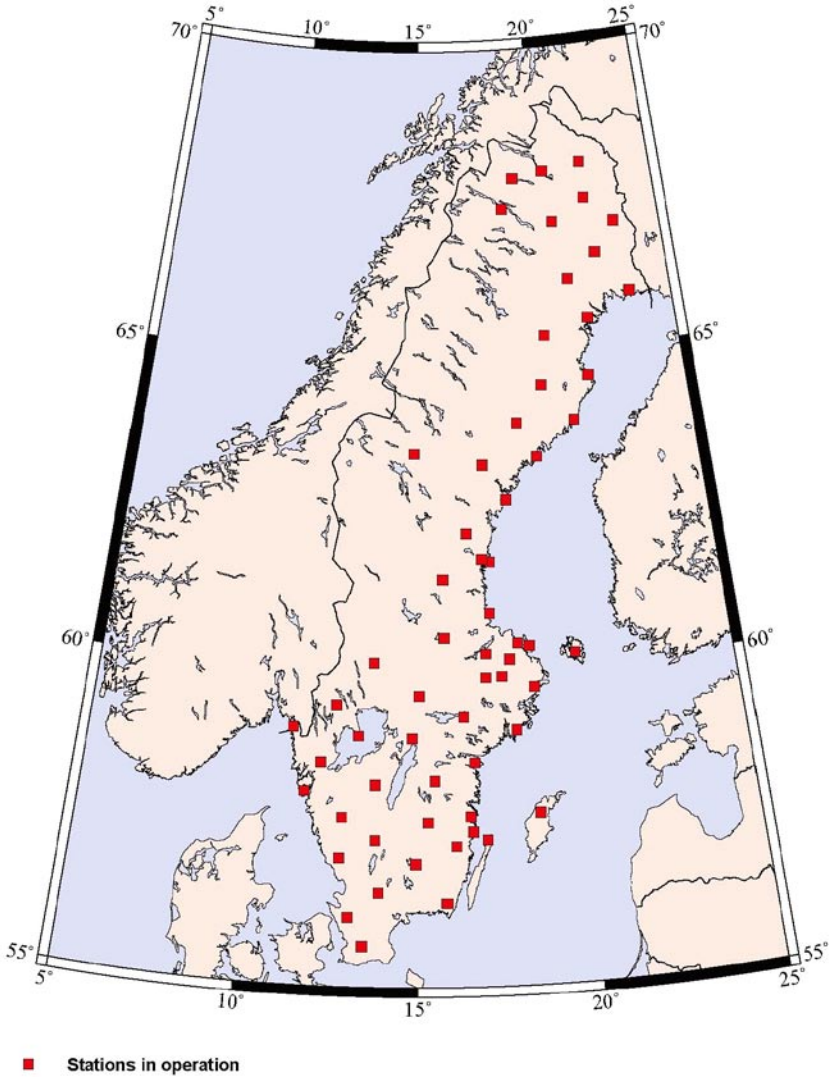

Figure 1-1. *The present Swedish National Seismic Network (SNSN).*

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 area.

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 site in Forsmark.

3 Recorded earthquakes during the first quarter of 2010

Figure 3-1 shows the recorded events in Sweden during January through March. During the period 1,929 events were located whereof 136 are estimated as real earthquakes (which are shown in Figure 3-2). 1,314 are estimated as explosions and 113 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 366 events in the very vicinity of the mines have been excluded in the report.

Event lists for January through March 2010 are given in sections 3.1 through 3.3.

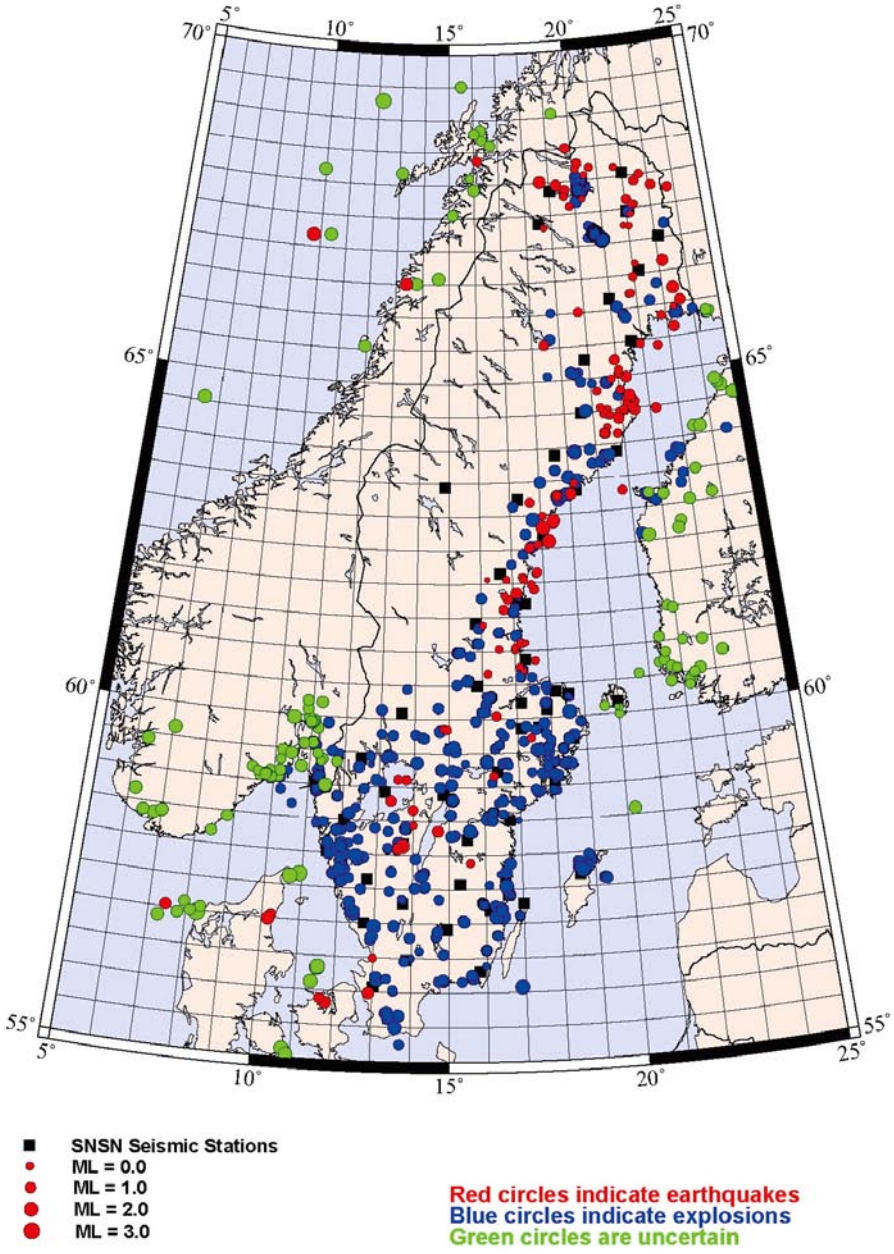

Figure 3-1. *Recorded events including explosions in the SNSN network during the period January through March 2010.*

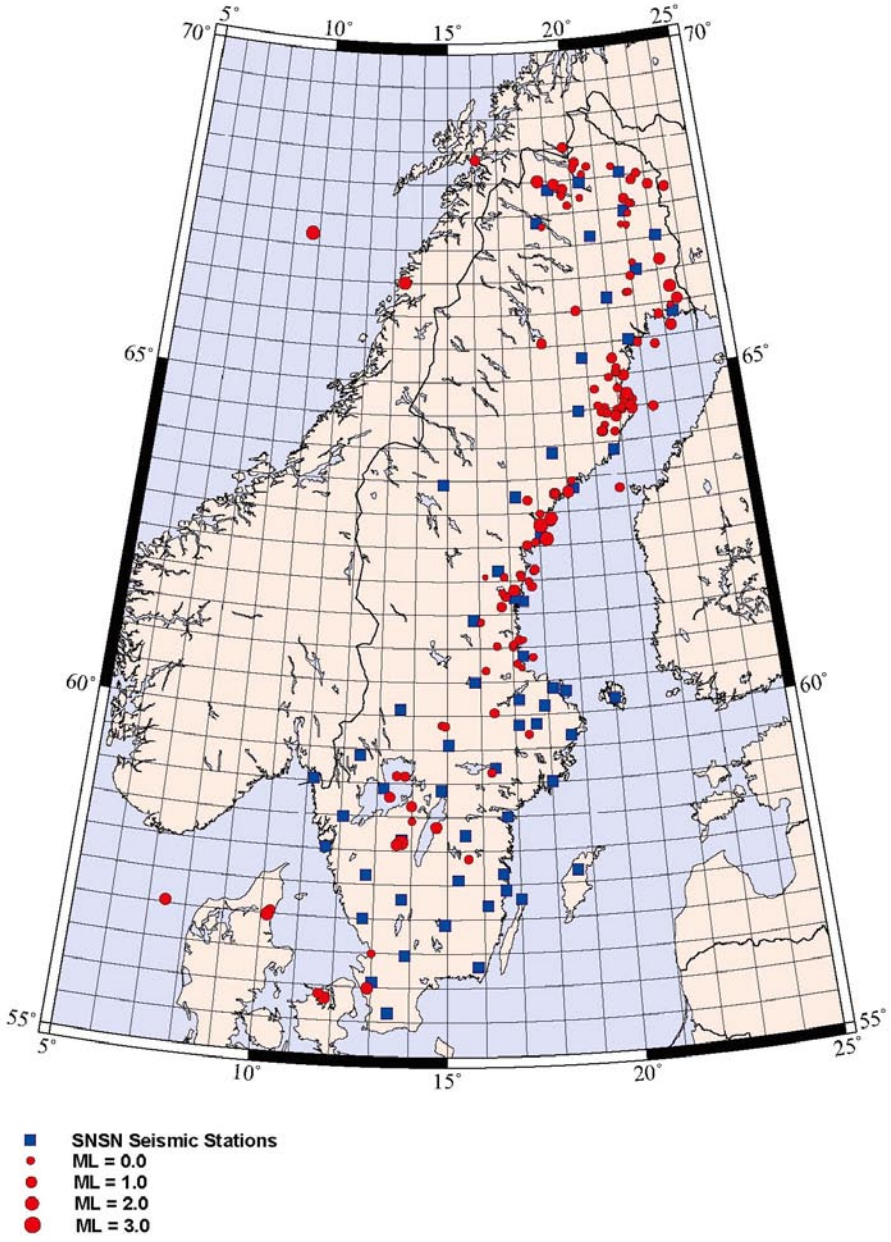

Figure 3-2. *Earthquake activity in Sweden during January through March 2010.*

3.1 January

An event list for January 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 January 53 events were located whereof one had magnitude M_L=2.3 located 18 km SE of Kramfors. One earthquake with magnitude M_L=2.2 was located 10 km SE of Falköping and one with magnitude M_L=2.1 was located in the Norwegian Sea. Additional 9 earthquakes had magnitudes between M_L=1.0 and M_L=1.7. The depth range of the events varies between 0.1 and 32.3 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
20100101	023219.9	59.108	13.783	6,555.8	1,384.0	12.8	0.6
20100101	132522.5	66.218	21.722	7,359.0	1,765.9	22.1	–0.1
20100101	183755.3	64.963	20.748	7,215.6	1,733.1	3.0	0.1
20100103	094244.8	66.220	21.802	7,359.5	1,769.4	18.2	–0.1
20100103	112804.0	65.396	22.549	7,271.4	1,812.8	10.3	0.4
20100103	153203.8	67.773	19.554	7,524.6	1,658.1	15.0	–0.3
20100104	012437.9	68.174	20.116	7,570.7	1,678.6	17.5	–0.1
20100104	145404.5	59.161	16.278	6,560.0	1,526.9	1.4	0.3
20100104	212423.4	57.040	7.445	6,354.9	993.1	28.9	1.3
20100106	004127.5	62.872	18.376	6,976.0	1,630.6	4.7	1.1
20100106	033106.1	67.889	19.432	7,537.1	1,652.2	1.2	–0.4
20100106	053437.8	66.502	13.388	7,380.1	1,392.3	0.1	1.7
20100106	065915.4	55.828	11.801	6,196.0	1,249.0	1.3	1.6
20100106	175317.6	62.137	17.757	6,893.0	1,601.6	9.3	0.2
20100107	020414.0	63.294	19.030	7,024.4	1,661.6	3.4	1.3
20100108	090140.7	62.064	16.204	6,883.4	1,520.7	11.0	–0.9
20100109	042327.3	60.702	17.260	6,732.5	1,579.3	6.7	–0.7
20100111	023837.6	67.253	21.827	7,474.3	1,759.4	3.7	–0.6
20100111	065219.9	67.182	9.726	7,466.7	1,237.0	0.1	2.1
20100111	154545.3	64.464	22.208	7,166.3	1,807.5	2.4	0.7
20100113	021530.8	62.565	17.863	6,940.8	1,605.6	6.2	0.0
20100113	044247.8	57.045	10.242	6,338.1	1,162.4	16.1	0.9
20100113	055033.3	56.987	10.167	6,331.9	1,157.3	12.1	1.7
20100114	012727.3	67.790	19.582	7,526.6	1,659.1	6.3	0.3
20100114	104801.8	68.001	22.686	7,561.2	1,787.1	12.4	0.2
20100115	101453.2	64.976	21.282	7,219.0	1,758.2	27.0	1.3
20100115	105101.2	67.643	22.050	7,518.6	1,764.7	9.6	0.5
20100116	144419.7	62.761	18.056	6,963.1	1,614.8	18.6	–0.1
20100116	144447.3	62.808	18.059	6,968.3	1,614.8	11.4	2.3
20100116	191015.2	67.550	22.337	7,509.6	1,777.9	7.9	–0.2
20100117	030031.7	64.502	21.175	7,166.0	1,757.6	27.1	0.1
20100117	035546.0	64.503	21.176	7,166.1	1,757.6	27.1	–0.1
20100117	054904.7	67.953	19.291	7,544.0	1,645.9	0.4	1.0
20100117	072819.4	65.449	21.928	7,274.4	1,783.5	14.6	0.3
20100118	155347.8	62.524	17.586	6,935.8	1,591.5	17.0	0.6
20100119	131859.8	65.246	20.931	7,247.7	1,739.2	2.7	0.7
20100120	070349.2	68.149	21.684	7,573.4	1,743.8	2.7	–0.3
20100120	140835.3	58.126	13.710	6,446.6	1,376.4	0.1	2.2
20100120	185913.6	60.853	17.614	6,749.8	1,598.1	12.8	0.1
20100123	112703.3	60.764	17.137	6,739.2	1,572.4	2.3	–0.1
20100123	145342.3	61.021	17.017	6,767.7	1,565.4	23.7	0.1
20100124	004149.4	68.183	20.685	7,573.5	1,702.1	32.3	0.1
20100124	033423.9	67.749	23.732	7,538.5	1,834.2	27.0	0.7
20100124	191430.3	61.766	16.843	6,850.5	1,554.6	5.1	0.5
20100124	234413.5	64.467	21.115	7,161.8	1,755.1	28.0	–0.2
20100125	200259.8	67.910	22.435	7,550.0	1,777.7	7.8	0.6
20100126	091056.6	65.036	21.030	7,224.7	1,745.7	8.1	0.5
20100126	093200.4	64.465	20.936	7,160.9	1,746.5	10.7	0.2
20100128	233741.1	67.870	19.639	7,535.5	1,661.0	7.1	0.6
20100131	061439.7	65.948	23.312	7,336.7	1,840.7	6.2	–0.5
20100131	081041.6	65.033	21.020	7,224.3	1,745.3	5.3	0.1
20100131	204116.1	64.513	20.506	7,164.6	1,725.4	9.0	0.3
20100131	223115.4	66.658	23.139	7,414.5	1,823.6	16.1	1.2

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 39 events were located whereof one with magnitude M_L=2.0, located 12 km east of Härnösand and another with magnitude M_L=1.8 was located 37 km NE of Härnösand. One earthquake with magnitude M_L=1.6 was located 14 km north of Kebnekaise fjäll station. Additional 6 events had magnitudes equal or above M_L=1.0. The depth range of the events varies between 0.8 and 34.7 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
20100204	090245.2	62.914	18.407	6,980.7	1,632.0	5.6	1.3
20100204	123737.5	59.862	14.846	6,638.4	1,446.1	23.1	0.2
20100205	013035.0	62.909	18.404	6,980.1	1,631.9	1.6	1.8
20100205	014055.9	63.452	19.164	7,042.4	1,667.3	9.9	–0.1
20100206	131037.0	61.049	17.019	6,770.9	1,565.4	25.7	–0.2
20100206	235213.2	62.984	18.056	6,987.9	1,613.9	34.7	0.0
20100208	112958.5	60.668	16.166	6,727.8	1,519.6	20.8	0.1
20100209	153817.6	64.477	21.461	7,164.4	1,771.6	13.4	1.2
20100210	100347.3	64.466	20.383	7,159.0	1,720.0	17.0	–0.1
20100210	215038.5	66.662	22.089	7,409.9	1,777.3	6.1	–0.4
20100212	023314.6	64.256	20.456	7,135.9	1,725.2	17.4	–0.3
20100212	115635.4	65.095	21.048	7,231.4	1,746.0	4.1	0.2
20100212	170712.8	61.904	17.672	6,866.9	1,598.0	21.5	0.5
20100212	183849.1	61.033	16.523	6,768.7	1,538.6	17.7	–0.2
20100212	230330.0	63.289	20.755	7,029.5	1,748.0	1.3	0.5
20100213	001942.2	66.231	23.386	7,368.5	1,840.2	2.0	1.6
20100213	141720.1	62.601	18.218	6,945.4	1,623.7	2.2	2.0
20100213	152601.9	67.414	22.143	7,493.6	1,771.2	5.9	–0.4
20100213	190646.0	62.057	16.807	6,882.9	1,552.2	2.9	–0.1
20100213	230133.7	64.601	21.504	7,178.3	1,772.4	23.1	0.2
20100214	054201.5	64.793	21.031	7,197.8	1,748.0	3.0	0.3
20100214	084955.7	64.807	20.202	7,196.3	1,708.6	18.7	0.3
20100214	231943.1	63.273	18.576	7,021.1	1,638.9	19.0	1.0
20100214	232219.4	63.276	18.591	7,021.5	1,639.6	21.6	0.1
20100215	062617.9	64.648	21.207	7,182.4	1,757.8	10.8	0.2
20100217	025434.0	59.850	14.939	6,636.9	1,451.3	24.4	0.4
20100220	180557.6	65.834	22.819	7,321.4	1,819.8	3.6	0.4
20100222	015758.4	61.978	17.583	6,875.1	1,593.0	19.8	–0.1
20100222	162643.4	67.618	19.774	7,507.9	1,668.5	20.1	0.1
20100222	183344.1	61.858	17.116	6,861.0	1,568.8	10.8	1.2
20100224	193007.8	66.462	21.954	7,387.1	1,773.6	15.8	0.3
20100224	220310.7	67.563	22.234	7,510.5	1,773.4	12.3	–0.1
20100225	165716.0	61.820	16.733	6,856.5	1,548.7	11.5	–0.3
20100227	050346.6	67.720	20.304	7,520.8	1,690.1	17.2	–0.4
20100227	062623.7	64.168	20.349	7,125.8	1,720.7	11.6	1.0
20100227	094406.7	64.661	21.389	7,184.6	1,766.3	0.8	0.5
20100227	215534.1	67.771	19.572	7,524.4	1,658.9	17.2	–0.2
20100228	042735.6	64.464	20.392	7,158.8	1,720.4	18.9	0.6
20100228	132150.8	68.013	18.647	7,549.3	1,618.6	6.0	1.6

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 had magnitude M_L=1.4 located 13 km NE of Landskrona. One earthquake with magnitude M_L=1.3 was located 15 km east of Skellefteå. Additional 6 earthquakes had magnitudes equal to or above M_L=1.0. The depth range of the events varies between 0.1 and 30.4 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
20100301	204316.8	66.011	19.772	7,328.9	1,679.8	4.6	0.5
20100305	204246.7	68.504	19.781	7,606.5	1,662.4	16.2	0.8
20100306	020201.4	55.883	11.653	6,202.7	1,240.1	0.1	0.9
20100306	062758.4	64.593	21.242	7,176.3	1,760.0	30.4	–0.2
20100307	091554.8	59.711	17.398	6,622.3	1,589.5	1.1	0.0
20100308	061811.5	58.090	13.589	6,442.8	1,369.1	10.0	1.0
20100309	232956.9	62.084	17.323	6,886.5	1,579.1	16.5	0.3
20100310	032022.0	65.651	23.222	7,303.3	1,840.5	17.8	1.1
20100312	002516.3	62.153	17.795	6,894.9	1,603.6	18.4	0.0
20100312	013735.9	58.439	14.003	6,480.9	1,394.6	27.3	–0.2
20100312	054501.5	68.263	20.205	7,580.9	1,681.6	8.1	0.7
20100312	104653.5	67.314	18.705	7,471.5	1,624.7	18.9	–0.4
20100313	064530.4	58.350	14.693	6,470.2	1,434.7	15.1	1.2
20100314	032527.1	64.551	20.276	7,168.1	1,714.1	17.6	0.0
20100314	055626.0	62.155	17.792	6,895.0	1,603.4	5.7	0.2
20100314	131020.5	62.153	17.790	6,894.8	1,603.3	5.9	0.5
20100314	143503.0	64.716	21.334	7,190.4	1,763.2	11.9	0.1
20100314	220854.4	68.370	16.133	7,586.4	1,513.3	0.1	0.7
20100315	013855.5	64.150	20.785	7,125.2	1,742.0	7.8	0.2
20100315	063348.1	61.613	16.693	6,833.4	1,546.9	9.5	0.5
20100315	185613.6	60.039	16.391	6,657.9	1,532.5	5.0	0.6
20100317	075521.6	68.072	20.458	7,560.4	1,693.7	5.0	–0.3
20100318	025115.9	58.797	13.359	6,521.9	1,358.4	25.8	1.1
20100318	095308.8	59.110	13.550	6,556.4	1,370.6	24.9	0.4
20100318	202124.2	63.192	17.654	7,010.4	1,592.9	4.5	0.5
20100318	213853.0	56.490	12.991	6,266.1	1,326.5	16.3	0.0
20100319	015330.4	64.427	20.585	7,155.3	1,730.0	8.5	0.1
20100319	081744.4	66.036	23.581	7,347.9	1,851.6	10.6	1.1
20100319	181520.1	64.568	21.208	7,173.4	1,758.6	26.0	0.3
20100321	071822.1	65.547	18.434	7,274.1	1,621.3	11.5	0.8
20100322	093113.5	64.521	21.389	7,168.9	1,767.7	22.1	0.4
20100322	130059.5	61.111	17.208	6,778.0	1,575.5	18.4	0.6
20100322	131041.5	61.118	17.330	6,778.9	1,582.0	12.3	–0.5
20100323	014134.7	64.494	21.086	7,164.7	1,753.4	19.9	0.1
20100323	103110.7	64.375	20.880	7,150.7	1,744.6	20.6	1.0
20100324	024948.4	67.235	22.035	7,473.3	1,768.6	17.4	–0.5
20100325	084201.3	62.051	17.355	6,882.9	1,580.9	10.2	0.1
20100326	052549.3	64.172	20.341	7,126.1	1,720.3	6.8	0.7
20100326	224632.0	67.817	23.092	7,542.8	1,806.4	2.7	0.7
20100329	035456.2	57.884	15.584	6,417.7	1,486.7	17.1	0.2
20100329	045359.9	58.663	13.986	6,505.9	1,394.3	11.4	0.8
20100330	044409.6	64.703	21.335	7,189.0	1,763.3	5.2	1.3
20100331	072622.0	61.389	16.041	6,808.1	1,512.4	8.2	–0.3
20100331	155826.0	55.985	12.909	6,210.0	1,319.1	21.5	1.4