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Swedish National Seismic Network (SNSN)

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

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July 2008

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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 brief information about the recorded seismicity during April through June 2008.

The Swedish National Seismic Network consists of 61 stations. During April through June, 1,434 events were located whereof 115 are estimated as real earthquakes, 1,041 are estimated as explosions, 134 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 144 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 April two earthquakes were located 39 and 28 km north of Kiruna with magnitudes $M_L = 2.2$ and $M_L = 2.1$ respectively. In May one earthquake with magnitude $M_L = 2.2$ was located 12 km NW of Sunne and an additional earthquake was located 38 km north of Kiruna. This earthquake had a magnitude of $M_L = 2.1$. The largest earthquake in June was located 23 km south of Skagsudde and had a magnitude of $M_L = 1.5$. Seven earthquakes with magnitudes above $M_L = 2.0$ were located outside the Swedish border, one was located in Skagerak and the other six were located in Norway.

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 april till juni 2008.

Det seismiska nätet består av 61 stationer. Under perioden april till juni, 2008 var det 1 434 registrerade händelser varav 115 bedömdes som äkta jordskalv, 1 041 bedömdes vara förorsakade av explosioner eller sprängningar, 134 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 144 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Fyra jordskalv lokaliserades i Sverige med magnitud över $M_L = 2,0$. I april lokaliserades två skalv, 39 och 28 km norr om Kiruna med magnitud $M_L = 2,2$ och $M_L = 2,1$. I maj registrerades ett skalv med magnitud $M_L = 2,2$ vilken var lokaliserad 12 km nordväst om Sunne och ytterligare ett skalv lokaliserades till 38 km norr om Kiruna med magnitud $M_L = 2,1$. Största skalvet i juni hade magnitud $M_L = 1,5$ och lokaliserades till 23 km söder om Skagsudde. Sju skalv med magnituder större än $M_L = 2,0$ lokaliserades utanför Sveriges gränser. Ett skalv lokaliserades till Skagerak och de övriga inträffade i Norge.

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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 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

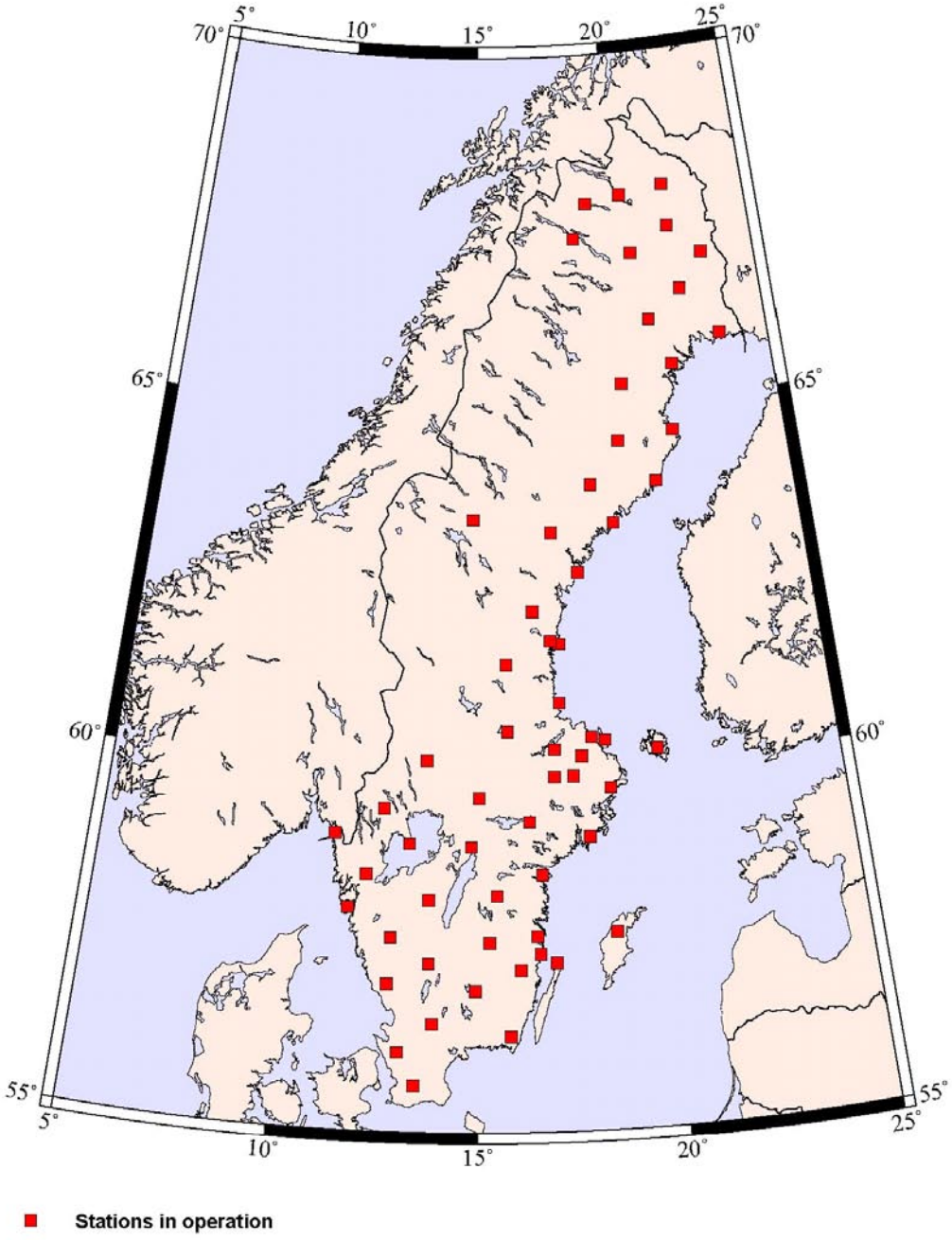

Figure 1-1. *The present Swedish National Seismic Network (SNSN).*

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 second quarter of 2008

Figure 3-1 shows the recorded events in Sweden during April through June. During the period 1,434 events were located whereof 115 are estimated as real earthquakes (which are shown in Figure 3-2). 1,041 are estimated as explosions and 144 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 134 events in the very vicinity of the mines have been excluded in the report.

Event lists for April through June 2008 are given in sections 3.1 through 3.3.

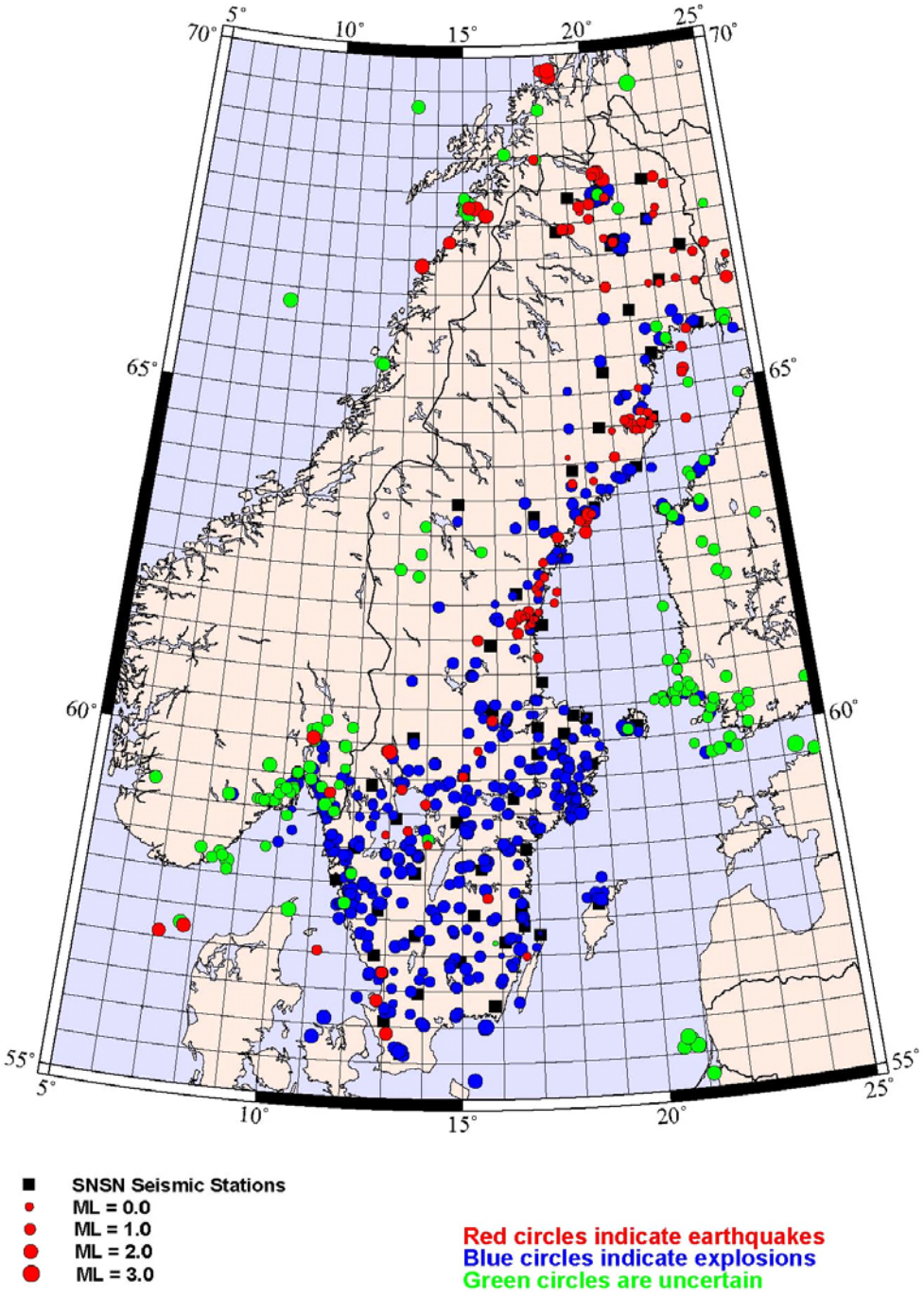

Figure 3-1. *Recorded events including explosions in the SNSN network during the period April through June 2008.*

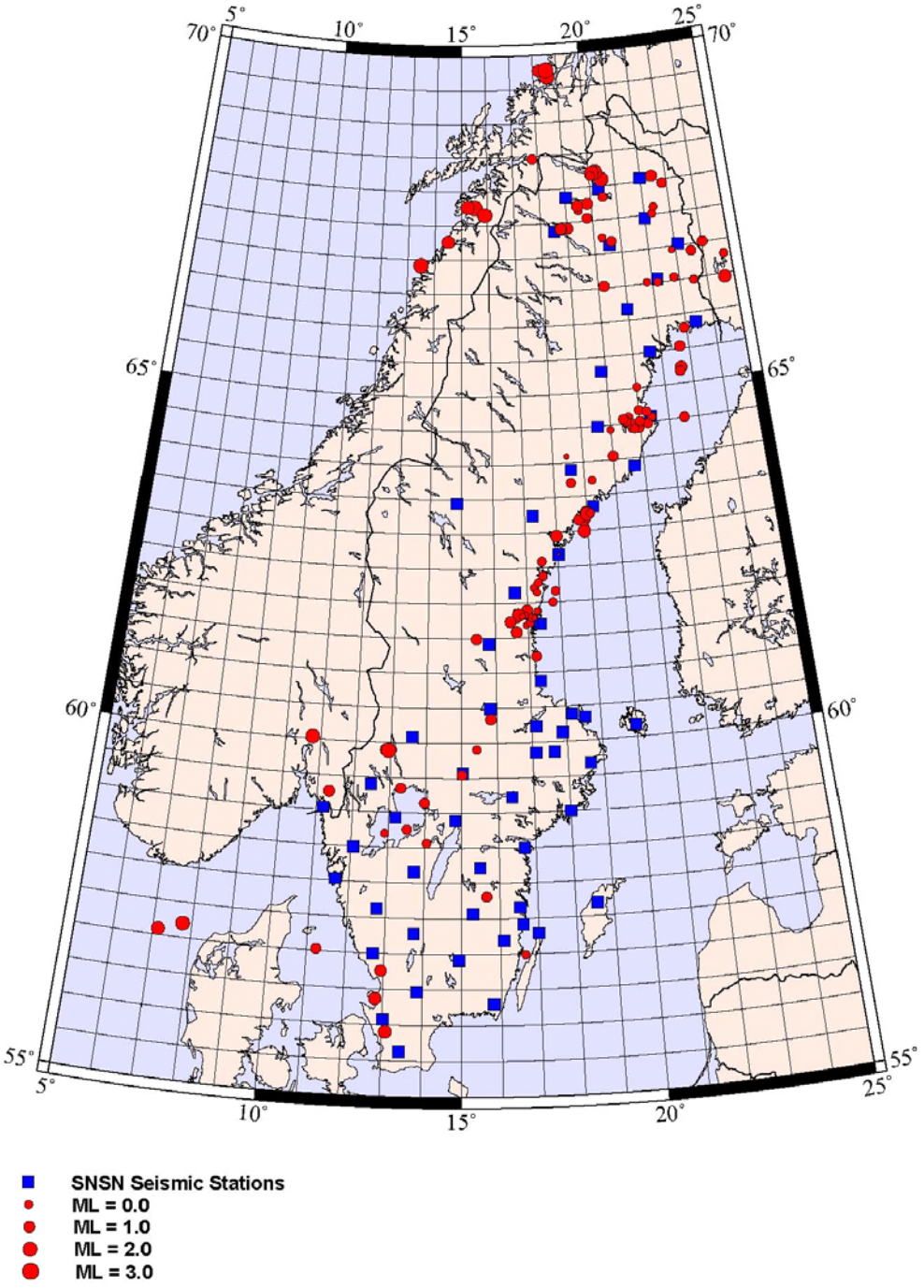

Figure 3-2. *Earthquake activity in Sweden during April through June 2008.*

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 44 events were located whereof one had magnitude M_L = 2.2 which was located 39 km N of Kiruna and another with magnitude M_L = 2.1was located 28 km N of Kiruna. Four earthquakes with magnitudes above M_L = 2.0 were located in Norway outside the network. Additional 6 earthquakes had magnitudes between M_L = 1.1 and M_L = 1.7. The depth range of the events varies between 0.0 and 32.9 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 Local Magnitude
20080402	041205.9	67.832	20.468	7,533.8	1,696.1	0.3	0.3
20080402	171924.4	61.766	16.663	6,850.5	1,545.1	17.3	–0.3
20080404	012946.5	66.451	24.653	7,400.3	1,893.4	2.1	1.6
20080404	013111.3	63.699	18.552	7,068.5	1,635.7	22.8	0.4
20080405	193130.6	66.506	22.189	7,393.0	1,783.5	13.7	–0.1
20080406	151537.3	67.941	22.827	7,555.2	1,793.7	3.6	0.6
20080407	181202.4	55.906	13.089	6,200.8	1,330.0	21.8	1.7
20080408	172102.9	64.093	18.456	7,112.1	1,629.1	7.3	–1.2
20080410	090035.5	67.754	19.843	7,523.2	1,670.4	17.8	1.1
20080410	092016.9	63.184	18.917	7,012.0	1,656.5	2.9	0.3
20080411	060257.1	67.760	15.513	7,518.3	1,487.5	0.4	2.5
20080412	023308.5	63.161	18.965	7,009.5	1,659.0	16.1	0.1
20080414	050413.1	58.759	13.505	6,517.5	1,366.7	17.0	0.5
20080414	085435.6	67.542	19.795	7,499.4	1,669.9	2.2	0.5
20080415	014052.5	65.540	22.676	7,288.1	1,816.9	0.0	0.9
20080415	091457.0	67.408	19.028	7,482.6	1,638.0	0.1	0.9
20080415	180600.4	63.161	18.730	7,008.9	1,647.2	7.8	0.8
20080416	210117.3	64.680	21.005	7,185.0	1,747.9	3.0	0.2
20080417	002948.7	66.475	23.506	7,396.2	1,842.3	4.5	0.0
20080418	020101.7	67.657	15.885	7,506.8	1,503.2	24.5	2.0
20080418	052412.6	59.148	13.976	6,559.9	1,395.1	19.5	0.8
20080418	222810.2	61.877	17.313	6,863.4	1,579.2	11.0	–0.4
20080420	091010.9	68.095	20.474	7,563.0	1,694.1	3.1	2.1
20080420	183119.0	66.899	23.567	7,443.4	1,839.1	16.5	0.5
20080420	192312.1	65.234	22.628	7,253.9	1,818.4	14.4	1.3
20080420	234440.6	61.819	17.059	6,856.7	1,565.9	17.7	–0.6
20080421	031835.5	61.680	16.936	6,841.1	1,559.7	12.5	–0.7
20080421	154436.3	67.660	19.481	7,511.8	1,655.8	0.6	–0.1
20080422	025315.8	67.771	15.238	7,519.6	1,475.9	1.4	1.7
20080423	041637.9	65.015	21.022	7,222.3	1,745.6	4.3	–0.2
20080423	063123.7	68.211	20.242	7,575.2	1,683.6	2.9	2.2
20080424	073955.1	62.586	17.492	6,942.6	1,586.5	27.8	0.3
20080424	171454.5	69.678	18.587	7,734.7	1,607.7	0.1	2.4
20080424	201552.1	69.772	18.240	7,744.6	1,593.9	0.1	1.3
20080424	215036.3	68.254	20.184	7,579.8	1,680.9	10.7	–0.1
20080425	045316.5	69.773	18.560	7,745.2	1,606.2	13.5	2.5
20080426	075626.5	64.427	20.722	7,155.8	1,736.5	9.9	0.1
20080426	181143.5	64.418	20.972	7,155.8	1,748.7	19.0	0.0
20080427	210231.3	63.720	19.241	7,072.5	1,669.5	21.4	–0.2
20080427	223551.6	67.172	20.642	7,460.9	1,709.2	0.9	0.6
20080427	232430.0	67.238	20.303	7,467.1	1,694.0	32.9	–0.1
20080428	170601.5	64.568	21.413	7,174.3	1,768.4	10.0	0.0
20080429	005005.0	64.476	21.269	7,163.4	1,762.4	23.1	0.4
20080429	074513.6	62.156	17.873	6,895.4	1,607.6	16.9	0.2

3.2 May

An event list for May 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 May 38 events were located whereof one with magnitude M_L = 2.2, located 12 km NW of Sunne. One earthquake with magnitude M_L = 2.1was located 38 km north of Kiruna. Two earthquakes with magnitudes above M_L = 2.0 were located in Norway and one with M_L = 2.0 was located in Skagerak. Additional 13 events had magnitudes equal to or above M_L = 1.0. The depth range of the events varies between 0.1 and 36.0 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	ML Local Magnitude
20080501	030411.7	56.367	12.808	6,252.8	1,314.6	19.6	1.5
20080501	081818.5	61.873	17.276	6,862.9	1,577.2	15.5	–0.4
20080502	080914.0	57.026	11.240	6,331.4	1,222.7	36.0	0.8
20080502	131206.4	67.264	14.500	7,463.6	1,443.6	8.0	1.6
20080502	184618.9	61.228	17.215	6,791.0	1,575.6	19.3	0.6
20080503	174841.5	59.895	12.875	6,645.3	1,335.9	31.3	1.5
20080503	174911.1	59.886	12.937	6,644.1	1,339.3	31.3	2.2
20080504	171312.1	59.908	15.437	6,643.2	1,479.2	24.9	0.1
20080505	031427.2	64.650	21.256	7,182.8	1,760.1	3.0	0.2
20080506	013310.0	58.566	14.052	6,494.9	1,397.8	9.7	0.3
20080508	055724.4	61.487	15.455	6,819.2	1,481.2	7.0	0.9
20080508	192501.3	62.213	17.232	6,900.8	1,574.1	18.5	0.1
20080510	131230.9	59.550	15.016	6,603.5	1,455.2	14.3	0.5
20080511	222523.8	56.994	16.639	6,318.9	1,550.5	0.8	0.0
20080512	100134.4	59.271	11.318	6,580.8	1,244.1	17.5	1.0
20080514	081256.3	67.409	18.752	7,482.2	1,626.2	3.6	1.4
20080515	090544.7	66.916	13.490	7,426.0	1,398.5	0.1	2.2
20080515	194036.6	59.354	13.312	6,584.1	1,358.0	13.0	0.7
20080517	125151.0	68.066	22.447	7,567.4	1,776.3	5.0	1.0
20080519	115119.6	68.194	20.119	7,572.9	1,678.6	3.8	2.1
20080520	164846.6	60.339	15.839	6,691.1	1,501.7	10.1	0.8
20080521	131932.7	61.895	16.986	6,865.0	1,561.9	17.4	0.9
20080522	020211.6	67.730	19.449	7,519.5	1,654.0	10.8	1.1
20080523	222520.4	64.432	19.983	7,153.9	1,701.0	9.6	–0.5
20080524	191656.0	63.052	18.901	6,997.2	1,656.4	7.6	0.3
20080525	011006.6	60.033	10.758	6,667.8	1,218.7	22.1	2.1
20080525	015801.8	64.589	20.634	7,173.6	1,730.9	18.3	0.4
20080525	133043.3	62.943	17.988	6,983.2	1,610.6	10.5	1.2
20080526	123343.5	67.413	18.760	7,482.7	1,626.5	16.1	1.1
20080526	170845.4	68.459	17.794	7,597.6	1,581.4	12.2	0.6
20080527	132225.9	56.759	12.934	6,296.1	1,324.2	2.9	1.2
20080528	233539.2	63.259	18.986	7,020.4	1,659.6	1.0	1.5
20080529	000709.6	63.243	19.003	7,018.7	1,660.4	2.4	1.7
20080531	071729.7	67.009	24.029	7,458.2	1,857.6	1.7	0.8
20080531	080552.1	64.495	20.706	7,163.3	1,735.2	23.0	0.7
20080531	093034.7	63.245	19.115	7,019.2	1,666.1	9.8	–0.2
20080531	201356.3	57.086	7.138	6,362.3	975.2	30.8	1.7
20080531	201357.2	57.201	7.752	6,370.5	1,013.8	0.1	2.0

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 33 events were located all below magnitude M_L = 2.0. The three largest earthquakes had magnitudes M_L = 1.5 located 23 km south of Skagsudde, M_L = 1.4 located 8 km NE of Delsbo and M_L = 1.1 located 30 km NE of Bollnäs. One earthquake with magnitude M_L = 1.0 was located 10 km SW of Delsbo. The depth range of the events varies between 0.7 and 49.6 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	ML Local Magnitude
20080601	023938.9	62.992	18.880	6,990.5	1,655.6	1.1	1.5
20080601	093118.5	64.518	20.517	7,165.3	1,725.9	0.8	0.0
20080603	170123.4	64.530	20.557	7,166.7	1,727.7	21.6	0.3
20080604	131721.2	67.515	22.289	7,505.5	1,776.2	1.6	–0.1
20080604	233941.1	61.820	16.911	6,856.7	1,558.1	9.0	–0.4
20080605	045907.8	64.051	19.999	7,111.5	1,704.6	5.1	0.8
20080605	084717.5	61.829	16.716	6,857.5	1,547.8	9.8	1.4
20080605	104841.7	61.711	17.063	6,844.6	1,566.3	10.6	–0.2
20080608	065418.2	61.729	16.465	6,846.1	1,534.7	2.5	1.0
20080608	100708.3	61.785	17.127	6,853.0	1,569.6	6.3	–0.2
20080608	233650.1	62.001	17.777	6,877.9	1,603.1	23.0	0.0
20080609	011252.2	65.799	22.922	7,318.1	1,824.9	9.3	0.6
20080610	014203.1	66.550	22.801	7,400.8	1,810.1	24.0	0.1
20080610	035339.6	64.572	20.443	7,171.0	1,721.9	49.6	0.4
20080610	040018.6	58.694	12.905	6,511.5	1,331.7	16.2	–0.2
20080610	061212.9	66.947	22.854	7,445.1	1,807.4	10.0	–0.6
20080610	201608.1	67.610	22.373	7,516.4	1,778.7	16.5	–0.2
20080615	120334.8	62.374	17.507	6,919.0	1,587.9	6.7	0.2
20080616	162455.8	62.685	18.031	6,954.5	1,613.8	0.7	–1.9
20080617	034514.8	62.283	17.352	6,908.7	1,580.1	19.8	–0.1
20080620	032641.0	61.581	16.643	6,829.8	1,544.3	3.3	1.1
20080621	085953.9	66.786	24.748	7,437.8	1,892.2	28.6	0.1
20080622	130252.6	66.526	20.204	7,387.6	1,695.3	6.1	0.9
20080622	150442.4	64.524	21.005	7,167.8	1,749.2	11.1	0.4
20080624	124836.5	65.179	22.572	7,247.5	1,816.4	5.5	0.6
20080624	142221.0	66.520	21.791	7,392.8	1,765.8	1.3	–0.3
20080626	161146.6	62.145	17.298	6,893.2	1,577.7	16.0	–0.3
20080627	132349.9	64.419	20.804	7,155.2	1,740.6	3.5	0.1
20080627	221505.9	64.510	22.511	7,173.0	1,821.5	5.4	0.6
20080627	235855.1	61.805	16.826	6,854.9	1,553.7	17.8	–0.8
20080628	191551.6	68.157	20.052	7,568.7	1,676.1	5.5	0.3
20080628	221209.6	61.787	17.191	6,853.3	1,572.9	12.0	–1.0
20080629	151626.4	57.814	15.658	6,409.9	1,491.1	19.1	0.6