

Swedish National Seismic Network (SNSN)

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

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October 2010

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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. SKB may draw modified conclusions, based on additional literature sources and/or expert opinions.

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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 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 July through September 2010.

The Swedish National Seismic Network consists of 61 stations. During July through September, 1,632 events were located whereof 130 are estimated as real earthquakes, 1,122 are estimated as explosions, 185 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 195 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

One earthquake had magnitudes above $M_L=2.0$ during the period. In September an earthquake was located 23 km NW of Härnösand with a magnitude of $M_L=2.1$. The second largest earthquake with a magnitude of $M_L=1.9$ occurred in the same month and was located 46 km NE of Kiruna.

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 juli till september 2010.

Det seismiska nätet består av 61 stationer. Under perioden juli till september, 2010 var det 1 632 registrerade händelser varav 130 bedömdes som äkta jordskalv, 1 122 bedömdes vara förorsakade av explosioner eller sprängningar, 185 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 195 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Endast ett jordskalv hade magnitud över $M_L=2.0$ under perioden. I september inträffade ett skalv 23 km nordväst om Härnösand med magnitud $M_L=2.1$. Ett skalv med magnitud $M_L=1.9$ inträffade 46 km nordost om Kiruna i samma månad.

Contents

1	Introduction	7
2	Objective and scope	9
3	Recorded earthquakes during the third quarter of 2010	11
3.1	July	12
3.2	August	14
3.3	September	14

1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the third 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 there are 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

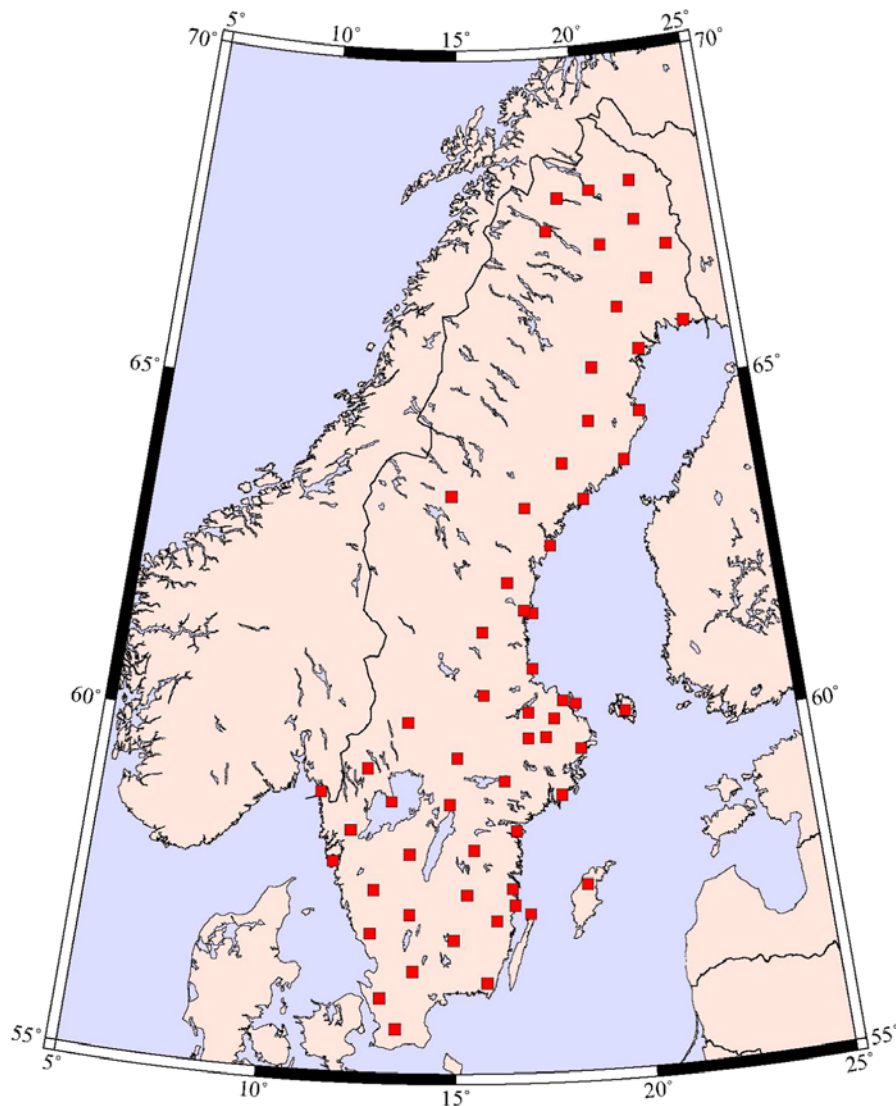


Figure 1-1. The present Swedish National Seismic Network (SNSN).

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 a magnitude of 0.0 near the proposed nuclear waste deposit site in Forsmark.

3 Recorded earthquakes during the third quarter of 2010

Figure 3-1 shows the recorded events in Sweden during July through September. During the period 1,632 events were located whereof 130 are estimated as real earthquakes (which are shown in Figure 3-2). 1,122 are estimated as explosions and 195 are still considered as uncertain but are most probably explosions and are mainly located outside the seismic network. Large amounts of induced seismicity around the mines in Kirunavaara, Malmberget and Aitik are observed and 185 events in the very vicinity of the mines have been excluded in the report.

Event lists for July through September 2010 are given in sections 3.1 through 3.3.

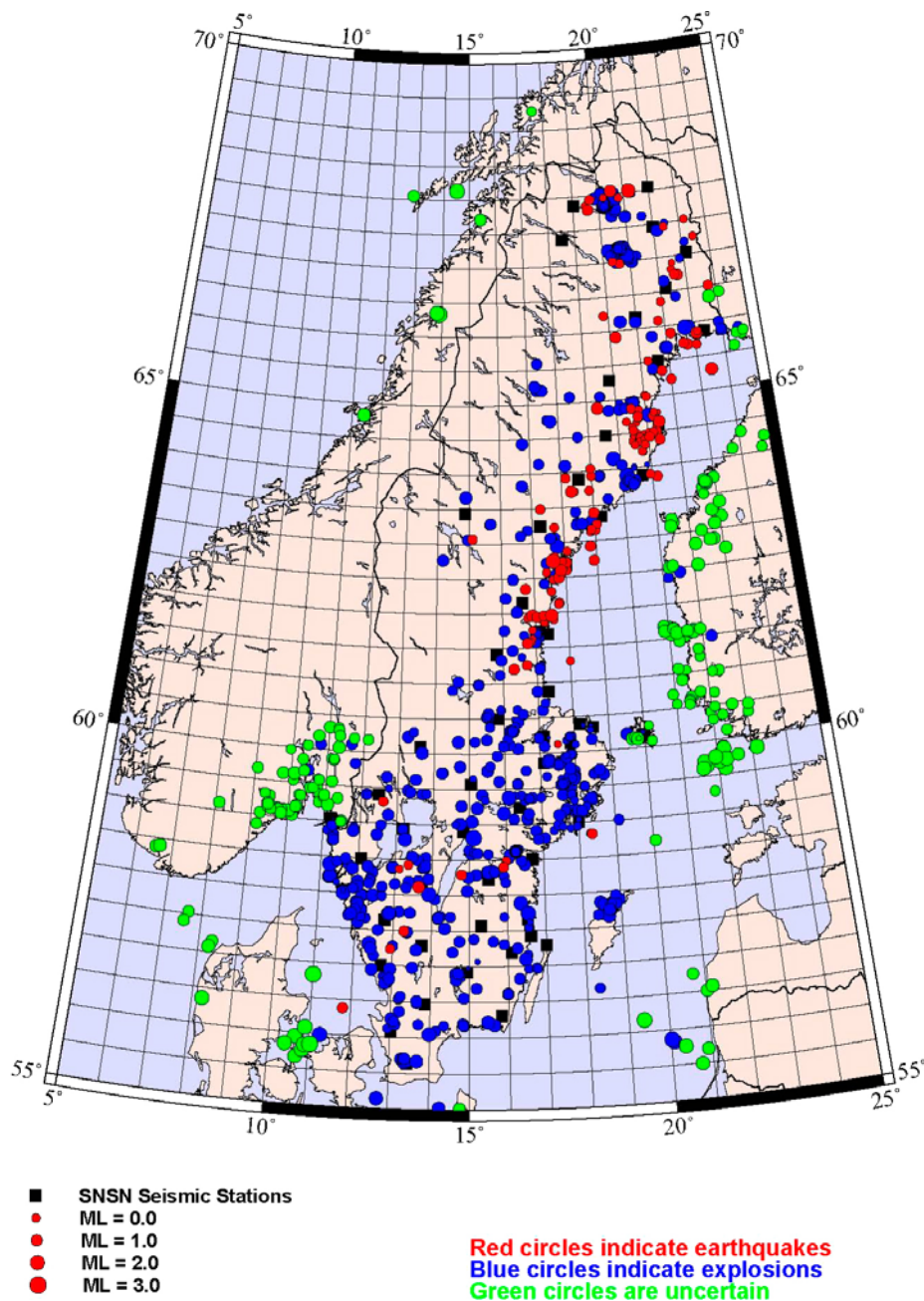


Figure 3-1. Recorded events including explosions in the SNSN network during the period July through September 2010.

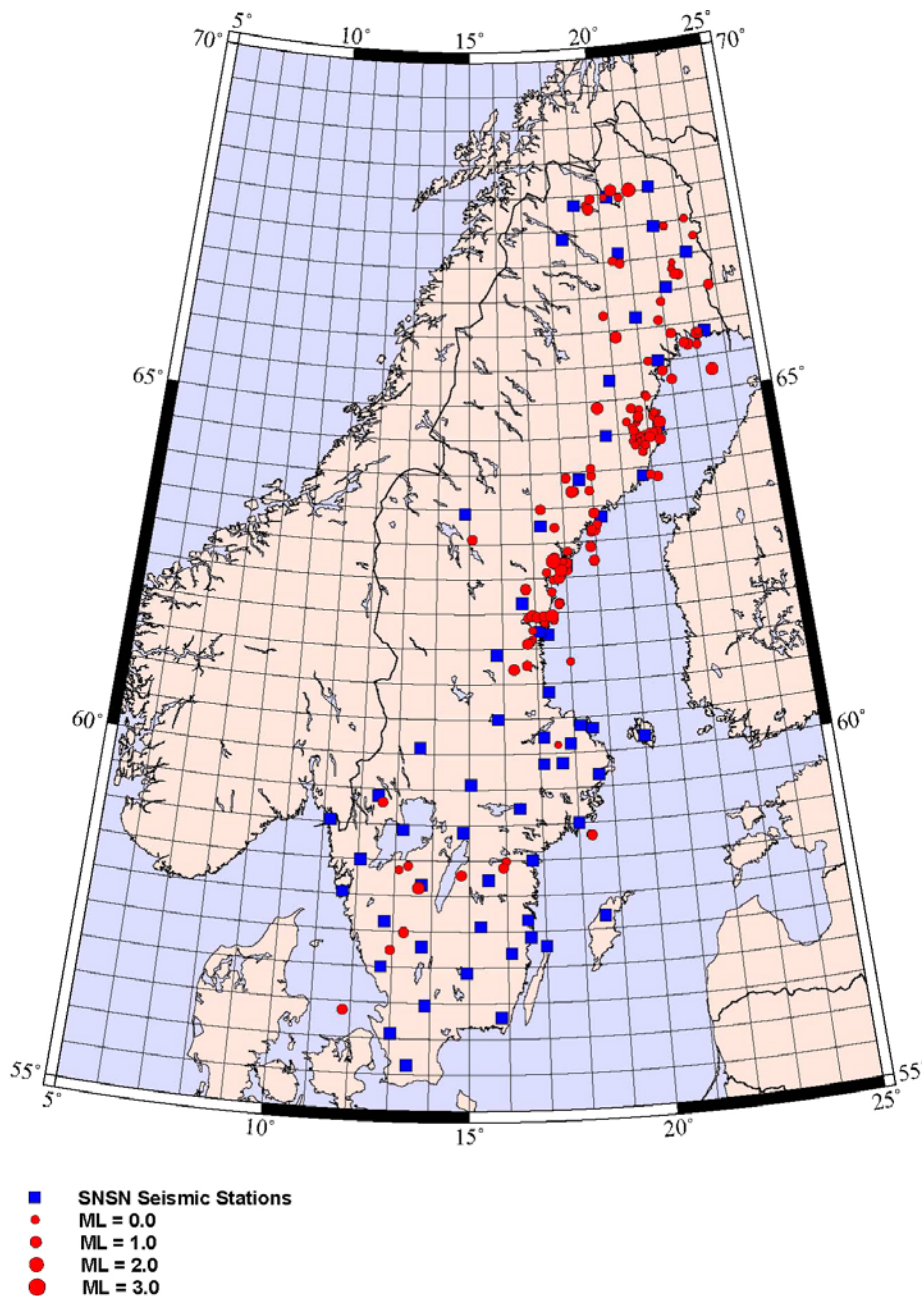


Figure 3-2. Earthquake activity in Sweden during July through September 2010.

3.1 July

An event list for July 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 July 48 events were located whereof one had a magnitude of $M_L=1.3$ located 30 km north of Hudiksvall. One earthquake with a magnitude of $M_L=1.2$ was located 24 km NE of Kiruna and one with a magnitude of $M_L=1.1$ was located 46 km NW of Älvsbyn. The remaining earthquakes during the period had magnitudes below $M_L=1.0$. The depth range of the events varies between 0.1 and 39.2 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M _L Local Magnitude
20100701	065254.7	66.229	19.829	7,353.4	1,680.8	12.3	0.2
20100701	213110.6	63.923	18.147	7,092.6	1,614.7	17.9	0.4
20100702	210928.8	64.465	20.851	7,160.6	1,742.4	20.5	-0.1
20100703	122601.7	64.763	21.391	7,195.8	1,765.4	14.0	-0.8
20100704	055954.6	64.549	21.310	7,171.7	1,763.6	20.4	-0.1
20100704	142129.5	60.116	17.516	6,667.6	1,594.9	12.6	-0.4
20100704	162227.4	63.132	18.861	7,006.0	1,653.9	3.8	0.0
20100704	165505.5	58.834	18.303	6,526.2	1,644.1	19.5	0.1
20100704	170128.5	58.825	18.346	6,525.3	1,646.5	17.4	0.5
20100704	234130.7	67.955	20.194	7,546.6	1,683.6	20.9	-0.4
20100705	094936.9	63.847	21.166	7,093.2	1,763.3	7.1	0.6
20100706	011143.2	61.624	16.896	6,834.8	1,557.7	18.1	-0.1
20100708	081236.3	62.579	17.397	6,941.7	1,581.7	5.4	0.1
20100708	204617.3	61.260	16.707	6,794.1	1,548.2	3.4	0.6
20100709	164723.4	61.854	17.273	6,860.8	1,577.1	1.3	0.2
20100710	022904.7	64.642	20.637	7,179.4	1,730.7	19.4	-0.4
20100710	104652.3	61.590	16.864	6,830.9	1,556.1	2.2	-0.5
20100710	204210.4	61.294	18.000	6,799.5	1,617.4	39.2	-0.1
20100711	142632.9	66.089	21.771	7,344.9	1,769.4	17.5	0.2
20100712	222816.8	64.219	20.776	7,132.9	1,741.0	27.5	-0.2
20100713	045759.2	61.903	17.555	6,866.7	1,591.8	1.9	0.3
20100713	091213.7	59.309	12.607	6,580.8	1,317.7	20.9	0.5
20100713	145556.6	64.854	20.504	7,202.5	1,722.6	5.6	0.4
20100714	022504.8	62.131	17.752	6,892.3	1,601.4	3.2	0.5
20100714	032221.2	62.121	17.737	6,891.2	1,600.6	8.4	0.3
20100714	215750.8	63.169	19.019	7,010.6	1,661.7	19.2	-0.1
20100714	220019.7	63.159	18.998	7,009.4	1,660.7	10.4	0.7
20100717	012312.9	67.852	19.493	7,533.2	1,655.0	21.2	0.0
20100717	012353.3	67.793	19.573	7,526.8	1,658.7	9.2	0.9
20100717	125000.7	65.697	22.712	7,305.7	1,816.6	18.3	0.9
20100718	144711.9	65.722	22.578	7,307.8	1,810.2	10.1	0.5
20100719	062900.8	61.932	16.767	6,869.0	1,550.3	19.8	0.1
20100719	234021.9	64.723	21.241	7,190.8	1,758.7	4.9	0.8
20100721	190928.4	58.487	15.990	6,484.9	1,510.6	10.6	0.1
20100721	215415.4	64.386	20.482	7,150.4	1,725.3	23.3	0.3
20100722	020519.3	57.238	12.941	6,349.4	1,326.9	18.2	0.4
20100723	083153.1	61.965	16.919	6,872.8	1,558.3	10.9	1.3
20100724	105019.8	68.047	20.503	7,557.8	1,695.7	10.5	1.2
20100724	141358.0	57.487	13.284	6,376.2	1,348.6	14.1	0.7
20100724	164515.3	66.355	21.944	7,375.2	1,774.3	7.0	0.0
20100724	165435.3	67.441	22.397	7,497.7	1,781.7	0.1	-0.1
20100725	062132.4	63.490	17.276	7,043.1	1,573.1	29.6	0.5
20100726	160844.8	61.920	17.182	6,868.1	1,572.2	7.0	-0.0
20100727	073616.4	58.363	13.114	6,474.2	1,342.3	19.6	-0.1
20100729	203135.2	64.471	20.592	7,160.3	1,729.9	8.7	0.9
20100731	115355.2	65.905	20.202	7,318.5	1,700.1	13.3	1.1
20100731	163235.1	62.719	17.915	6,958.1	1,607.7	9.3	0.7
20100731	170202.0	63.400	18.998	7,036.2	1,659.3	0.5	0.8

3.2 August

An event list for August 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 August 27 events were located whereof one with a magnitude of $M_L=1.3$, located 9 km SE of Falköping, one with a magnitude of $M_L=1.2$ located 18 km west of Härnösand and one with a magnitude of $M_L=1.0$ located 54 km NW of Örnsköldsvik. The remaining earthquakes during the period had magnitudes below $M_L=1.0$. The depth range of the events varies between 0.1 and 26.8 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M_L Local Magnitude
20100802	144302.7	62.555	17.874	6,939.8	1,606.3	6.8	0.3
20100804	230407.5	64.668	20.313	7,181.3	1,715.0	6.8	-0.1
20100806	000319.7	63.072	15.088	6,995.9	1,463.6	13.7	0.6
20100806	040460.0	66.968	20.595	7,438.1	1,708.9	26.8	0.2
20100806	052342.1	63.721	18.898	7,071.7	1,652.6	26.4	0.2
20100806	165100.9	61.943	17.047	6,870.5	1,565.0	22.3	0.8
20100807	040519.4	64.418	20.688	7,154.7	1,735.0	19.4	-0.4
20100808	033654.3	66.809	22.479	7,428.0	1,792.8	25.1	-0.3
20100808	114310.4	62.349	16.726	6,915.5	1,547.5	2.9	0.7
20100809	151127.6	58.116	13.646	6,445.5	1,372.6	7.9	1.3
20100809	225541.7	61.571	16.743	6,828.8	1,549.6	9.8	0.7
20100812	155825.6	65.358	21.713	7,263.4	1,774.5	19.1	0.6
20100812	211511.8	64.431	20.959	7,157.2	1,747.9	20.4	-0.4
20100814	123102.3	64.434	20.716	7,156.6	1,736.2	18.6	-0.2
20100817	162412.6	63.884	20.931	7,096.3	1,751.5	7.4	0.2
20100819	000209.2	64.365	20.718	7,148.9	1,736.9	1.3	0.1
20100819	172419.7	65.221	21.998	7,249.4	1,789.2	7.3	0.5
20100819	174940.2	61.862	17.262	6,861.7	1,576.5	0.1	-0.3
20100819	223356.3	62.300	17.527	6,910.8	1,589.2	16.1	0.0
20100821	054344.7	64.394	20.867	7,152.8	1,743.8	4.6	-0.1
20100821	072716.5	62.872	18.080	6,975.5	1,615.6	23.7	0.0
20100823	065803.4	64.494	21.311	7,165.6	1,764.2	24.8	0.2
20100827	044335.9	62.596	18.036	6,944.6	1,614.4	6.7	0.3
20100827	121034.9	62.698	17.676	6,955.4	1,595.6	8.7	1.2
20100828	014504.5	63.722	18.399	7,070.7	1,628.0	12.9	0.2
20100828	145731.0	63.726	18.308	7,071.0	1,623.5	3.6	1.0
20100829	200159.2	65.518	21.252	7,279.2	1,751.6	12.0	0.1

3.3 September

An event list for September 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 September 55 events were located whereof one had a magnitude of $M_L=2.1$ located 23 km NW of Härnösand. One earthquake with a magnitude of $M_L=1.9$ was located 46 km NE of Kiruna and one with a magnitude of $M_L=1.6$ was located 34 km NE of Hudiksvall. Additional 5 earthquakes had magnitudes equal to or above $M_L=1.0$. The depth range of the events varies between 0.1 and 38.6 km.

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

Date	Time (UTC)	Latitude	Longitude	X RT90 Km	Y RT90 Km	Depth Km	M _L Local Magnitude
20100901	115133.7	64.482	21.046	7,163.2	1,751.6	19.2	0.2
20100902	071602.4	64.227	20.753	7,133.7	1,739.8	16.4	-0.0
20100902	105256.9	62.473	17.598	6,930.2	1,592.3	20.0	0.1
20100902	113955.5	62.793	17.663	6,965.9	1,594.6	1.1	0.4
20100902	232319.9	64.319	20.866	7,144.4	1,744.4	22.1	0.1
20100904	030507.1	65.291	23.424	7,264.4	1,854.6	0.1	1.4
20100904	035354.6	62.721	18.911	6,960.4	1,658.6	4.6	0.8
20100904	043340.5	65.885	22.160	7,323.9	1,789.3	38.6	0.5
20100904	043515.1	62.621	17.960	6,947.3	1,610.4	3.2	-0.7
20100904	104016.5	64.322	20.531	7,143.5	1,728.3	5.4	-0.1
20100905	100503.7	64.829	20.764	7,200.7	1,735.1	17.1	-0.3
20100905	193606.9	64.376	21.373	7,152.7	1,768.3	28.0	0.7
20100906	062839.9	68.026	21.212	7,557.9	1,725.5	6.4	1.9
20100906	070912.7	58.424	13.354	6,480.4	1,356.6	16.8	0.2
20100906	172925.8	66.720	22.684	7,419.1	1,802.8	29.0	0.7
20100907	070416.2	65.842	23.080	7,323.6	1,831.6	3.0	1.3
20100907	070416.4	61.959	17.263	6,872.5	1,576.3	3.0	0.5
20100908	005223.1	64.584	20.485	7,172.5	1,723.9	8.3	-0.1
20100909	154033.5	58.293	14.785	6,463.7	1,440.0	18.0	0.7
20100909	224533.3	65.861	23.121	7,326.0	1,833.2	6.2	-0.2
20100910	205222.3	65.675	23.026	7,304.9	1,831.3	5.4	0.2
20100910	214804.6	63.219	17.700	7,013.5	1,595.1	14.5	0.3
20100910	233601.1	65.033	21.020	7,224.4	1,745.3	3.0	-0.1
20100912	092732.7	61.756	16.902	6,849.5	1,557.8	0.9	-0.3
20100913	060408.7	67.008	20.338	7,441.6	1,697.3	38.0	0.1
20100913	155247.5	63.932	18.985	7,095.4	1,655.8	24.7	0.3
20100914	224938.8	62.493	17.770	6,932.7	1,601.1	2.9	0.9
20100915	194956.0	58.398	15.913	6,474.9	1,506.1	17.3	0.6
20100916	001307.8	66.508	23.739	7,401.1	1,852.1	12.9	0.5
20100916	220138.8	64.710	20.708	7,187.3	1,733.5	6.0	0.4
20100916	230446.9	63.236	19.065	7,018.1	1,663.6	14.0	0.3
20100917	002731.3	64.491	21.183	7,164.7	1,758.1	20.0	0.1
20100918	210911.2	62.708	18.047	6,957.1	1,614.5	7.7	0.5
20100918	233309.2	64.899	19.352	7,204.1	1,667.7	4.1	1.3
20100919	070414.0	64.774	21.259	7,196.5	1,759.0	16.7	-0.3
20100919	071942.8	56.378	11.802	6,257.2	1,252.6	13.7	0.8
20100920	030311.1	62.731	17.915	6,959.5	1,607.7	7.4	-0.1
20100920	134611.1	65.010	21.057	7,222.0	1,747.3	37.8	0.1
20100921	020229.9	64.036	18.986	7,107.0	1,655.2	27.9	0.2
20100922	025312.7	61.201	16.321	6,787.2	1,527.6	15.1	0.9
20100922	152629.8	66.728	22.566	7,419.4	1,797.6	3.6	0.5
20100922	202537.4	64.420	21.039	7,156.3	1,751.9	20.6	0.6
20100922	232432.6	67.251	23.439	7,481.8	1,828.7	25.1	-0.2
20100923	041524.5	62.605	17.843	6,945.3	1,604.5	2.6	1.3
20100923	103740.2	67.942	19.678	7,543.7	1,662.1	8.2	0.4
20100925	030516.7	62.739	17.613	6,959.9	1,592.2	2.5	2.1
20100925	062121.1	61.960	17.503	6,872.9	1,588.9	2.4	1.6
20100925	114521.8	67.512	23.194	7,509.5	1,814.7	19.0	-0.2
20100925	120956.3	66.898	22.519	7,438.0	1,793.4	1.4	-0.6
20100925	213356.1	63.168	18.884	7,010.1	1,654.9	18.9	0.3
20100926	174919.6	62.926	18.822	6,983.0	1,653.0	1.7	0.7
20100926	211952.4	67.933	20.797	7,546.0	1,709.0	22.9	-0.2
20100926	220237.5	64.731	20.712	7,189.6	1,733.4	23.5	0.6
20100928	123317.2	64.536	20.521	7,167.3	1,726.0	21.2	0.2
20100929	123944.8	64.630	21.414	7,181.2	1,767.8	13.4	1.2