

# **Swedish National Seismic Network (SNSN)**

## **A short report on recorded earthquakes during the third quarter of the year 2008**

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October 2008

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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 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](http://www.skb.se).

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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 July through September 2008.

The Swedish National Seismic Network consists of 61 stations. During July through September, 688 events were located whereof 75 are estimated as real earthquakes, 439 are estimated as explosions, 103 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 71 events are still considered as uncertain but these are most likely explosions and are mainly located outside the network.

Three earthquakes had magnitudes above  $M_L=2.0$ . In July one earthquake with magnitude  $M_L=2.2$  was located 28 km SE of Örnköldsvik. In August one earthquake with magnitude  $M_L=2.2$  was located 3 km north of Kalix and in September one with magnitude  $M_L=2.4$  was located 21 km SE of Luleå.

# 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 juli till september 2008.

Det seismiska nätet består av 61 stationer. Under perioden juli till september 2008 var det 688 registrerade händelser, varav 75 bedömdes som äkta jordskalv, 439 bedömdes vara förorsakade av explosioner eller sprängningar, 103 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 71 var osäkra händelser, men dessa var i huvudsak lokaliserade utanför det seismiska nätet och är sannolikt förorsakade av explosioner.

Tre jordskalv hade magnitud över  $M_L=2,0$ . I juli inträffade ett skalv 28 km sydost om Örnsköldsvik med magnitud  $M_L=2,2$ . I augusti inträffade ett skalv på  $M_L=2,2$ , 3 km norr om Kalix. I september inträffade ett skalv 21 km sydost om Luleå med magnitud  $M_L=2,4$ .

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# 1 Introduction

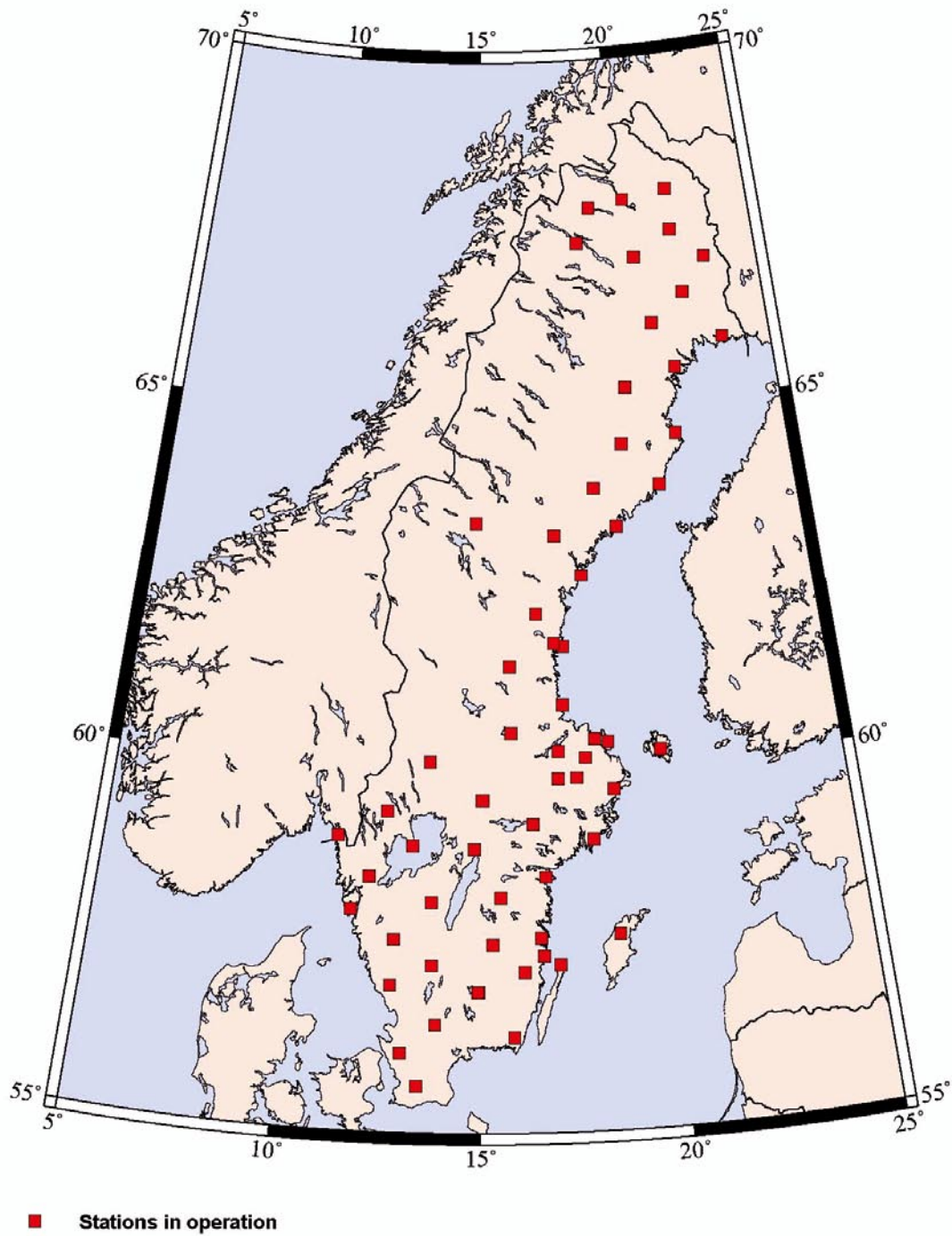
This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the third quarter of the year 2008. The work was carried out in accordance with activity plan AP PU 400-06-004. In Table 1-1 controlling document for performing this activity is listed. The activity plan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

<b>Activity plan</b>	<b>Number</b>	<b>Version</b>
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 third quarter of 2008**

Figure 3-1 shows the recorded events in Sweden during July through September. During the period 688 events were located whereof 75 are estimated as real earthquakes (which are shown in Figure 3-2). 439 are estimated as explosions and 71 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 103 events in the very vicinity of the mines have been excluded in the report.

Event lists for July through September 2008 are given in sections 3.1 through 3.3.

#### **3.1 July**

An event list for July 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 July 24 events were located whereof one had magnitude  $M_L=2.2$  located 28 km SE of Örnsköldsvik. Additional 3 earthquakes had magnitudes between  $M_L=1.0$  and  $M_L=1.6$ . The depth range of the events varies between 1.1 and 26.2 km.

#### **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 28 events were located whereof one with magnitude  $M_L=2.2$ , located 3 km north of Kalix. Additional 5 events had magnitudes equal to or above  $M_L=1.0$ . The depth range of the events varies between 1.1 and 20.4 km.

#### **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 23 events were located whereof one with magnitude  $M_L=2.4$ , located 21 km SE of Luleå. Additional 6 earthquakes had magnitudes equal to or above  $M_L=1.0$ . The depth range of the events varies between 2.8 and 33.2 km.

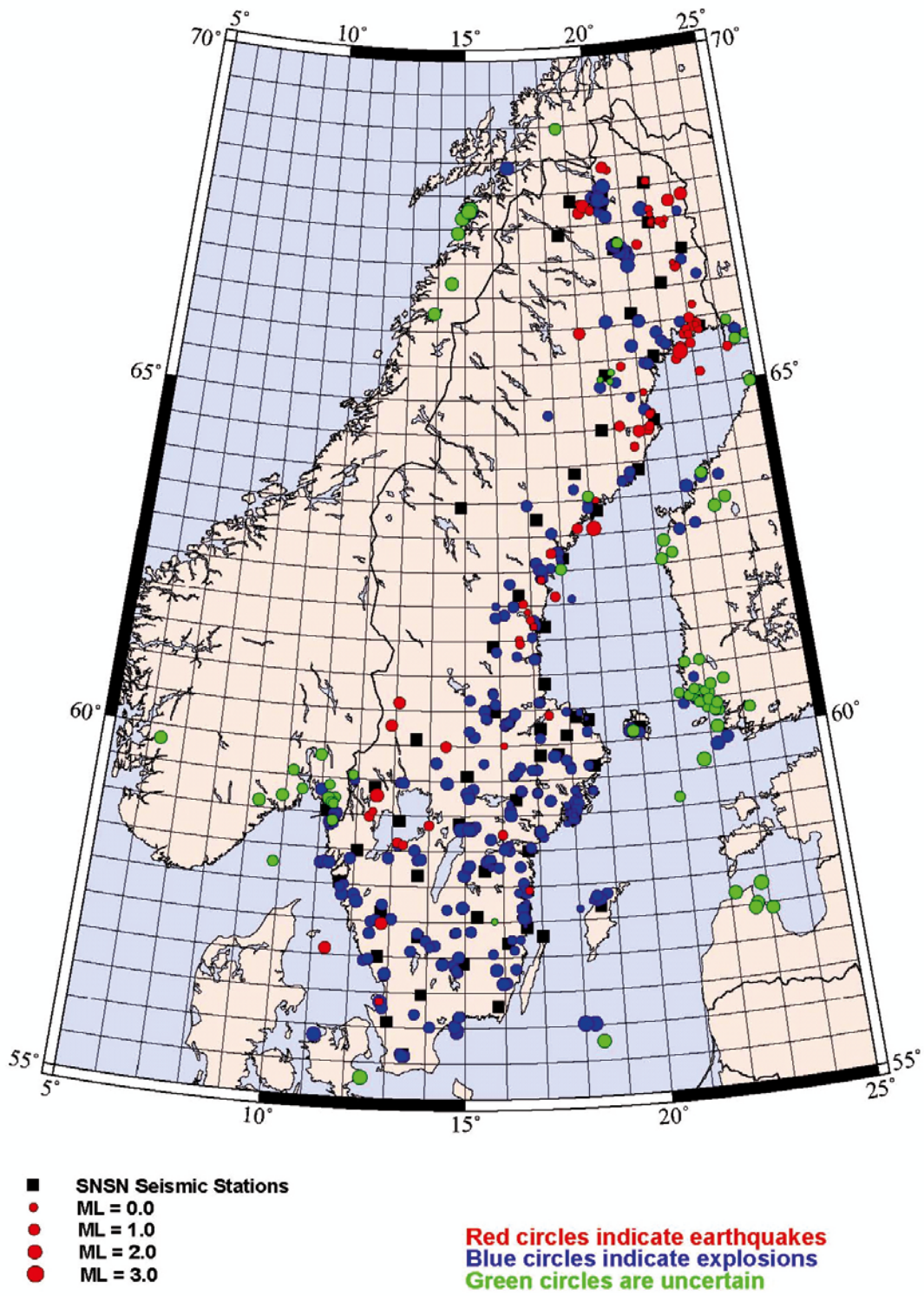


Figure 3-1. Recorded events including explosions in the SNSN network during the period July through September 2008.

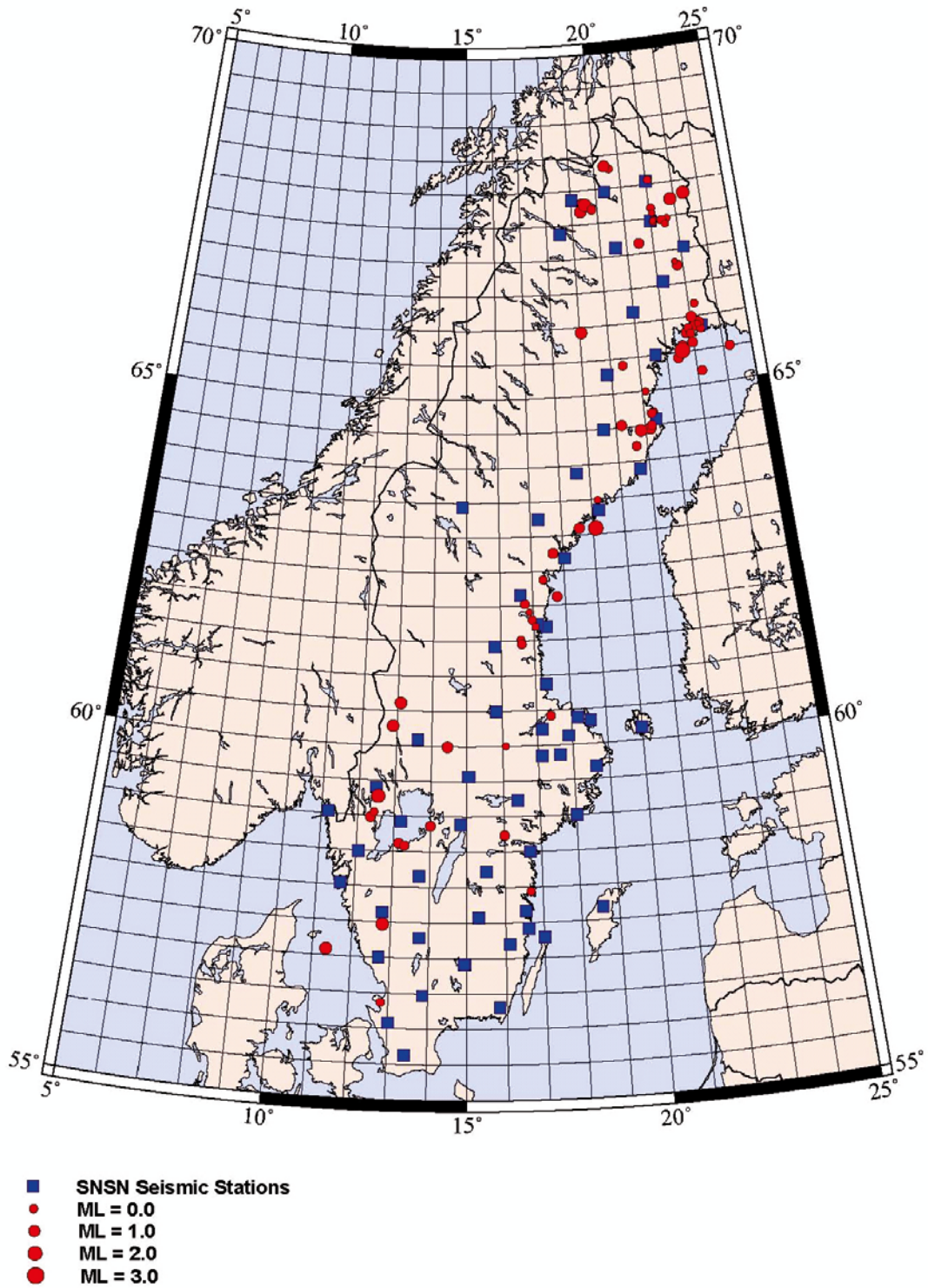


Figure 3-2. Earthquake activity in Sweden during July through September 2008.

**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
20080703	094122.1	65.198	23.150	7,252.6	1,843.1	11.5	0.4
20080707	083738.8	64.450	21.146	7,160.1	1,756.7	26.2	1.1
20080707	090306.5	63.098	18.553	7,001.5	1,638.5	15.2	0.8
20080707	122921.5	62.026	16.749	6,879.5	1,549.2	11.3	0.2
20080707	173536.0	56.365	12.815	6,252.5	1,315.1	20.1	0.2
20080707	211219.6	58.733	16.011	6,512.3	1,511.7	15.5	0.5
20080707	222019.3	64.686	21.315	7,187.0	1,762.6	14.4	-0.1
20080711	140541.4	64.497	21.218	7,165.6	1,759.7	21.8	0.2
20080718	024815.2	68.294	20.598	7,585.5	1,697.6	16.3	-0.2
20080718	051313.1	65.399	20.427	7,262.9	1,714.5	7.4	0.3
20080718	151155.4	57.469	12.784	6,375.6	1,318.6	5.0	1.6
20080720	010311.2	65.587	22.582	7,292.9	1,812.0	2.4	0.7
20080720	020022.4	58.977	12.341	6,544.6	1,300.7	17.0	-0.3
20080720	135818.7	60.005	16.084	6,653.9	1,515.4	17.8	-0.4
20080720	140309.9	62.753	17.686	6,961.5	1,596.0	12.0	0.8
20080723	034907.3	63.085	19.080	7,001.3	1,665.2	10.2	2.2
20080723	232314.2	60.614	13.082	6,724.8	1,350.8	5.4	1.3
20080724	083857.7	64.533	20.191	7,165.8	1,710.2	6.0	0.7
20080725	044425.8	61.514	16.596	6,822.3	1,541.9	17.3	-0.1
20080725	184115.9	58.619	13.144	6,502.6	1,345.2	5.4	0.5
20080726	075415.9	62.379	17.334	6,919.4	1,578.9	1.1	-0.2
20080727	042347.1	67.444	22.084	7,496.6	1,768.3	8.7	-0.2
20080727	131642.4	64.215	20.630	7,131.9	1,733.9	13.2	0.3
20080727	183205.1	61.909	16.880	6,866.5	1,556.3	16.5	-0.6



**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
20080803	162336.7	65.892	23.123	7,329.4	1,832.9	1.1	1.2
20080803	170022.4	65.885	23.191	7,329.0	1,836.0	1.6	2.2
20080804	020148.5	58.976	12.348	6,544.5	1,301.0	16.6	0.5
20080804	102803.6	57.090	11.358	6,338.0	1,230.4	15.7	1.4
20080804	153855.0	64.665	21.247	7,184.4	1,759.5	1.1	0.2
20080806	064640.8	61.798	16.959	6,854.2	1,560.7	20.4	-0.0
20080808	115214.8	58.588	13.302	6,498.8	1,354.3	15.0	0.4
20080809	095237.6	66.768	22.780	7,424.9	1,806.4	2.9	0.5
20080809	205022.0	68.062	22.069	7,565.2	1,760.7	12.3	-0.2
20080809	231001.7	65.996	23.025	7,340.4	1,827.1	2.9	0.8
20080810	131342.2	67.475	22.632	7,502.5	1,791.3	18.2	-0.7
20080811	041752.4	59.277	12.539	6,577.4	1,313.7	9.0	1.9
20080813	102739.2	67.151	21.461	7,461.6	1,744.7	5.6	0.6
20080814	053737.0	67.469	22.111	7,499.6	1,769.2	16.6	-0.4
20080814	093123.0	65.771	22.786	7,314.3	1,819.1	6.7	0.9
20080814	102823.9	66.827	22.706	7,431.0	1,802.5	17.0	-1.0
20080815	022749.1	59.052	12.445	6,552.7	1,307.1	14.1	-0.2
20080817	065753.0	60.420	17.405	6,701.2	1,588.0	17.8	0.2
20080817	083955.8	67.672	19.396	7,512.9	1,652.1	5.8	0.0
20080818	024942.7	65.806	23.317	7,321.0	1,842.8	19.7	-0.1
20080819	101902.2	65.622	22.950	7,298.6	1,828.5	6.7	0.5
20080820	014006.8	61.703	17.050	6,843.8	1,565.7	19.3	-0.3
20080823	000554.0	57.942	16.685	6,424.5	1,551.9	19.3	0.0
20080823	050138.9	67.812	19.414	7,528.5	1,651.9	3.0	0.2
20080823	100108.3	67.645	22.067	7,518.9	1,765.3	15.8	-0.1
20080827	003217.4	60.285	12.881	6,688.7	1,338.1	2.4	1.3
20080830	044848.9	67.745	22.856	7,533.6	1,797.4	2.6	1.4
20080831	053626.3	65.839	22.876	7,322.3	1,822.3	2.4	0.1

**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
20080901	123738.9	65.880	23.229	7,328.7	1,837.8	16.9	-0.6
20080908	092117.7	62.121	17.749	6,891.2	1,601.3	18.8	0.6
20080909	135820.0	58.868	14.003	6,528.7	1,395.9	33.2	0.6
20080912	011227.2	67.454	22.425	7,499.3	1,782.7	4.1	0.2
20080912	095604.7	64.992	21.120	7,220.3	1,750.4	16.5	-0.4
20080914	102219.9	67.396	22.531	7,493.3	1,788.0	18.8	-0.4
20080914	153402.8	67.574	22.082	7,511.1	1,766.8	14.7	-0.6
20080918	045001.8	65.421	22.390	7,273.5	1,805.1	4.3	0.5
20080918	095847.7	65.521	22.564	7,285.4	1,812.0	4.8	2.4
20080919	105251.3	66.184	23.201	7,362.2	1,832.6	17.9	-0.2
20080920	005911.8	67.457	22.079	7,498.1	1,768.0	24.2	-0.8
20080920	090038.9	68.339	20.413	7,590.0	1,689.6	7.5	1.0
20080920	160628.4	65.752	22.930	7,312.9	1,825.9	2.8	0.1
20080922	105257.1	67.688	19.353	7,514.6	1,650.1	15.6	1.2
20080922	143008.9	67.811	23.377	7,543.5	1,818.4	4.9	1.6
20080922	225316.6	64.433	20.828	7,156.9	1,741.6	9.9	1.3
20080924	223933.7	63.485	19.208	7,046.2	1,669.3	12.4	-0.5
20080926	024333.1	59.995	14.446	6,653.6	1,424.0	29.2	0.9
20080926	110154.3	65.503	24.229	7,292.7	1,888.8	9.5	0.4
20080929	234344.4	65.924	19.053	7,317.4	1,647.7	6.4	1.2
20080930	103521.0	67.783	19.539	7,525.6	1,657.4	15.3	1.6
20080930	143719.8	67.709	19.783	7,518.0	1,668.2	19.1	0.2
20080930	144621.1	61.454	16.624	6,815.6	1,543.5	2.8	0.2