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Swedish National Seismic Network (SNSN)

A short report on recorded earthquakes during the first quarter of the year 2009

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April 2009

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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 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, 1,571 events were located whereof 125 are estimated as real earthquakes, 1,044 are estimated as explosions, 269 are induced earthquakes in the vicinity of the mines in Kiruna and Malmberget and 133 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 January one earthquake was located 6.5 km west of Härnösand with magnitude $M_L = 2.2$. In February an earthquake, also with magnitude $M_L = 2.2$, was located 143 km WSW of Kiruna and in March an earthquake with magnitude $M_L = 2.1$ was located 55 km west of Övertorneå.

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 2009.

Det seismiska nätet består av 61 stationer. Under perioden januari till mars, 2009 var det 1 571 registrerade händelser varav 125 bedömdes som äkta jordskalv, 1 044 bedömdes vara förorsakade av explosioner eller sprängningar, 269 var inducerade skalv i närheten av gruvorna i Kiruna och Malmberget och 133 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 januari inträffade ett skalv 6,5 km väster om Härnösand med magnitud $M_L = 2,2$. I februari lokaliserades ett skalv också med magnitud $M_L = 2,2$, 143 km väster om Kiruna. I mars inträffade ett skalv med magnitud $M_L = 2,1$, 55 km väster om Övertorneå.

Contents

1 Introduction

This document reports the seismic events recorded by the Swedish National Seismic Network (SNSN) for the first quarter of the year 2009. 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

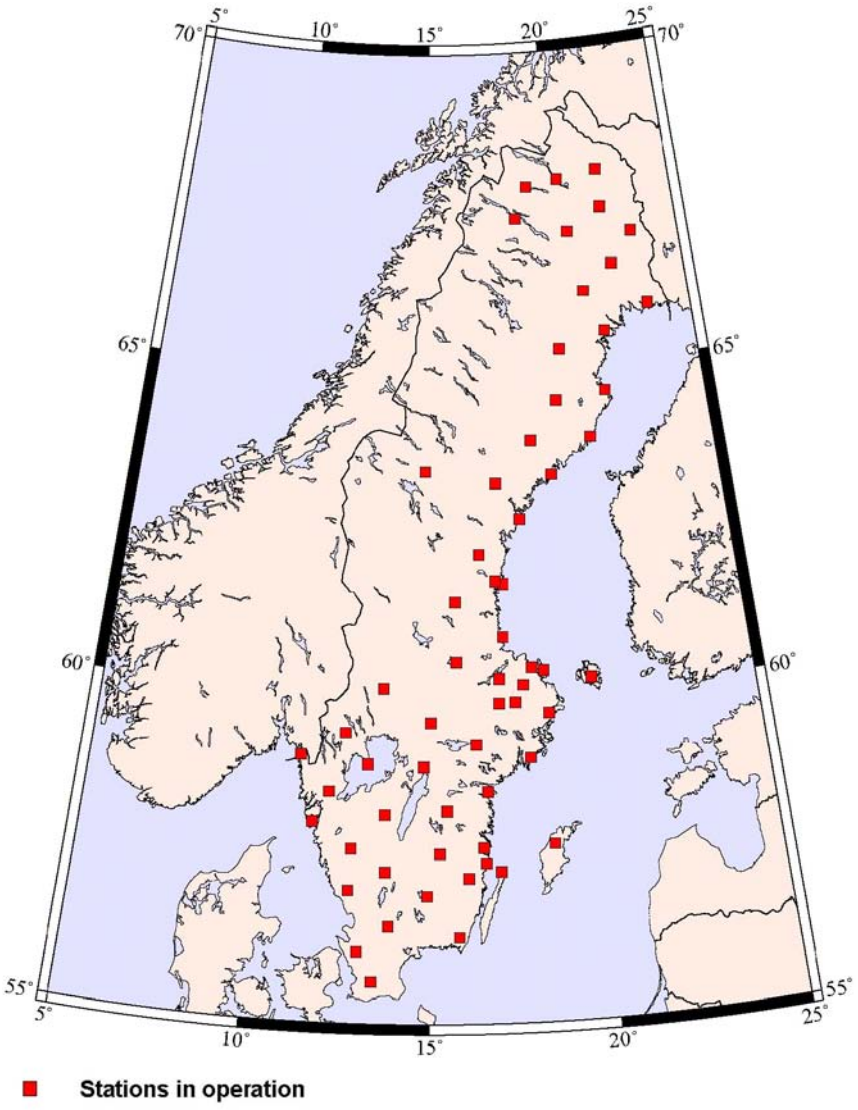

Figure 1-1. *The present Swedish National Seismic Network (SNSN).*

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 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 2009

Figure 3-1 shows the recorded events in Sweden during January through March. During the period 1,571 events were located whereof 125 are estimated as real earthquakes (which are shown in Figure 3-2). 1,044 are estimated as explosions and 133 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 269 events in the very vicinity of the mines have been excluded in the report.

Event lists for January through March 2009 are given in sections 3.1 through 3.3.

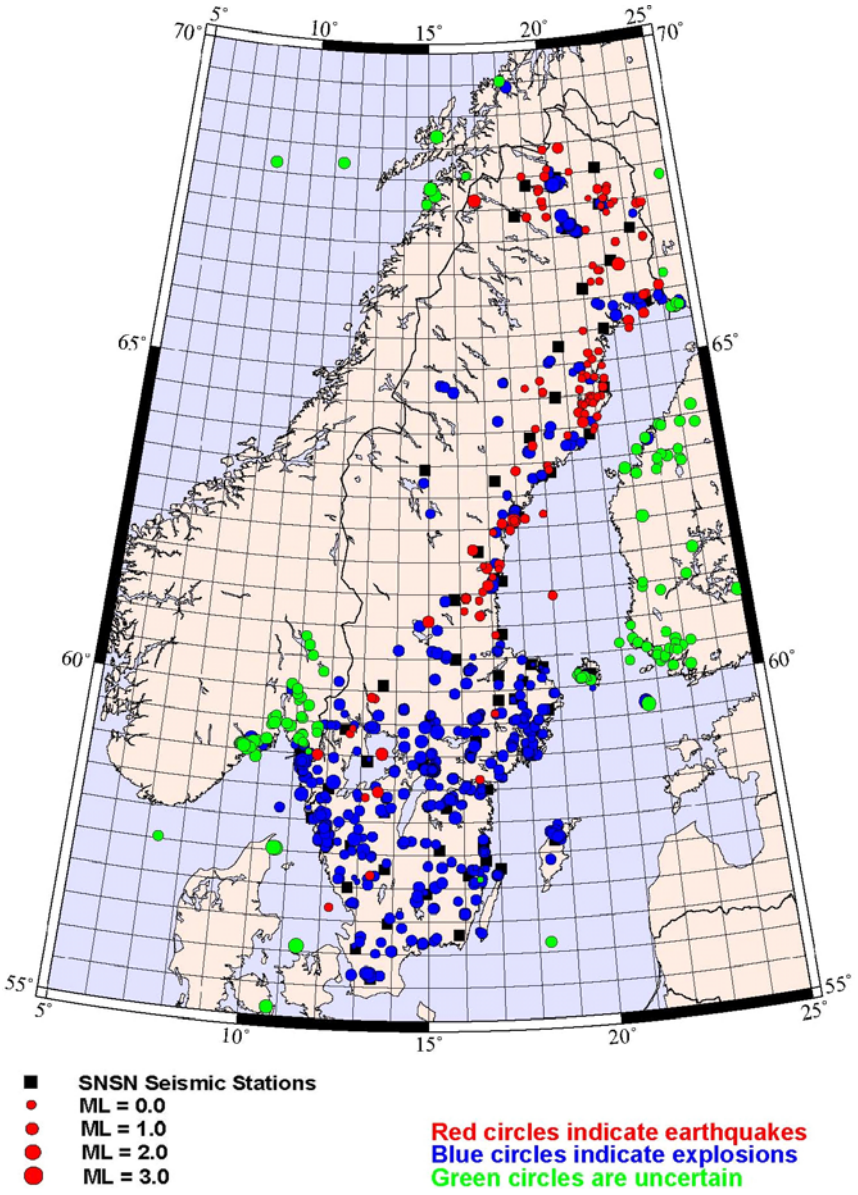

Figure 3-1. *Recorded events including explosions in the SNSN network during the period January through March 2009.*

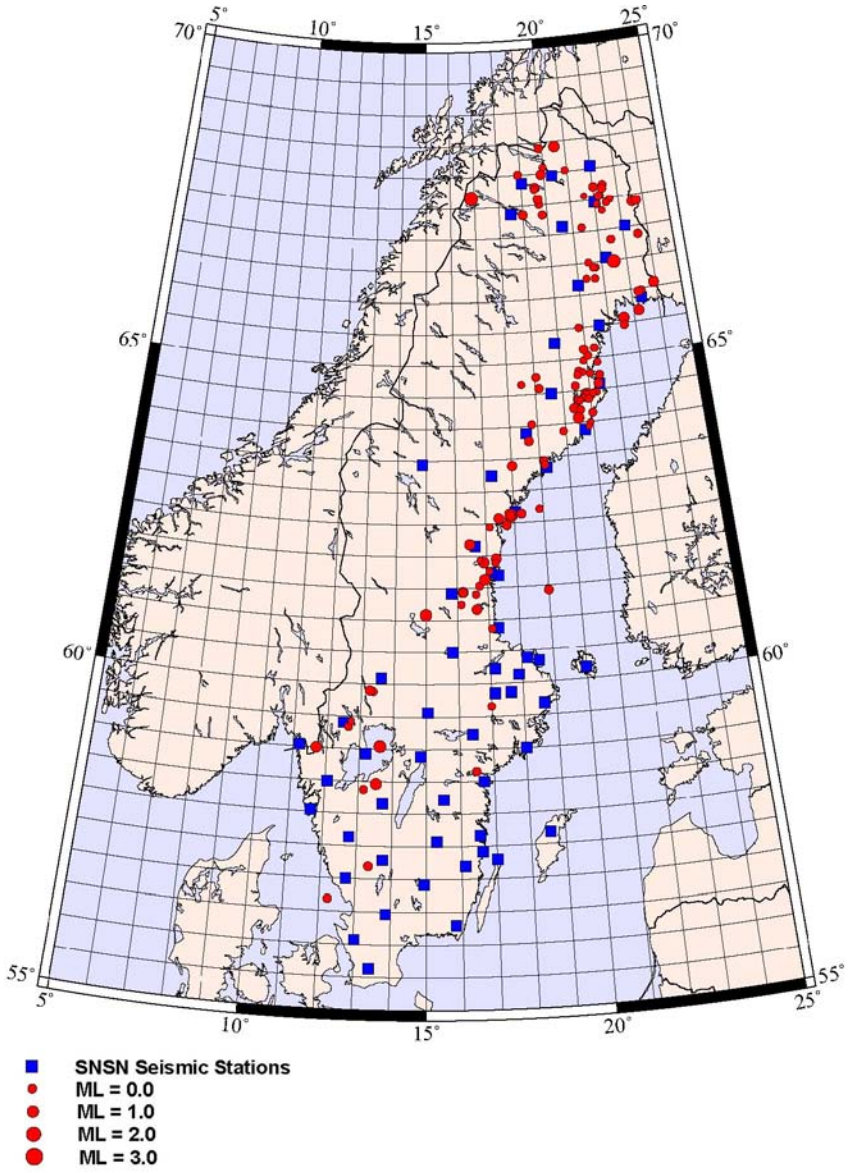

Figure 3-2. *Earthquake activity in Sweden during January through March 2009.*

3.1 January

An event list for January 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 January 44 events were located whereof one had magnitude M_L = 2.2, located 6.5 km west of Härnösand. One earthquake with magnitude M_L = 1.8 was located in Vänern, 33 km south of Skoghall. Additional 4 earthquakes had magnitudes between M_L = 1.0 and M_L = 1.3. The depth range of the events varies between 0.4 and 36.8 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
20090101	035005.2	67.480	22.637	7,503.2	1,791.4	13.0	–0.2
20090102	112514.8	67.551	22.254	7,509.3	1,774.3	17.4	–0.1
20090102	192417.4	64.756	21.065	7,193.7	1,750.0	13.6	–0.1
20090103	162232.2	58.659	16.483	6,504.2	1,539.2	25.2	0.4
20090103	185256.8	67.703	22.027	7,525.2	1,763.0	12.5	0.5
20090103	223105.1	67.313	22.266	7,482.9	1,777.6	36.8	–0.3
20090105	205932.1	67.432	22.472	7,497.1	1,785.0	11.6	–0.2
20090106	020734.9	59.882	13.363	6,642.8	1,363.1	22.3	0.3
20090107	084012.3	67.333	19.800	7,476.2	1,671.6	22.7	0.3
20090107	092242.4	66.252	21.315	7,361.0	1,747.3	2.8	–0.2
20090109	160129.0	61.441	16.182	6,814.0	1,520.0	3.0	1.0
20090109	204323.8	62.618	17.875	6,946.8	1,606.1	6.8	2.2
20090110	061514.4	65.671	23.187	7,305.2	1,838.7	18.8	1.0
20090110	091800.4	68.417	20.557	7,599.1	1,694.8	0.4	1.3
20090110	165140.2	66.415	21.748	7,380.9	1,765.0	17.3	–0.3
20090110	191239.3	67.779	19.572	7,525.2	1,658.8	1.3	0.7
20090111	074826.1	68.018	20.909	7,555.8	1,712.9	34.6	–0.1
20090111	225917.3	68.003	18.892	7,548.6	1,628.9	15.3	0.2
20090112	052819.6	66.865	23.588	7,439.8	1,840.5	9.6	0.4
20090112	094743.9	67.725	22.411	7,529.3	1,778.9	4.3	0.3
20090114	103423.2	66.421	21.650	7,381.1	1,760.5	16.5	0.1
20090114	185523.7	61.400	16.610	6,809.6	1,542.8	16.3	0.0
20090115	142439.5	64.811	20.660	7,198.3	1,730.3	10.8	0.0
20090115	173416.0	64.787	20.804	7,196.2	1,737.3	11.9	–0.3
20090118	073349.2	67.354	18.997	7,476.5	1,637.0	9.3	0.6
20090120	091656.6	61.247	16.120	6,792.3	1,516.7	15.0	0.1
20090120	113219.9	67.550	22.194	7,509.0	1,771.8	16.5	0.3
20090120	184731.7	64.591	21.338	7,176.5	1,764.5	16.5	0.6
20090120	230414.5	64.024	18.794	7,105.3	1,645.9	17.0	0.1
20090121	015725.3	59.002	11.686	6,549.6	1,263.2	28.8	1.3
20090121	154417.7	59.045	13.609	6,549.1	1,373.8	7.7	1.8
20090122	114755.6	61.434	16.193	6,813.2	1,520.5	3.0	0.5
20090122	164038.5	59.657	16.989	6,615.8	1,566.5	10.4	0.0
20090124	015730.1	62.554	17.471	6,939.1	1,585.5	21.6	0.2
20090125	045920.2	62.611	17.892	6,946.1	1,606.9	17.0	–0.1
20090125	080125.2	67.982	19.878	7,548.7	1,670.2	3.0	0.8
20090125	090321.2	66.251	21.632	7,362.3	1,761.5	19.3	–0.6
20090125	093603.5	66.243	21.653	7,361.4	1,762.5	2.6	0.0
20090126	043602.7	68.094	19.984	7,561.4	1,673.8	18.7	–0.1
20090128	012349.5	62.699	18.869	6,957.8	1,656.6	4.3	0.1
20090128	201040.2	63.450	19.124	7,042.0	1,665.4	4.1	0.3
20090129	034920.7	61.532	16.723	6,824.4	1,548.7	16.2	0.2
20090131	181445.3	67.503	19.700	7,494.8	1,666.1	10.0	0.0
20090131	210531.6	64.969	20.872	7,216.7	1,738.9	17.2	–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 30 events were located whereof one with magnitude M_L = 2.2, located 13 km north of Sallohaure or 143 km WSW of Kiruna. One earthquake with magnitude M_L = 1.6 was located 25 km south of Skellefteå. Additional three events had magnitudes equal or above M_L = 1.0. The depth range of the events varies between 0.1 and 29.8 km.

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 51 events were located whereof one had magnitude M_L = 2.1, located 55 km west of Övertorneå. One earthquake with magnitude M_L = 1.5 was located 25 km east of Mora. Additional 6 earthquakes had magnitudes equal to or above M_L = 1.0. The depth range of the events varies between 0.1 and 28.0 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
20090202	155057.5	62.640	18.247	6,949.9	1,625.0	13.8	0.5
20090204	000105.1	57.193	13.356	6,343.4	1,351.8	15.0	0.5
20090204	175425.8	65.502	20.826	7,275.8	1,732.1	11.9	0.1
20090206	0163847	67.660	16.870	7,507.5	1,545.1	0.1	2.2
20090207	093907.7	67.393	23.546	7,498.1	1,831.3	6.4	0.9
20090208	003020.2	64.585	19.145	7,168.5	1,659.8	16.9	0.4
20090208	020829.8	63.766	18.653	7,076.1	1,640.3	21.2	0.5
20090211	034920.5	61.762	17.067	6,850.3	1,566.4	5.6	–0.2
20090211	171315.4	60.866	17.097	6,750.5	1,570.0	18.8	0.1
20090211	171430.3	61.631	16.911	6,835.6	1,558.5	17.3	1.3
20090211	194042.1	61.168	16.624	6,783.8	1,543.9	9.2	0.9
20090215	003854.7	67.665	22.376	7,522.5	1,778.2	0.1	0.4
20090215	113213.8	58.466	13.519	6,484.8	1,366.4	10.2	1.4
20090215	155510.2	65.044	21.053	7,225.7	1,746.8	9.6	0.2
20090215	203900.2	66.506	21.467	7,389.8	1,751.5	12.3	–0.2
20090217	040355.9	64.378	20.760	7,150.5	1,738.8	18.6	–0.2
20090218	032119.9	63.986	20.896	7,107.5	1,748.8	0.4	–0.3
20090218	074314.5	64.422	20.786	7,155.6	1,739.7	23.4	0.2
20090219	043352.2	62.597	17.902	6,944.5	1,607.5	6.8	1.1
20090219	061610.5	64.432	20.960	7,157.3	1,748.0	19.1	–0.2
20090219	112721.6	62.580	17.451	6,941.9	1,584.4	22.2	0.9
20090219	164223.9	61.949	17.305	6,871.5	1,578.5	8.1	0.9
20090221	015232.0	64.409	21.022	7,155.0	1,751.1	17.2	–0.2
20090224	060901.7	64.141	21.022	7,125.2	1,753.6	29.8	0.2
20090225	095044.6	58.374	13.156	6,475.3	1,344.8	9.6	0.3
20090226	043417.8	64.435	20.861	7,157.3	1,743.2	4.6	1.6
20090226	043815.9	64.433	20.870	7,157.0	1,743.6	12.4	0.0
20090226	043910.4	64.429	20.881	7,156.7	1,744.2	3.0	0.0
20090226	100132.3	62.618	17.880	6,946.8	1,606.3	17.8	0.4
20090226	200517.2	67.572	21.595	7,508.9	1,746.1	19.2	–0.5

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	ML Local Magnitude
20090301	011408.0	64.453	21.236	7,160.8	1,761.0	28.0	–0.2
20090302	014240.3	61.882	17.277	6,864.0	1,577.2	16.6	–0.2
20090302	043406.9	66.479	22.474	7,391.3	1,796.5	3.2	2.1
20090302	114109.8	64.925	21.379	7,213.8	1,763.2	11.4	–0.2
20090303	011109.7	65.583	22.585	7,292.4	1,812.2	2.3	1.3
20090303	054907.5	63.448	19.142	7,041.9	1,666.3	14.9	0.0
20090303	172318.3	65.968	23.384	7,339.3	1,843.7	15.9	0.2
20090303	213204.9	65.951	23.275	7,336.8	1,839.0	3.2	0.6
20090304	192325.9	59.340	12.623	6,584.2	1,318.8	1.7	0.2
20090304	222844.5	62.470	17.723	6,930.0	1,598.8	10.6	0.7
20090305	000218.4	61.900	16.892	6,865.5	1,557.0	8.0	1.2
20090305	000218.4	61.900	16.894	6,865.6	1,557.1	8.3	1.2
20090305	094102.7	68.408	19.874	7,596.0	1,666.9	19.6	0.4
20090305	195749.8	64.764	19.059	7,188.2	1,654.6	7.1	0.3
20090309	023019.8	64.748	20.607	7,191.1	1,728.3	25.2	0.0
20090309	204102.5	64.367	20.489	7,148.4	1,725.8	4.3	–0.1
20090310	092941.8	63.392	18.016	7,033.2	1,610.4	25.0	0.7
20090310	110606.1	64.446	21.103	7,159.5	1,754.7	10.2	–0.2
20090311	020630.2	64.389	20.744	7,151.7	1,737.9	19.2	–0.6
20090311	130333.9	59.899	13.259	6,644.8	1,357.4	22.2	0.8
20090311	170051.2	63.382	19.169	7,034.7	1,668.0	8.3	0.0
20090311	233037.8	64.250	20.391	7,135.0	1,722.1	20.6	0.0
20090312	000253.5	64.580	20.483	7,172.0	1,723.8	4.6	0.3
20090312	224234.3	67.405	23.715	7,500.3	1,838.4	12.9	0.8
20090313	184248.7	64.359	20.924	7,149.1	1,746.9	0.9	0.0
20090314	051149.1	64.350	20.554	7,146.7	1,729.1	5.7	0.5
20090314	052110.0	65.158	21.334	7,239.5	1,758.9	22.4	0.3
20090315	074239.4	63.886	19.908	7,092.9	1,701.3	3.0	0.1
20090316	034303.2	61.932	16.768	6,869.0	1,550.4	19.6	–0.5
20090316	034620.0	65.151	20.927	7,237.1	1,739.9	24.2	0.5
20090316	062651.2	66.832	22.478	7,430.5	1,792.4	2.8	0.2
20090316	111626.9	64.662	18.507	7,175.6	1,628.9	21.4	–0.2
20090317	190320.1	62.185	16.441	6,896.9	1,532.9	17.3	1.1
20090318	103317.5	64.231	20.373	7,132.8	1,721.4	3.7	0.7
20090318	220815.4	66.069	23.919	7,353.5	1,866.4	1.0	1.2
20090318	221246.6	64.200	20.593	7,130.1	1,732.2	14.6	0.2
20090320	164337.5	67.420	22.081	7,494.0	1,768.5	10.4	–0.1
20090322	034455.1	67.070	21.354	7,452.1	1,740.9	0.1	0.1
20090322	193555.9	61.426	18.994	6,816.4	1,670.0	14.1	0.5
20090323	004730.2	62.445	17.132	6,926.5	1,568.3	23.6	–0.1
20090323	071237.3	64.723	21.416	7,191.5	1,767.0	11.4	0.2
20090323	191309.2	63.930	20.835	7,101.0	1,746.4	20.3	–0.5
20090324	213852.5	61.089	14.981	6,775.0	1,455.4	11.5	1.5
20090325	000705.8	64.344	20.597	7,146.1	1,731.2	18.1	–0.3
20090329	082316.2	67.591	19.658	7,504.5	1,663.7	18.7	0.5
20090329	193450.1	59.424	12.715	6,593.3	1,324.4	26.9	–0.1
20090329	211524.5	67.421	22.077	7,494.1	1,768.3	16.6	–0.3
20090329	231627.9	67.755	19.544	7,522.5	1,657.8	6.5	0.1
20090331	003124.3	64.074	20.491	7,115.8	1,728.3	3.1	1.3
20090331	014523.1	56.685	12.235	6,289.8	1,281.1	14.8	0.4
20090331	084819.9	65.466	22.560	7,279.3	1,812.5	3.0	0.3