Seismicity of Norway and surrounding areas

for the period

July 1st to December 31st, 1997

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1. Introduction

This semi-annual report on the seismicity of Norway and the surrounding areas encompasses the time period July 1st - December 31st, 1997. The earthquake locations have been compiled from all available seismic stations operating on Norwegian territory including the Arctic islands of Spitsbergen, Bjørnøya and Jan Mayen. In addition, stations from neighbouring countries have been included for large or well recorded events. For this report it should, however, be noticed that data from October through December, recorded on Jan Mayen and Bjørnøya is missing. This is due to late arrival of the data tapes and tape reading problems.

In Norway, the University of Bergen (UiB) and the Norwegian Seismic Array (NORSAR) operate seismic stations (Figure 3). These stations are sponsored by different organisations. The UiB operates the Norwegian National Seismic Network (NNSN) which comprises 14 stations and includes the Svalbard array (SVAESS) operated by NORSAR. In addition, there are 12 other seismic stations which are operated by UiB (including two IRIS i.e. Incorporated Research Institutions for Seismology stations), and two seismic arrays (NORESS and ARCESS) in Norway operated by NORSAR. Phase data from arrays in Russia (Apatity), Finland (Finess), Sweden (Hagfors) and from stations operated by the British Geological Survey (BGS) are also included when available. All phase data collected are submitted to UiB, and a monthly bulletin is prepared and distributed. A brief overview of the events published in the monthly bulletins is given in this semi annual report. Again, please notice that the bulletins for October, November and December are preliminary.

All local and regional events with magnitude larger than 1.5 and all teleseismic events that are detected by the Bergen network are included. The merging of data between NORSAR and Bergen is done on the following principles:

i) All local and regional events recorded by NORSAR that are also detected by the Bergen network are included,

ii) in addition all local and regional events with local magnitude larger than 2.0 detected by NORSAR and not recorded by the Bergen network are included.

iii) All teleseismic events recorded by NORSAR and also detected by the Bergen network are included

iv) In addition all teleseismic events with NORSAR magnitude $M_b \geq 5.0$ are included.

Macroseismic data for all felt earthquakes in Norway are also collected, and macroseismic maps are presented. All data from the network is available FTP.IFJF.UIB, directory SEISMO.

2. Velocity models and magnitude relations

The velocity model used for locating all local and regional events, except for the local Jan Mayen events, is shown on the table below (Havskov and Bungum, 1987). Event locations are performed using the HYPOCENTER program (Lienert and Havskov, 1995) and all processing is performed using the SEISAN data analysis software (Havskov, 1997).

P-wave velocity (km/sec)	Depth to layer interface (km)
6.2	0.0
6.6	12.0
7.1	23.0
8.05	31.0
8.25	50.0
8.5	80.0

Magnitudes are calculated from coda duration and/or amplitudes. The coda wave magnitude scale (M_C) is estimated through the relation:

$$M_C = -3.0 + 2.6 * \log10(T) + 0.001 * D.$$

where T is the coda length in seconds and D is the epicentral distance in km. The coda magnitude is recognised to be higher than local magnitude calculated at NORSAR and in Bergen. A new coda magnitude scale is under development and will be finished during 1998. When instrument corrected maximum ground amplitudes A (nm) are available, local magnitude M_L is calculated using the equation given by Alsaker et al. (1991):

$$M_L = 1.0 * \log(A) + 0.91 * \log(D) + 0.00087 * D - 1.67$$

where D is the hypocentral distance in km.

For the Jan Mayen area, a local model and coda magnitude scale are used (Sørnes and Navrestad, 1975)

P-wave velocity (km/sec)	Depth to layer interface (km)
3.14	0
6.33	3
8.27	18

The coda magnitude for Jan Mayen is given by Westre (1975):

$$M_C = 3.27\log(T)-3.24+0.001*D$$

where T is the coda duration and D is the epicentral distance in km.

The regional and teleseismic events recorded by the network are located using the global velocity model IASPEI91 (Kennett and Engdahl, 1991).

Body wave magnitude is calculated using the equation by Veith and Clawson (1972):

$$Mb = \log(A/T) + Q(D,h)$$

here h is the hypocentre depth (km), A is the amplitude (microns), T is period in seconds and Q(D,h) is the correction for distance and depth.

Surface wave magnitude Ms is calculated using the equation (Karnik et al., 1962):

$$Ms = \log(A/T) + 1.66\log(D) + 3.3$$

where A is the amplitude (microns), T is period in seconds and D is the hypocentral distance in degrees.

3. Events recorded by the Norwegian stations

A total of 2128 local and regional events, based on the criteria mentioned in section 1, were detected by the Norwegian seismic stations during the last half of 1997. Compared to the previous half year this is an increase of 18%. Of the local and regional events analysed during the last six months of 1997, 46% were located. The number of local/regional and teleseismic events, analysed per month in this period is shown in Figure 1. The average number of local and regional events analysed per month is 355.

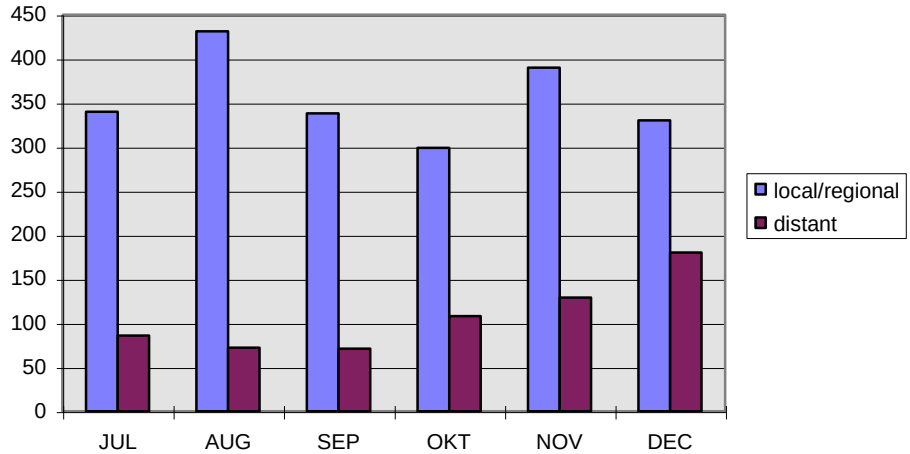

Figure 1. Monthly distribution of local and teleseismic events, analysed during the last six months of 1997.

A total of 646 teleseismic events were analysed during the last half of 1997, of which 67% were located. The monthly average is 107 teleseismic events. All events (480 teleseismic, regional and local) analysed from July to December 1997 with M ≥ 3 are plotted in Figure 2.

The station recording statistics for each month from July to December and in total for the last half year of 1997 are given in Table 1. This table gives for each station the number of local events that were recorded only at one station, local events that were recorded on more than one station and teleseismic events that were recorded. During the first half of 1997 events identified as probable explosions and which could not be located, were not analysed i.e. no phases were picked. These events were therefore not included in the statistics in report no. 10. This procedure was changed again 1st July, 1997 so that from this date the statistics include all events.

Changes in processing routines.

The seismic events in this report include both earthquakes and explosions, and it is likely that more than 70 %, based on statistics for a period of 10 years, of the onshore events are explosions. In the last reporting period, events recognised as probably explosions and which were recorded on less than three stations were not processed but stored in the database (as of January 1st, 1997). This routine has been reversed so that from 1st July, 1997 all recorded events are processed. This change reflect changes in the statistic in Table 1 relative to previous report.

4. The seismicity of Norway and surrounding areas

Figure 3 shows all local and regional events analysed during the last half of 1997. Before any of the recorded data is further presented it should be stressed that some data from Bjørnøya and the three Jan Mayen stations not have been analysed. Therefore the numbers presented will differ slightly from the final result. One can note that most of the recorded events at Jan Mayen and Bjørnøya are earthquakes. The number of located events, in the area between 54°N-82°N and 15°W-32°E, including NORSAR readings, increased from 801 in the first six months of 1997 to 910 in the last six months of 1997. Using the explosion filter (Ottemöller, 1995, Benson et. al., 1992) more than 59% of these events are identified as probable explosions. In Figure 4, confirmed and probable explosions are omitted.

Figure 5 and Table 2 show the 41 local and regional events with any of the reported magnitudes larger than or equal to 3.0. From Figure 5 it is interesting to notice that there are events west of Lofotodden and one earthquake north of Færøyene. At large distances it is difficult to distinguish between earthquakes and explosions. Some of the events in Denmark and Latvia might be explosions.

The largest earthquake occurred on December 13th, at 07:02 (UTC), slightly west of Jan Mayen, with $M_{L(BER)}$=4.5 and $M_{B(PDE)}$=5.3. This earthquake was felt by the staff at the Jan Mayen station, and several of them woke up. Seismograms for this earthquake are shown in Figure 6, where the identified phases are marked. For strong earthquakes located in the Norwegian/Greenland see, T-phases are relatively often recorded which also can be seen for some of the stations in Figure 6. T-phases (tertiary waves) are seismic waves that travel at low phase velocities, and correspond to sound waves trapped in the oceanic layer. It is high frequency waves, usually monochromatic and has no sharp onset.

In the vicinity of the Norwegian mainland the largest earthquake was one of two earthquakes with magnitude above 3.0 located west of Lofoten. The earthquake occurred on 20th December, 1997, with magnitudes $3.8_{C(BER)}$, $3.4_{L(BER)}$ and $3.3_{L(NAO)}$. The second largest earthquake was located slightly north-east of Sauda in Rogaland and it was felt by the local population.

Figure 2. Epicentre distribution of earthquakes with M ≥ 3.0, located by the Norwegian seismic stations from July to December 1997. The triangle indicates the location of Bergen. Teleseismic events recorded only by NORSAR have M≥5.0.

Table 1 Monthly statistics of events recorded at each station for the last half of 1997

Abbreviations are: Event types: **LM**=Number of local events recorded at more than one station, **LS**=local events recorded at only one station and **D**=teleseismic events per month in the time period July to December, 1997.

Stations: ASK=Askøy, BER=Bergen, BJO=Bjørnøya, BLS=Blåsjø, EGD=Espegrend, FOO=Florø, HYA=Høyanger, JMI,JNE,JNW=Jan Mayen, KBS=Kings Bay, KMY=Karmøy, KONO=Kongsberg, KTK=Kautokeino, LOF=Lofoten, MOL=Molde, MOR=Mo i Rana, NSS=Namsos, ODD=Odda, OSG=Oseberg, SUE=Sulen, TRO=Tromsø

	JULY			*AUGUST*			*SEPTEMBER*			*OCTOBER*			*NOVEMBER*			*DECEMBER*			*JAN.-JUNE*		
STATION	**LM**	**LS**	**D**	**LM**	**LS**	**D**	**LM**	**LS**	**D**	**LM**	**LS**	**D**	**LM**	**LS**	**D**	**LM**	**LS**	**D**	**LM**	**LS**	**D**
ASK	11	0	2	30	0	1	20	0	5	26	0	3	28	0	7	25	1	4	140	1	22
BER	3	0	5	8	0	0	2	0	7	1	0	2	3	0	3	0	0	0	17	0	17
BJO1	1	0	0	0	2	7	4	1	7	10	0	4	2	2	6	7	1	6	24	6	30
BLS5	23	1	11	29	5	12	19	2	9	19	2	21	19	1	17	18	0	16	127	11	86
EGD	11	0	0	22	0	0	11	0	3	21	0	3	25	0	5	23	0	3	113	0	14
FOO	7	0	3	17	1	3	7	0	6	9	0	5	5	1	1	15	0	0	60	2	18
HYA	5	0	6	37	5	7	28	2	4	30	3	8	33	1	10	29	1	13	162	12	48
JMI	15	0	0	13	3	1	22	0	0	15*	-	-	2*	-	-	-	-	-	68*	3*	1*
JNE	25	0	0	25	0	0	28	0	0	21*	-	-	2*	-	-	-	-	-	101*	-	-
JNW	25	0	0	25	0	0	29	0	2	21*	-	-	2*	-	-	-	-	-	102*	-	-
KBS	10	6	38	5	10	33	9	5	36	22	2	66	11	3	64	8	10	86	65	36	323
KMY	22	1	6	28	8	7	17	1	7	12	0	8	5	0	6	14	1	8	98	11	42
KONO	3	0	44	3	2	41	2	0	29	[1]2	0	67	1	0	62	4	0	93	15	2	336
KTK1	122	31	21	95	88	13	56	65	9	91	45	21	76	124	20	87	48	29	527	401	113
LOF	54	4	14	28	6	5	17	7	4	22	1	10	61	7	21	74	11	38	256	36	92
MOL	14	8	15	29	15	12	11	4	8	14	13	18	20	10	0	32	8	4	120	58	57
MOR8	80	22	19	95	23	14	57	20	12	93	10	35	83	31	34	104	26	57	512	132	171
NSS	21	19	16	21	19	7	5	5	6	11	4	17	19	11	16	21	5	2	98	63	64
ODD1	10	0	3	13	0	4	11	0	7	8	0	0	17	0	0	20	6	3	79	6	17
SUE	12	0	8	27	0	5	17	1	2	21	0	8	29	2	6	28	2	5	134	5	34
TRO	3	0	5	58	1	15	55	1	13	77	1	35	45	2	29	60	0	49	298	5	146

[1] * Due to tape reading problems these numbers are not final.

Figure 3. Epicentre distribution of events analysed during July to December, 1997. Squares indicate stations that are part of the NNSN. Triangles indicate stations operated by the Institute of Solid Earth Physics, University of Bergen (UiB), whereas circles indicate array stations operated by NORSAR. The stars show the two IRIS stations operated by UiB.

Figure 4. Epicentre distribution of events analysed from July to December, 1997. Known and probable explosions are not included. Squares indicate stations that are part of the NNSN. Triangles indicate stations operated by the Institute of Solid Earth Physics, University of Bergen (UiB), whereas circles indicate array stations operated by NORSAR. The stars show the two IRIS stations operated by UiB.

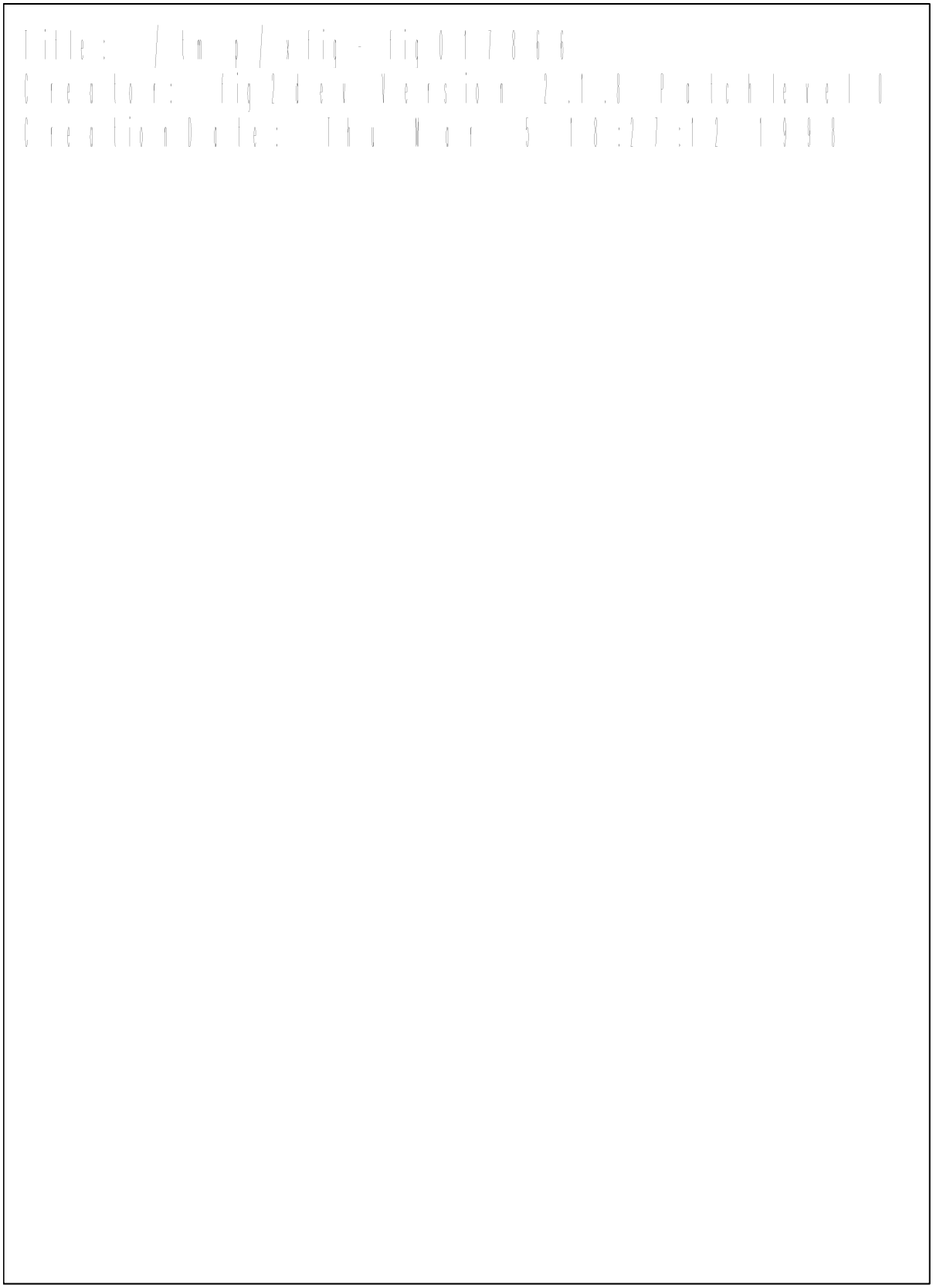

Figure 5. Epicentre distribution of analysed events, with M ≥ 3, from July to June, 1997. Squares indicate stations that are part of the NNSN. Triangles indicate stations operated by the Institute of Solid Earth Physics, University of Bergen (UiB), whereas circles indicate array stations operated by NORSAR. The stars show the two IRIS stations operated by UiB.

Table 2. Local and regional events with any magnitude ≥ 3.0 for the time period July to December, 1997, in the area between 54°N-82°N and 15°W-32°E. For depth determination see section 5.

year	moda	hrmi	sec	mde	lat	long	depthFF	ns	rms	magnitudes		
1997	7 7	2142	47.2	JL	75.147	-5.749	10.0F	8	0.3	3.7CBER	3.7LBER	
1997	711	0921	15.2	L	72.728	1.374	10.0F	2	0.2	3.8CBER	3.0LBER	3.7BPDE
1997	714	1147	56.5	L*	61.509	3.573	15.0F	22	1.0	3.1CBER	2.8LBER	2.8LNAO
1997	720	1305	32.3	L	77.806	8.051	10.0F	6	1.1	2.7CBER	3.0LBER	3.1LNAO
1997	810	0439	28.1	JL	70.954	-6.583	10.0F	3	0.1	2.6CBER	3.3LBER	
1997	812	0814	24.1	L*	59.819	6.647	12.0F	14	1.0	2.7CBER	2.8LBER	3.4LNAO
1997	815	1857	6.8	L	71.931	-1.893	10.0F	4	0.7	3.6CBER	3.0LBER	
1997	819	0345	5.7	L*	64.072	-8.125	10.0F	14	1.5	3.5CBER	2.6LBER	2.6LNAO
1997	819	0529	40.8	L	55.924	11.739	15.0F	8	0.7	3.0CBER	1.9LBER	2.3LNAO
1997	828	0602	39.6	L	59.702	13.104	8.0F	15	0.8	3.3CBER	2.8LBER	2.9LNAO
1997	831	0817	29.1	JL	71.179	-8.352	18.0F	3	0.0	2.7CBER	3.2LBER	
1997	917	2155	21.9	JL	71.174	-6.902	15.0F	3	0.1	3.2CBER	3.3LBER	
1997	918	0641	47.7	JL	70.914	-6.784	10.0F	10	0.7	2.9CBER	3.5LBER	4.3BPDE
1997	918	0710	2.9	JL	71.153	-6.997	15.0F	3	0.1	3.0CBER	3.0LBER	
1997	918	0858	21.5	JL	71.561	-6.842	7.0F	5	0.3	2.7CBER	3.5LBER	
1997	920	1421	36.4	L	57.503	10.951	15.0F	4	0.6	3.1LBER		
1997	927	1013	7.2	JL	71.494	-10.091	8.0F	3	0.1	3.1CBER	3.3LBER	
1997	930	2312	6.5	L	76.630	25.469	23.0F	8	1.1	3.1LBER		2.7LNAO
1997	10 4	1952	18.1	L	71.857	0.439	10.0F	3	0.2	3.5CBER	2.4LBER	
1997	10 5	0022	5.0	L	76.707	25.114	17.0F	10	1.2	3.6CBER	3.3LBER	3.1LNAO
1997	10 6	1233	31.4	L*	76.475	24.057	15.0F	12	3.7	3.4CBER	3.8LBER	3.5LNAO
1997	10 6	2113	8.1	L	73.290	7.498	10.0F	20	1.8	3.8CBER	3.5LBER	3.1LNAO
1997	10 6	2129	7.2	L	73.516	8.638	10.0F	15	1.3	3.5CBER	3.4LBER	2.5LNAO
1997	10 6	2129	9.4	L	73.450	5.764	10.0F	13	4.1	3.4LBER		3.1LNAO
1997	10 6	2129	19.0	L	73.430	7.466	10.0F	11	0.7			3.1LNAO
1997	10 6	2345	39.9	L	73.491	7.748	19.0F	20	1.4	3.5CBER		3.0LNAO
1997	1012	1931	25.5	JL	72.077	-12.519	10.0F	5	0.4	4.2CBER	3.3LBER	
1997	1015	2123	29.4	L	77.024	22.366	15.0F	9	1.2	3.4CBER	3.0LBER	3.1LNAO
1997	1016	0214	18.9	L	66.652	29.400	3.0F	10	0.9	3.1CBER	2.3LBER	2.2LNAO
1997	1019	1950	59.7	L	65.330	22.425	15.0F	13	2.3	3.4CBER	3.2LBER	3.0LNAO
1997	1025	0652	55.7	L	79.423	21.152	7.0F	8	1.0	2.7CBER	3.1LBER	3.2LNAO
1997	1027	1101	23.1	L	57.277	22.967	15.0F	11	1.1	3.5CBER	3.3LBER	1.6LNAO
1997	1027	1354	12.0	L	76.464	23.543	20.0F	5	1.1	2.6CBER	3.0LBER	2.6LNAO
1997	1115	1611	55.4	L	57.002	7.802	10.0F	17	0.7	3.4CBER	3.1LBER	
1997	12 2	0002	8.2	L	71.734	-2.497	10.0F	19	1.3	4.1LBER		3.6LNAO
1997	12 4	2203	47.2	L	56.881	7.699	15.0F	15	1.6	3.8SBER		3.2LNAO
1997	12 6	1935	47.4	L	78.259	7.618	10.0F	3	1.0	2.7CBER	3.1LBER	2.4LNAO
1997	1213	0702	3.5	JL	71.014	-9.892	10.0F	17	1.0	4.5LBER	4.7BBER	5.3BPDE
1997	1219	0147	24.4	L	76.562	25.305	15.0F	10	1.6	3.5CBER	4.1LBER	3.4LNAO
1997	1220	2140	50.1	L*	67.901	10.036	15.0F	20	1.8	3.8CBER	3.4LBER	3.3LNAO
1997	1221	1830	12.2	L	67.970	10.308	10.0F	12	1.4	3.1CBER	2.5LBER	2.1LNAO

Abbreviations are:
date: **year**, **mo** = month, **da** = day
origin time given in UTC: **hr** = hour, **mi** = minutes, **sec** = seconds
m= model identification (blank=standard model, J=Jan Mayen model, L=only nearest stations used)
d = distance identification (L=local, R=regional, D=teleseismic)
e=event identification (*=well recorded, P=probable explosion, E=known explosion)
location: **lat** = latitude, **long**=longitude
depth = focal depth (km)
FF: first F for fixed depth, second F for fixed location
ns = number of stations
rms = root mean square of the travel-time residuals
magnitudes: magnitude type (C=coda, L=local, B=body wave, W=moment)
and magnitude reporting

agency (BER=Bergen, NAO=NORSAR, PDE=Preliminary Determination of Epicenters)

Figure 6. Seismograms for the earthquake on December 13th 1997 at 07:02 (UTC). All seismograms are filtered between 4 and 9 Hz. The station abbreviations are: BJO=Bjørnøya,KBS=Kings Bay, LOF=Lofoten, TRO=Tromsø, KTK=Kautokeino, MOR8=Mo i Rana, HYA=Høyanger, NSS=Namsos, MOL=Molde, FOO=Florø, TRON=Trondheim, SUE=Sulen, ASK=Askøy, EGD=Espegrend, RUND=Rundemannen, KONO=Kongsberg, BLS5=Blåsjø.

5. Well recorded events

Since January, 1995, well recorded earthquakes have been selected during the daily analysis and specially marked in the Bergen data base. The event selection is based on signal to noise ratio and the number of recording stations and this means that both small events near the network and large events further away have been selected. These events are studied in more detail than the remaining events. Additional phase readings and waveform data are collected if available, mainly from NORSAR and BGS. Particularly the location and the depth estimates are checked. For each event the rms-vs-depth plot is checked and if possible the event is located using only the nearest stations (D< 200 km) to see if this gives a better location with a well constrained depth. If this is the case, the depth is fixed and the event is relocated using all stations. If no reasonable depth can be determined, the depth is fixed at 15 km for continental earthquakes and at 10 km for oceanic. The same principles for depth determination is also used for the local and regional events with magnitude equal to or above 3.0.

For this report 13 events have been analysed (see Table 3). The locations of these events are shown in Figure 7.

Fault plane solutions were determined for one well recorded event. This earthquake was also the second largest recorded close to the Norwegian mainland and was located onshore north of Sauda in Rogaland. The values of strike, dip and rake are given in Table 3. The fault plane solutions are shown in Figure 8.

The earthquake on August 19th was included in this list not due to good signal-to-noise ratio, but due to the interesting location. It is rare that earthquakes are located in the vicinity of Færøyene.

Table 3. List of 13 well recorded events in the last half year of 1997 including the values of strike, dip and rake in the line following the event line.

year	damo	hrmi	sec	mde	lat	long	depth	FF	ns	rms	magnitudes				MO	ST	OM	f0	R	AI
•1997	7	5	0740	19.8	L*	61.545	5.010	8.0	F	13	0.9	2.7CBER	2.4LBER	2.2LNAO	2.5WBER	12.8	10.7	2.0	8.23	0.15	
•1997	714	1147	56.5	L*	61.509	3.573	15.0	F	22	1.0	3.1CBER	2.8LBER	2.8LNAO	2.9WBER	13.4	15.6	5.3	5.71	0.25	
•1997	725	1743	27.8	L*	59.264	6.195	28.0	F	11	1.9	2.1CBER	2.0LBER	1.4LNAO	2.0WBER	12.0	2.0	7.5	8.58	0.15	
•1997	812	0814	24.1	L*	59.819	6.647	12.0	F	14	1.0	2.7CBER	2.8LBER	3.4LNAO	2.8WBER	13.3	7.9	1.7	5.41	0.23	
strike: 183.7			dip: 64.30			rake: 16.1														
•1997	818	0509	27.4	L*	61.392	4.516	7.0	F	7	1.3	1.8CBER	1.0LBER		1.3WBER	11.0	0.3	14.9	9.89	0.13	
•1997	819	0345	5.7	L*	64.072	-8.125	10.0	F	14	1.5	3.5CBER	2.6LBER	2.6LNAO	2.6WBER	13.0	10.1	9.9	7.31	0.17	
•1997	821	2236	9.7	L*	64.982	5.447	12.0	F	14	1.0	2.9CBER	2.4LBER	2.2LNAO	2.6WBER	13.0	7.4	26.0	6.63	0.18	
•1997	831	0547	38.8	L*	61.263	3.073	15.0	F	28	2.0	2.7CBER	2.2LBER	2.0LNAO	2.4WBER	12.7	1.5	19.0	5.17	0.24	
•1997	915	1558	48.6	L*	60.185	5.199	9.0	F	14	0.9	2.6CBER	2.5LBER	2.4LNAO	2.5WBER	12.8	9.6	11.1	8.37	0.15	
•1997	10	6	1233	31.4	L*	76.475	24.057	15.0	F	12	3.7	3.4CBER	3.8LBER	3.5LNAO	3.8WBER	14.7	8.5	3.1	1.68	0.77	
•1997	1113	0921	44.2	L*	60.123	4.621	7.0	F	13	1.2	2.5CBER	2.2LBER	2.4LNAO	2.2WBER	12.3	0.4	16.3	4.28	0.29	
•1997	1218	0908	57.8	L*	61.373	4.677	15.0	F	9	1.7	1.9CBER	1.6LBER	1.6LNAO	1.9WBER	11.9	1.4	11.1	8.01	0.16	
•1997	1220	2140	50.1	L*	67.901	10.036	15.0	F	20	1.8	3.8CBER	3.4LBER	3.3LNAO	3.5WBER	14.4	17.0	15.4	3.14	0.40	

Abbreviations are:

date: **year mo** = month **da** = day, **origin time given in UTC**: **hr** = hour **mi** = minutes **sec** = seconds, **m**= model identification (blank=standard model, J=Jan Mayen model, L=only nearest stations used); **d** = distance identification (L=local, R=regional, D=teleseismic), **e**=event identification (*=well recorded, P=probable explosion, E=known explosion); **location**: **lat** = latitude, **long**=longitude **depth** = focal depth (km); **FF**: first F for fixed depth, second F for fixed location; **ns** = number of stations; **rms** = root mean square of the travel-time residuals, **magnitudes**: magnitude type (C=coda, L=local, B=body wave, W=moment) and magnitude reporting agency (BER=Bergen, NAO=NORSAR, PDE=Preliminary determination of epicenters), **MO** = log of seismic moment in Nm, **ST** = stress drop in bar, **OM** = log spectral level in nm sec, **f0** = corner frequency in Hz, **R** = source radius in km, **AI** = addidional waveform files has been used (+ = YES, - = NO)

Figure 7. Epicentre distribution of well recorded events in the last half of 1997. To be able to spot the earthquake locations no stations are marked on this map.

Figure 8. Earthquake focal mechanism (indicated by stereographic projection) in the last half of 1997. Squares indicate stations operated by the Institute of Solid Earth Physics, University of Bergen (UiB), whereas the star shows the IRIS station KONO. The epicentres is indicated by a circle also giving the magnitude.

6. Felt events

Four events were reported felt during the last half of 1997 (see Table 4 and Figure 9), all occurring in areas where earthquakes have been felt before. Two of the earthquakes were felt by a sufficient number of people so that questionnaires were sent. The isoseismal maps can be seen in Figure 10.

The strongest of the four events was felt at Jan Mayen, and was reported to have an intensity of IV. Unfortunately the one digital system crashed just hours prior to the event and no SP digital records were made. The broad band (BB) digital system recorded the earthquake, but due to the earlier mentioned tape reading problem in Bergen no digital data is yet retrieved. However, good analogue data from one station (JMI) is used when location the earthquake and in Figure 6 recordings made on Bjørnøya , Kings Bay and the mainland stations can be seen. Several weaker aftershocks were occurring within 2-3 days after the main shock, some of these were also felt.

Table 4 Earthquakes felt in Norway during the time period July to December, 1997.

Date	Time (UTC)	Max Intensity (on MMI scale)	Magnitude (BER)	Epicentral Location, Area
12.08.97	08:14	II	2.7 (M_C) 3.0 (M_L)	59.80N / 6.52E Sauda, Sunnhordland
15.09.97	15:58	IV	2.6 (M_C) 2.5 (M_L)	60.18N / 5.19E Offshore, Southwest of Bergen
13.12.97	07:02	IV	4.5 (M_L) 4.7 (M_B)	71.04N / 9.66W close to Jan Mayen Island
20.12.97	21:40	II	3.8 (M_C) 3.4 (M_L)	67.89N / 10.12 West of Lofoten

Figure 9. Locations of the four felt earthquakes during last half of 1997. To be able to spot the earthquake locations no stations are marked on this map.

Figure 10. Isoseismal maps for the two felt earthquakes where questionnaires were sent out. **a**: 12th August and **b**: 15th September. The numbers show the intensity at a location, intensity 1 indicates that the earthquake not was felt.

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