Hungarian Earthquake Bulletin
1998

GeoRisk
Geophysical Research and Consulting Ltd.

HUNGARIAN EARTHQUAKE BULLETIN

1998

L. TÓTH, P. MÓNUS, T. ZSÍROS

CONTRIBUTORS:

M. KISZELY
Z. KOSZTYU

Bibliographic reference

Tóth, L., P. Mónus and T. Zsíros, 1999.
Hungarian Earthquake Bulletin, 1998.
GeoRisk, Budapest, pp. 71.

BUDAPEST 1999

Ringló u. 101/B, H-1221 Budapest, HUNGARY
Fax: (36 1) 226 4573 * http://georisk.seismology.hu

This work was supported by PAKS NUCLEAR POWER PLANT LTD.

ISSN: 1219-963X

Felelős kiadó: Dr. Tóth László

Back cover page: Historical (456-1994) and recent (1995-98) seismicity in Hungary

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ACKNOWLEDGEMENTS

The project is sponsored by *Paks Nuclear Power Plant Ltd. (PA RT)* under *GeoRisk*'s contracts No. 8257000002 and 8257000003.

Special thanks due to the *Geodetic and Geophysical Research Institute (GGKI)* who is responsible for the national seismological network and whose cooperation was utmost important.

Other organisations supplying data for this Bulletin are:

Paks Nuclear Power Plant Ltd. (PA RT)
MOL Rt.
GeoRisk Ltd.

Data interchange with a number of seismic stations from the neighbouring countries contributed to the accuracy of event locations. Those are *Austria, Croatia, Czech Republic, Germany, Romania and Slovakia.*

INTRODUCTION

Even in Europe, where the number of seismograph stations in national networks are relatively high, it is hardly possible to go down with the overall detection capability to monitor low magnitude events at local scale.

Until latest time, in most part of Hungary, the detection and location capability of seismograph stations could not go beyond the level of felt earthquakes. The earthquake catalogue entries – that means the basic input data for all seismicity and seismic hazard studies – were almost entirely based on macroseismic observations. The present understanding of the seismicity in the Pannonian Basin is mostly based on epicenter distribution of historical earthquakes. Since macroseismic information is the only source of these events, all earthquake parameters are estimated from intensity distribution. The further we go back in time, the macroseismic information is more heterogeneous and more incomplete. As the intensity values are only defined at settlements, reflecting the colony structure of the given age, the macroseismic epicenters are rather uncertain (+/-10-50 km). In addition the magnitude threshold of known events is usually high. All these difficulties might lead to conclude that the seismicity in the Pannonian Basin is diffuse or with other words there is no strong correlation between the known seismicity and known tectonics.

In September 1993, after its review mission at Paks Nuclear Power Plant the IAEA recommended to install a local network of high quality digital seismographs what would be capable of detecting and locating low scale activity. The design, installation and operation of the seismic monitoring network and its data processing have been carried out through a wide expert participation, fully transparent way, according to present international seismological practice.

The Paks Microseismic Monitoring Network has been operational since April 1995. The typical detection threshold of the network, supported by other existing stations, is around 1.5-2.0 ML, somewhat lower in the middle of the country and a little higher towards the border regions. This means that in most part of the country it is very unlikely that felt earthquakes go undetected.

In 1998, in the fourth year of the project some 500 earthquakes have been recorded by the monitoring network and 55 of them happened in the monitored geographic window given below. The developing database of these well located earthquakes can be used, in one hand, to resolve the tectonic framework in the Pannonian Basin and

required on the other hand to refine our understanding of the level of seismic risk in Hungary. This helps in assessment of the level of precautionary measures which should be taken in respect of existing and new buildings and constructions, and installations which could prove hazardous in the event of damage or disruption.

Further to the better understanding of the seismic hazard for the Paks NPP and surrounding area, the seismic monitoring project has been successful in accumulating seismic data to an accuracy not before possible, giving a significant contribution to improve the understanding of the earthquake mechanisms within the whole Pannonian Basin.

This Earthquake Bulletin is the annual summary report of the earthquake monitoring project. The information in the Bulletin is based on all available earthquake related data provided by different organizations. The geographic region covered is bounded by latitudes 45.5-49.0N and longitudes 16.0-23.0E.

1.

SUMMARY OF 1998 SEISMICITY

1998 was a quiet year again for Hungarian seismicity. There were 55 earthquakes ($0.2 \leq ML \leq 3.9$) located within the area of interest. Five earthquakes were reported as felt, of those two with epicentres outside of Hungary, one in Slovenia and one in Serbia. None of the earthquakes caused significant damage. The highest magnitudes (ML) assigned to a shock was 3.9 and 3.2 for earthquakes both in Croatia.

The highest intensity reported during the year was 5 EMS, slight earthquake damage was reported.

Reviewing the more notable earthquakes of the year in chronological order, a shock of magnitude 2.0 ML on the 12th of January in Balatonfűzfő produced report of intensity 3-4 EMS. On April 12th, an earthquake in Slovenia with a magnitude of 5.6 ML was felt at Western part of Hungary with a maximum intensity of 3-4 EMS. On May 8th an earthquake (2.0 ML) in Budakeszi gave rise to reports of intensity 3 EMS. The Serbia earthquake of 29th September had intensity 8 at the epicentral area and produced reports of intensity 5 EMS from the border region in Hungary. The area in which it was felt in Hungary was relatively large, about 10.000 km^2. On December 6th, an earthquake with a magnitude of 2.6 ML was felt over a small area of 100-150 km^2 (Hárskút, Márkó) with a maximum intensity of 3-4 EMS.

2.

SEISMOGRAPH STATIONS IN HUNGARY

In 1998, there have been no substantial changes with the Hungarian earthquake monitoring network compared to the previous year.

The Microseismic Monitoring Network (MMN) established by the *Paks Nuclear Power Plant Ltd.* in 1995, has been operational throughout the year.

In addition to the information from the eleven station PAKS MMN, data is contributed by four stations operated by the *Seismological Observatory, Geodetic and Geophysical Research Institute (GGKI).* Of those, one belongs to the *Ministry of Foreign Affairs* and is operated in cooperation with the German GEOFON network.

Data interchange with stations from the neighbouring countries and international data centres was also important.

The estimated detection capabilities of the present network with average noise conditions, supposing that at least four stations is needed for origin determination, is typically around 1.5-2.0 ML, somewhat lower in the middle of the country and a little higher towards the border regions. (See Fig. 2.4) This means that in most parts of the country it is very unlikely that felt events go undetected.

During the reporting period we also had access to five strong motion accelerograph stations belonging to and operated by different organisations such as *Paks Nuclear Power Plant, GeoRisk, GGKI, Ministry of Environment* and *MOL RT.*

Seismograph Stations

Table 2.1. *Seismic stations, instrumentation and lithology*

Code	Latitude (N)	Longitude (E)	Elevation (m)	Foundation	Type of station (1)	Sensor type (2)	Recording (3)	Org. (4)
BUD	47.4836	19.0239	196	dolomite	3C LP	Kirnos	A - C	GGKI
BUDA	47.4836	19.0239	196	dolomite	3C SP	LE-3D	D - E	GR
GYL	46.5981	21.1718	92	sand	3C SP	SS-1	D - E	GGKI
PENC*	47.7905	19.2817	250	alluvium	3C SP	LE-3D	D - E	GGKI
PKS0	46.5743	18.8449	100	sand	3C SP	LE-3D	D - E	GR
PKS2	46.4920	19.2131	106	sand	3C SP	LE-3D	D - E	GR
PKS4	46.2340	18.4635	220	limestone	3C SP	LE-3D	D - E	GR
PKS6	46.5998	19.5645	120	sand	3C SP	LE-3D	D - E	GR
PKS7	47.0473	19.1609	95	mud	3C SP	LE-3D	D - E	GR
PKS8	46.8787	18.6765	135	rhyolite tuff	3C SP	LE-3D	D - E	GR
PKS9	46.5870	18.2789	240	loess	3C SP	LE-3D	D - E	GR
PKSc	47.3806	18.4371	200	dolomite	3C SP	LE-3D	D - E	GR
PKSm	46.2119	18.6413	170	granite	3C SP	LE-3D	D - E	GR
PKSn	46.8972	19.8673	110	sand	3C SP	LE-3D	D - E	GR
PSZ	47.9184	19.8944	940	andesite	3C BB	STS-2	D - C	GGKI
SOP	47.6833	16.5583	260	gneiss	3C SP	SS-1	D - E	GGKI

(1) 1C - one component vertical seismometer, 3C - three component seismometer
SP - short period seismometer, BB - broad band seismometer, SM - strong motion accelerograph

(2) STS-2 - Streckeisen broad band seismometer, LE-3D - Lennartz three directional 1Hz geophone,
SS-1 - Kinemetrics 1Hz seismometer, Kirnos - 12 s long period seismometer

(3) A - analogue, D - digital, C - continuous recording, E - event recording

(4) GGKI - Geodetic and Geophysical Research Institute, GR - GeoRisk Ltd., PART - Paks Nuclear Power Plant Ltd.

(*) PENC on date 1998/11/19

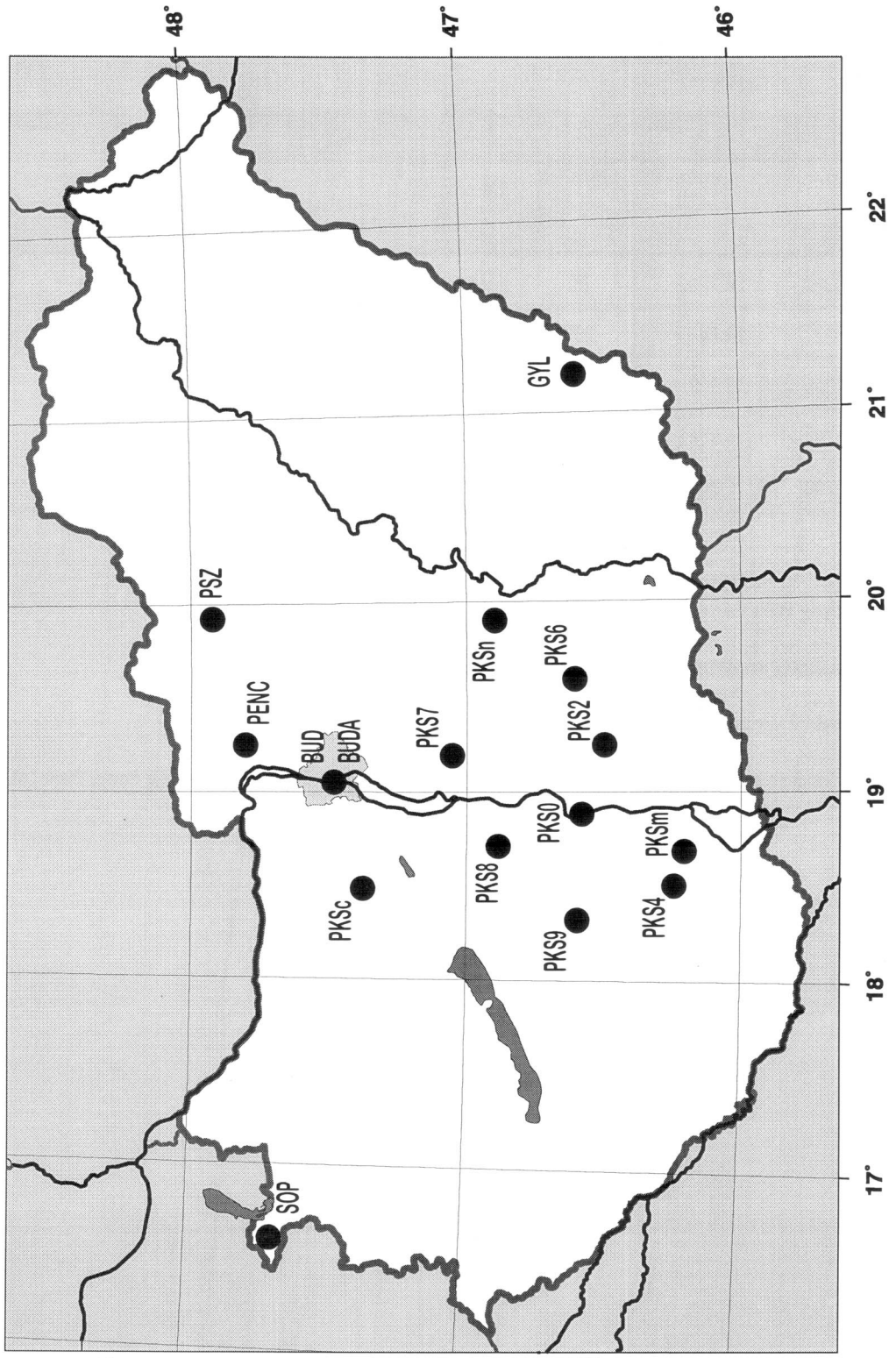


Figure 2.1. *Seismograph stations in Hungary (See Table 2.1. for details)*

Seismograph Stations

Table 2.2. *Strong motion accelerograph stations*

Code	Latitude (N)	Longitude (E)	Elevation (m)	Foundation	Type of station (1)	Sensor type (2)	Recording (3)	Org. (4)
ALGY	46.3332	20.2092	90	loose sand	3C SM	AC-23	D - E	GR
BOD	47.322	18.241	250	limestone	3C SM	AC-23	D - E	GR
BPGY	47.4836	19.0239	196	dolomite	3C SM	AC-23	D - E	GGKI
PAKB	46.5743	18.8587	100	sand	3C SM	AC-23	D - E	PART
PAKK	46.5743	18.8449	100	loose sand	3C SM	AC-23	D - E	GGKI

(1) 3C - three component seismometer
SM - strong motion accelerograph

(2) AC-23 - triaxial accelerometer package (full scale 0.5g)

(3) D - digital, E - event recording

(4) GGKI - Geodetic and Geophysical Research Institute, GR - GeoRisk Ltd., PART - Paks Nuclear Power Plant Ltd.

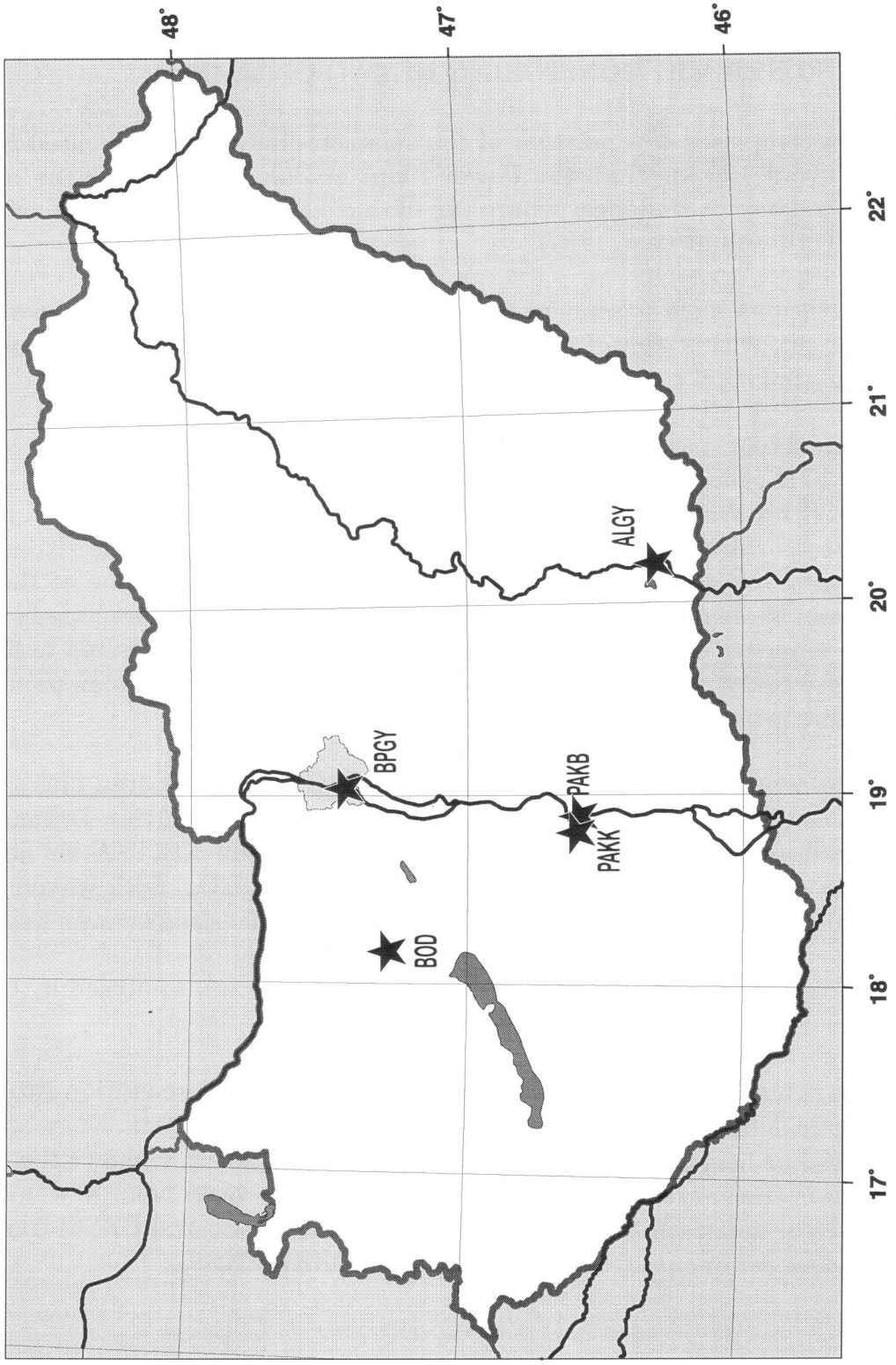


Figure 2.2. *Strong motion accelerograph stations in Hungary (See Table 2.2. for details)*

Seismograph Stations

PAKS MICROSEISMIC MONITORING NETWORK (MMN)

The system comprises of a network of ten seismometer stations, located within a radius of about 100 km from the Power Plant at Paks (situated in the centre of Hungary) and one in Budapest where the data centre is set up and collected data analysed (Tóth and Mónus, 1997).

The field stations each consist of a three component short period seismometer located in a pit, with a digital recorder and time signal receiver housed nearby in a heat insulated steel container building.

The seismometers used are the LE-3D three directional compact size high sensitivity 1 Hz geophones. The digital acquisition system is the MARS-88 recorder that uses 20 bit AD converters sampling the data 125 times per second. The recorder also performs signal detection by its internal STA/LTA algorithm. Three of the stations are accessible over commercial telephone lines (one of them is a mobile phone) while the others store event and continuous monitor channel data on rewritable magneto-optical disks, which are collected and transferred to the data centre on a weekly basis. Most of the stations are powered by solar panels, and absolute time is provided by DCF-77 time code receivers.

At the data centre a SUN SPARC workstation with large on-line disk capacity serves as a powerful tool for the routine data processing and analysis. Lennartz M88 database software is used for the data management and XPITSA for advanced seismogram analysis. All recorded data are archived on CDs. Both waveform and bulletin data are available over the INTERNET for authorized remote users.

The MMN is currently operated and its data processed and analysed by *GeoRisk Ltd.*

In 1997, an extensive noise survey has been carried out at those station sites where magneto-optical disks storage allowed to store large amount of data. Noise segments of 3 minutes has been recorded with 11 hours shifts. Figure 2.3. shows the vertical components of the very long term averaged (near to one year) noise power spectra. There is a clear separation of the rocky sites (PKSm, PKSc and PKS8) from those of having loose sediments (PKSn, PKS2, PKS6, PKS7, PKS9).

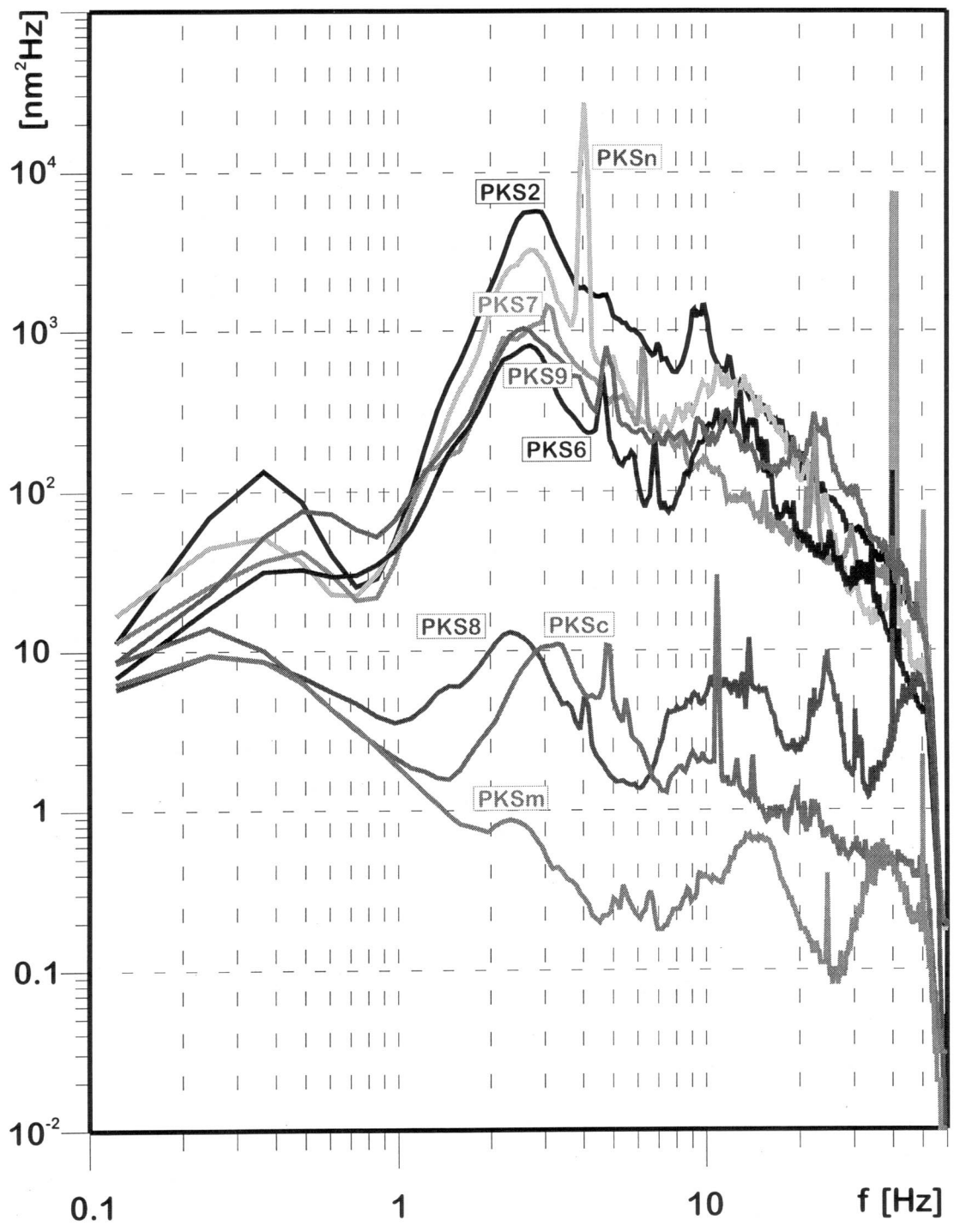


Figure 2.3. *Average noise power spectra for the MMN stations. (See text for details)*

Seismograph Stations

STATIONS OPERATED BY GGKI

During 1998 GGKI operated three digital and one analogue seismological stations.

Station *Piszkés (PSZ)* has been installed as an 'Open Station' under a cooperation between the Ministries for Foreign Affairs of Hungary and of Germany with the primary goal of nuclear test ban monitoring (Tóth, 1992). The station is equipped with a triaxial Streckeisen STS-2 broad-band seismometer and Quanterra's data acquisition system with a 24 bit, 80 Hz high resolution digitizer. Three component continuous data streams are recorded in circular buffers on magnetic disks and archived on tape cartridge. Continuous data is available on-line for more than a month. All data can be accessed directly and retrieved either in interactive or automatic mode. A menu driven software (DRM) serves a powerful and easy tool for data access, extraction of data segments at different sampling rates. In 1998 PSZ also contributed data to GEOFON Project.

GYL and SOP are three component short period stations installed in 1994 under a local project, „Soproni Regionális Műszerközpont (SROM)". Kinemetrics SSR-1 16bit digitizers and event recorders sample and record the output of three component SS-1 Ranger seismometers. Data of recorded events are collected via commercial telephone links.

A long period analogue recording seismograph is operated at the *Seismological Observatory* in Budapest mostly for demonstration purposes.

STRONG MOTION STATIONS

Although the five strong motion accelerograph stations belong to five different organisations, they are all equipped with the same instrumentation: a AC-23 triaxial accelerometer package (full scale 0.5g) and an SM-2 digital event recorder (manufactured by SIG^{SA}, Switzerland).

During 1998 we had access to all of these stations.

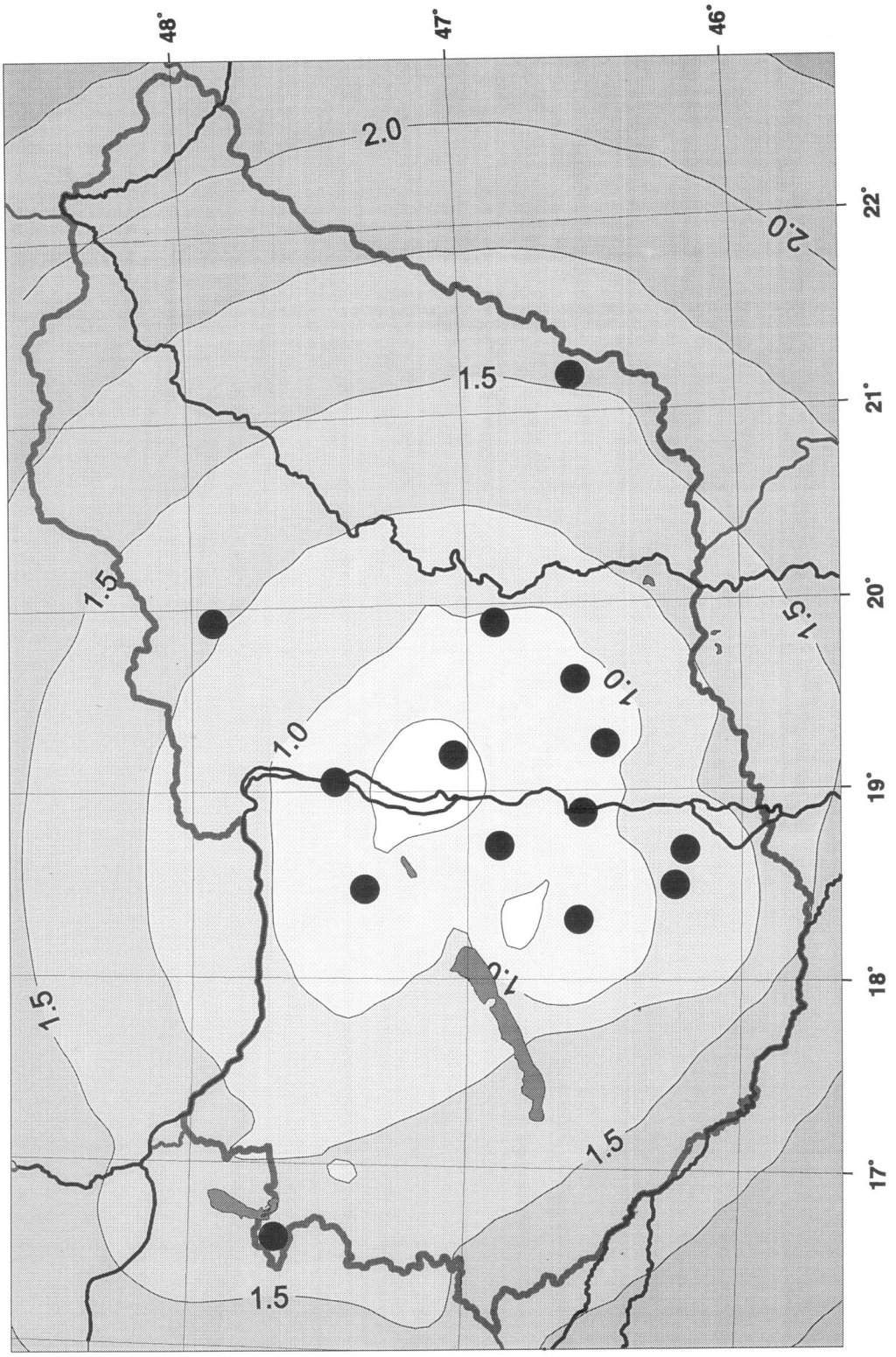


Figure 2.4. *Detection capability with average noise conditions. Contour values are Richter local magnitudes (ML).*

Seismograph Stations

3.

List of Origins / Hypocentre Parameters

Hypocentre Parameters

METHOD FOR HYPOCENTRE PARAMETER DETERMINATION

HYPO71PC (Lee and Lahr, 1975) was used for the routine calculation of hypocentre parameters. The original program has been slightly modified in order to implement a routine for Richter local magnitude calculation for the instruments used. For the magnitude calculations the method published by Bakun and Joyner (1984) was used.

The hypocentre parameters were calculated using phase readings of seismological stations from Hungary and from the neighbouring countries. However, a distance weighting was applied, phase data from stations with epicentral distance greater than 450 km have been assigned a weight of 0 in most cases. In some cases, when enough P readings were available, S phase readings were not used in the calculations.

CRUSTAL VELOCITY MODEL

The three layer crustal velocity model used in the hypocentre calculations has been derived from crustal phase travel times of several hundreds of local earthquakes (Mónus, 1995).

Velocity (v_P) [km/s]	*Depth [km]*	*Thickness [km]*	v_P/v_S
5.60	0.0	20.0	1.78
6.57	20.0	11.0	
8.02	31.0	∞	

Table 3.1. *List of events in 1998*

Day	Origin time UTC hr mn sec	Geographic coordinates Lat	Long	Depth (km)	ML	I_{MAX} (EMS)	Locality/Region
JANUARY, 1998							
12	4:15:45.9	47.050N	18.076E	4	2.0	3.5	Balatonfűzfő
18	2:05:28.6	46.041N	16.920E	10	2.7	-	Croatia
18	2:11:19.4	46.018N	16.935E	15	1.8	-	Croatia
18	7:30:08.5	46.036N	16.937E	15	2.8	-	Croatia
28	10:57:04.4	47.756N	18.508E	8	1.1	-	Lábatlan
29	0:11:22.8	45.711N	19.557E	15	1.9	-	Yugoslavia
FEBRUARY, 1998							
02	11:30:42.5	47.495N	18.486E	10	1.8	-	Szár
MARCH, 1998							
11	10:55:45.5	47.470N	18.514E	10	1.8	-	Csákvár
11	11:33:29.0	47.933N	16.420E	10	1.6	-	Austria
22	8:39:12.4	46.675N	21.425E	10	2.2	-	Dénesmajor
APRIL, 1998							
13	17:08:25.3	47.409N	18.310E	5	1.4	-	Csákvár
15	10:28:00.5	47.475N	18.524E	10	1.5	-	Csákvár
22	1:36:39.2	46.168N	20.180E	10	1.7	-	Tiszasziget
23	10:27:48.8	47.313N	18.386E	2	1.4	-	Csákvár
MAY, 1998							
05	11:32:36.6	48.148N	18.256E	10	1.6	-	Slovakia
06	0:23:16.8	47.627N	18.625E	3	0.6	-	Bajna
08	4:06:54.2	47.513N	18.930E	10	2.0	3	Budakeszi
08	10:13:19.9	46.159N	19.795E	9	1.3	-	Bokortanya
12	15:18:03.4	46.033N	16.642E	10	3.2	-	Croatia
13	10:27:32.0	47.442N	18.529E	10	2.2	-	Vértesboglár
27	12:35:45.5	46.104N	16.719E	10	1.9	-	Croatia
27	18:45:27.4	46.816N	18.928E	15	0.4	-	Dunaföldvar
JUNE, 1998							
01	13:07:46.6	45.805N	17.973E	9	2.7	-	Vejti
02	18:02:57.1	46.068N	17.118E	10	3.9	-	Croatia
28	3:12:12.8	47.503N	18.924E	6	0.5	-	Budakeszi
28	12:19:40.5	47.498N	18.927E	8	1.4	-	Budakeszi

Hypocentre Parameters

JULY, 1998							
03	9:56:07.7	47.382N	18.475E	8	2.0	-	Csákvár
03	15:35:21.1	46.933N	19.042E	17	2.1	-	Szalkszentmárton
05	3:43:13.0	47.054N	19.676E	12	1.5	-	Nagykőrös
09	23:21:28.7	47.055N	19.685E	13	1.1	-	Nagykőrös
09	23:31:29.7	47.039N	19.670E	14	1.1	-	Nagykőrös
17	9:57:03.5	47.495N	18.388E	6	2.2	-	Oroszlány
AUGUST, 1998							
06	11:04:42.6	47.271N	18.624E	11	0.6	-	Velence mt.
10	9:56:00.3	47.434N	18.556E	10	1.9	-	Bodmér
14	8:58:12.2	47.378N	18.435E	0	2.1	-	Csákvár
26	7:38:05.2	47.052N	18.208E	10	1.6	-	Balatonfőkajár
26	10:22:15.1	47.449N	18.504E	7	1.7	-	Vérteskozma
SEPTEMBER, 1998							
15	3:48:36.5	46.016N	17.063E	10	2.1	-	Croatia
21	23:57:54.2	47.497N	18.925E	10	1.0	-	Budaörs
23	19:07:09.9	47.107N	18.351E	10	0.9	-	Polgárdi
28	9:41:10.9	47.444N	18.382E	2	1.5	-	Vértes mt.
29	11:41:57.0	47.441N	18.709E	13	0.8	-	Etyek
OCTOBER, 1998							
06	8:30:49.2	47.473N	18.575E	10	1.3	-	Vértes mt. (expl?)
09	8:52:04.5	47.431N	18.269E	10	1.3	-	Vértes mt. (expl?)
27	9:22:50.2	47.137N	18.211E	15	1.4	-	Nádasladány
31	20:01:15.1	46.331N	18.082E	6	0.9	-	Szabadi
NOVEMBER, 1998							
02	18:32:08.6	46.410N	17.764E	10	1.1	-	Kaposvár
06	9:19:26.3	47.488N	18.436E	10	1.6	-	Vértes mt. (expl.)
19	13:18:52.8	46.139N	18.852E	11	1.2	-	Báta
22	1:30:01.0	47.683N	19.345E	7	0.9	-	Penc
22	9:21:04.9	47.699N	19.307E	8	1.3	-	Penc
25	20:57:19.2	47.429N	18.976E	5	0.2	-	Budaörs
DECEMBER, 1998							
06	14:35:03.8	47.206N	17.828E	6	2.6	3.5	Hárskút
23	21:25:24.4	46.392N	20.458E	10	1.9	-	Hódmezővásárhely
26	3:55:56.2	46.605N	20.188E	10	1.2	-	Szentes

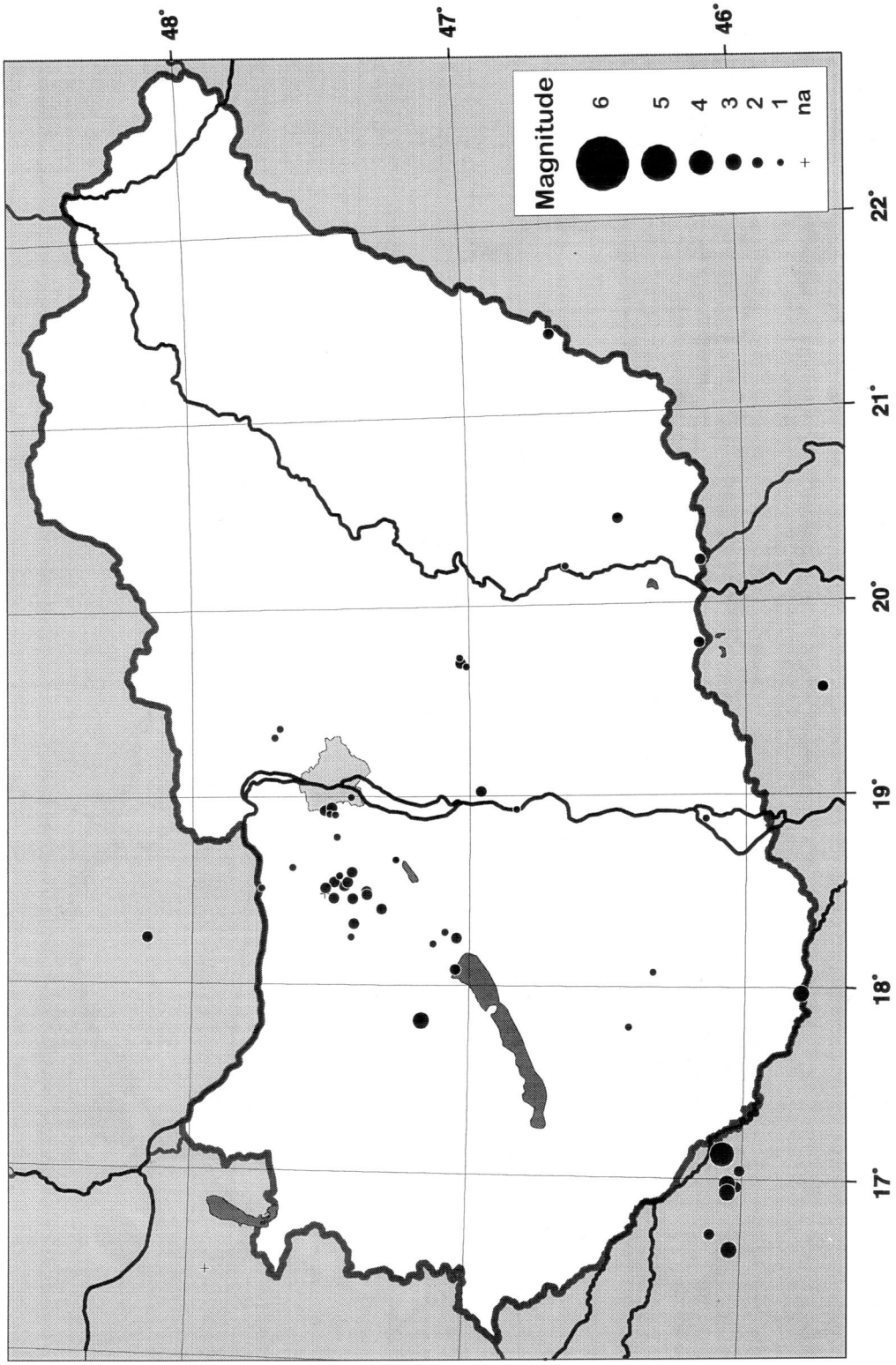


Figure 3.1. *Epicentres of 1998 earthquakes*

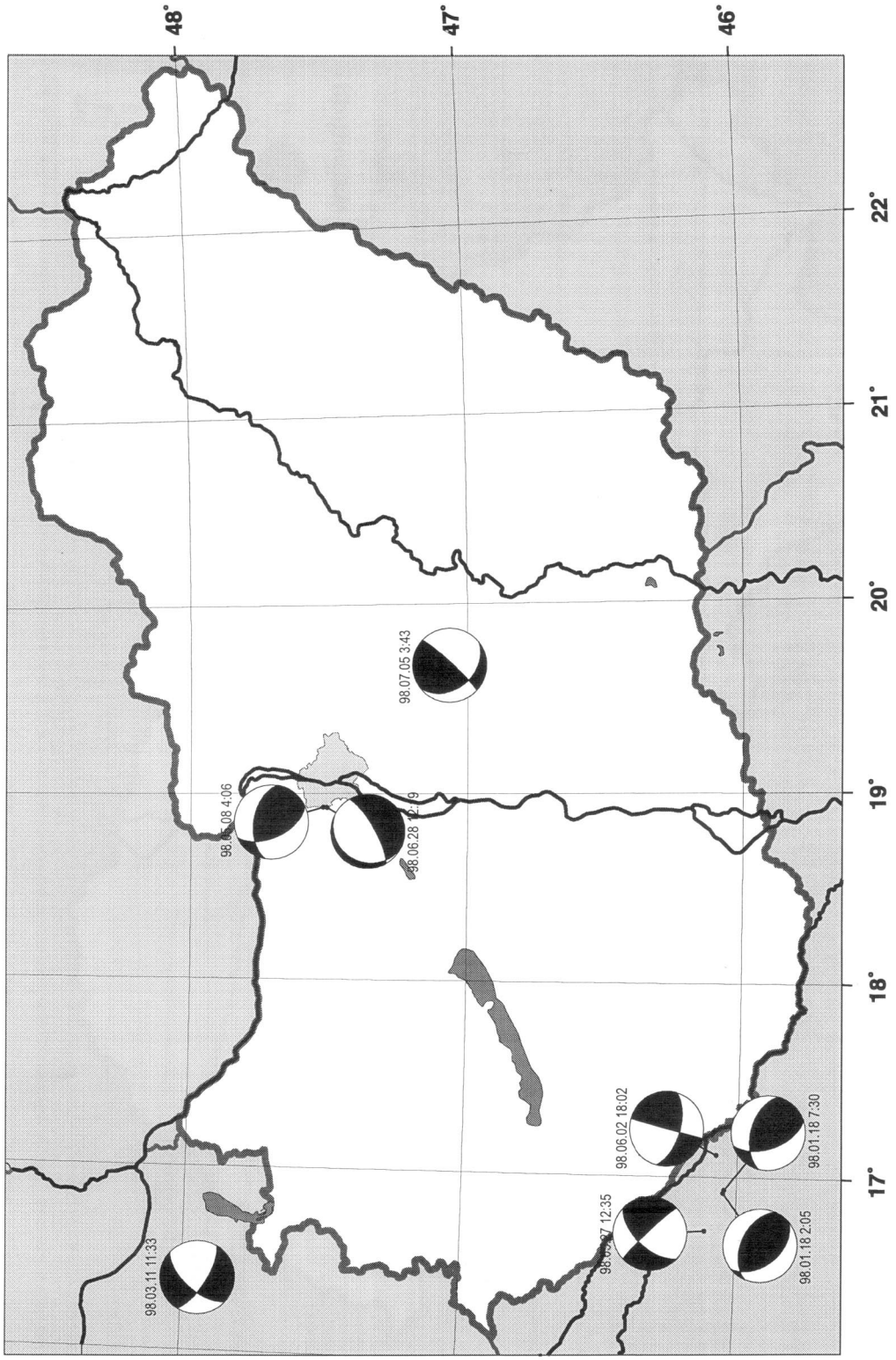


Figure 3.2. *Fault plane solutions of 1998 earthquakes*

PHASE DATA

Key to phase data encoding

time:	Time of occurrence of event in hours, mins and secs (UTC).
ML:	Richter local magnitude of the earthquake.
lat:	Latitude of the event in degrees.
lon:	Longitude of the event in degrees.
h:	Depth of the hypocentre in km.
erh:	Standard error of the epicentre in km. ($erh = \sqrt{SDX^2 + SDY^2}$, where SDX and SDY are the standard errors in latitude and longitude respectively, of the epicentre.) If erh = ---, this means that erh could not be computed because of insufficient data.
erz:	Standard error of the focal depth in km. If erz = ---, this means that erz could not be computed either because focal depth is fixed in the solution or because of insufficient data.
nr:	Number of station readings used in locating the earthquake. P and S arrivals for the same stations are regarded as 2 readings.
gap:	Largest azimuthal separation in degrees between stations.
rms:	Root mean square error of time residuals in seconds. ($rms = \sqrt{\sum R_i^2 / nr}$, where R_i is the time residual of the i^{th} station.
Locality:	A geographical indication of the epicentral area, usually the nearest settlement.
Comments:	Additional comments about the event, eg. maximum EMS intensity
sta:	Station name. (For details see Chapter 2.)
dist:	Distance from earthquake epicentre to station in km.
azm:	Azimuthal angle between epicentre to station measured from North in degrees.
phase:	Phase identifier; the first letter characterizes onset e = emergent i = impulsive, the second and third indicate the phase eg. Pn, Pg, Sn and Sg, the forth indicates the polarity C=compression/up D=dilatation/down.
hr mn sec:	Arrival time of the phase from input data.
res:	Residual of the phase in secs. ($res = T_{obs} - T_{cal}$, where T_{obs} is the observed and T_{cal} is the calculated travel time respectively.

Fault plane solutions was attempted for each events where any information for the stress field could be drawn. Stereographic projections of the lower focal hemisphere are shown, P and T are the main compression and tension axes respectively.

Hypocentre Parameters

1.

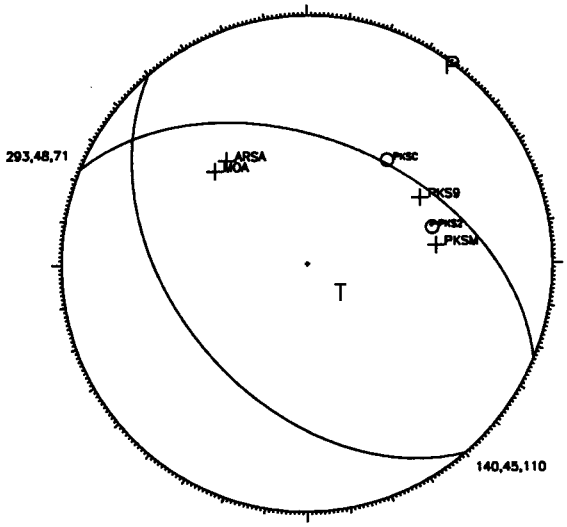
1998-01-12 time: 4:15:45.88 UTC ML= 2.0
lat: 47.050N lon: 18.076E h= 4.2 km
erh= 3.0km erz=45.8km
nr= 8 gap=242 rms=0.58
Locality: Balatonfűzfő
Comments: felt 3.5 EMS

sta	dist	azm	phase	hr mn sec	res
PKSC	45.9	37	iPgD	4:15:53.70	-0.41
			eSg	15:59.90	-0.62
PKS7	82.5	90	ePgC	4:16:01.20	0.57
			eSg	16:11.90	-0.23
PKSM	102.7	155	iPgC	4:16:04.30	0.06
			eSg	16:17.10	-1.46
PKS2	106.7	126	iPgD	4:16:05.70	0.74
			eSg	16:19.00	-0.83

2.

1998-01-18 time: 2:05:28.61 UTC ML= 2.7
lat: 46.041N lon: 16.920E h= 10.0 km
erh=****km erz=****km
nr= 8 gap=233 rms=0.77
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	121.0	60	iPnC	2:05:49.10	-0.35
			iSn	06:06.70	0.99
PKSM	134.4	82	iPnC	2:05:51.10	-0.02
			iSn	06:07.60	-1.08
ARSA	171.8	322	iPnC	2:05:55.50	-0.28
			iSn	06:16.50	-0.48
PKS2	183.8	74	iPnD	2:05:57.30	0.02
			iSn	06:18.90	-0.74
PKSC	188.8	38	iPnD	2:05:57.50	-0.40
			iSn	06:25.90	5.14
PKS7	205.1	57	ePn	2:06:03.50	3.56
			iSn	06:29.20	4.83
PKS6	213.0	73	iPnC	2:06:06.60	5.68
			iSn	06:24.90	-1.22
SRO	223.8	28	ePn	2:06:05.90	3.63
			eSn	06:38.50	9.98
MOA	285.0	315	iPnC	2:06:10.60	0.70
			iSn	06:41.20	-0.92



3.

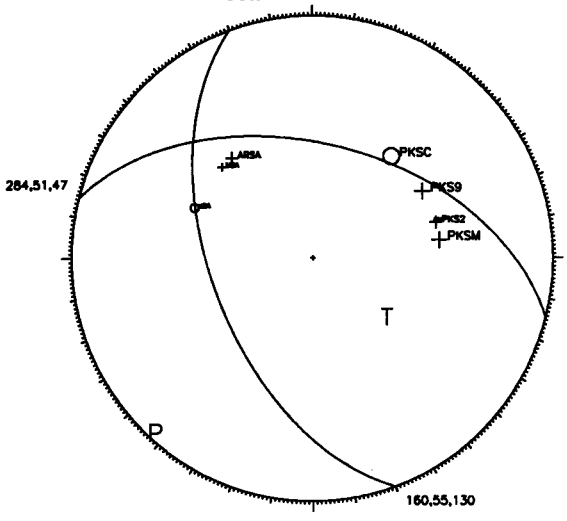
1998-01-18 time: 2:11:19.43 UTC ML= 1.8
lat: 46.018N lon: 16.935E h= 14.6 km
erh= 7.3km erz= 5.3km
nr= 8 gap=241 rms=0.94
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	121.3	59	iPnD	2:11:40.50	0.78
			iSn	11:56.20	0.65
PKSM	133.7	81	iPnD	2:11:40.50	-0.76
			eSn	11:57.00	-1.29
ARSA	174.5	322	iPn	2:11:46.80	0.45
			iSn	12:05.80	-1.56
PKS2	183.4	73	iSn	2:12:08.20	-1.13
PKSC	190.1	37	ePnC	2:11:49.90	1.60

4.

1998-01-18 time: 7:30:08.52 UTC ML= 2.8
lat: 46.036N lon: 16.937E h= 15.0 km
erh=****km erz=****km
nr= 9 gap=211 rms=0.76
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	120.2	59	ePnC	7:30:28.50	-0.11
			iSn	30:45.80	1.51
PKSM	133.2	82	iPnC	7:30:30.50	0.26
			eSn	30:49.70	2.52
ARSA	173.0	321	iPnC	7:30:34.90	-0.31
			iSn	30:55.50	-0.52
PKS2	182.7	74	PnC	7:30:35.80	-0.61
			iSn	30:58.30	0.13
PKSC	188.4	38	iPnD	7:30:36.90	-0.23
PKS6	211.9	73	iPnC	7:30:45.90	5.85
			iSn	31:04.10	-0.55
SRO	223.7	28	ePn	7:30:45.40	3.88
			eSn	31:18.50	11.23
BUD	226.5	45	eSn	7:31:15.90	8.00
MOA	286.4	315	iPnC	7:30:50.00	0.66
			iSn	31:20.60	-0.58
KBA	298.8	293	iPnD	7:30:56.90	6.01
			iSn	31:32.50	8.55
KHC	426.9	324	ePn	7:31:08.00	1.14
			eSn	32:10.00	17.63



Hypocentre Parameters

5.

1998-01-28 time: 10:57:04.36 UTC ML= 1.1
lat: 47.756N lon: 18.508E h= 7.9 km
erh= ---km erz= ---km
nr= 4 gap=243 rms=0.17
Locality: Lábatlan
Comments:

sta	dist	azm	phase	hr mn sec	res
SRO	15.9	294	e g	10:57:07.50	-0.03
PKSC	42.1	187	iPgC	10:57:12.10	0.10
			eSg	57:17.20	-0.76
PKSM	172.0	177	iPnD	10:57:31.80	-0.03

6.

1998-01-29 time: 0:11:22.82 UTC ML= 1.9
lat: 45.711N lon: 19.557E h= 15.0 km
erh= ---km erz= ---km
nr= 3 gap=354 rms=0.08
Locality: Yugoslavia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSM	90.2	308	iP*C	0:11:38.80	-0.08
			eS*	11:51.50	0.09
PKS9	138.7	315	iPnD	0:11:45.30	0.07
PRU	605.9	322	iPnC	0:12:21.70	-21.78

7.

1998-02-02 time: 11:30:42.47 UTC ML= 1.8
lat: 47.495N lon: 18.486E h= 10.0 km
erh=223 km erz=45.4km
nr= 6 gap=339 rms=0.60
Locality: Szár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	13.3	196	iPgC	11:30:45.10	-0.33
			eSg	30:46.60	-1.15
PKS9	102.2	189	iPgC	11:31:01.60	0.80
			eSg	31:14.80	-0.30
PKSM	143.2	175	ePn	11:31:06.10	0.03
			eSn	31:23.90	-0.59

8.

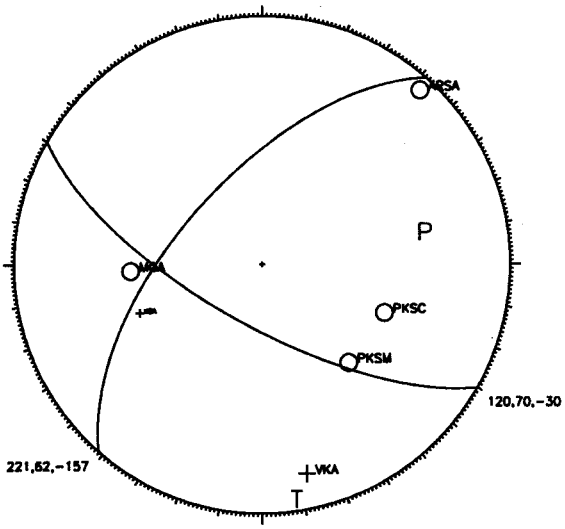
1998-03-11 time: 10:55:45.51 UTC ML= 1.8
lat: 47.470N lon: 18.514E h= 10.0 km
erh=29.9km erz=10.1km
nr= 6 gap=326 rms=0.72
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	11.5	210	iPgC	10:55:47.70	-0.53
			eSg	55:49.60	-0.75
PKS9	99.8	190	iPgC	10:56:04.20	0.79
			eSg	56:17.90	0.52
PKSM	140.2	176	ePn	10:56:08.70	-0.04
			eSn	56:24.20	-2.67

9.

1998-03-11 time: 11:33:28.95 UTC ML= 1.6
lat: 47.933N lon: 16.420E h= 10.0 km
erh= 1.8km erz= 1.8km
nr= 11 gap= 83 rms=0.72
Locality: Austria
Comments:

sta	dist	azm	phase	hr mn sec	res
VKA	37.7	348	iPgC	11:33:36.20	0.28
			iSg	33:41.00	-0.35
ZST	58.7	60	ePg	11:33:39.40	-0.18
			eSg	33:46.60	-1.28
ARSA	101.5	222	iPgD	11:33:46.80	-0.37
			iSg	33:59.60	-1.78
MOA	161.4	267	iPnD	11:33:55.60	0.77
			iSn	34:15.70	0.69
PKSC	163.5	112	iPnD	11:33:55.70	0.61
KBA	250.4	248	iPnC	11:34:11.80	5.87
			iSn	34:42.10	7.33
PKSM	255.1	139	iPnD	11:34:06.80	0.28



10.

1998-03-22 time: 8:39:12.45 UTC ML= 2.2
lat: 46.675N lon: 21.425E h= 10.0 km
erh=17.7km erz= 7.2km
nr= 7 gap=286 rms=1.13
Locality: Dénesmajor
Comments:

sta	dist	azm	phase	hr mn sec	res
GYL	21.2	246	iPg	8:39:16.96	0.32
			iSg	39:19.96	0.06
PSZ	180.3	320	iPn	8:39:40.47	-0.22
			eSn	40:00.76	-1.95
BUD	203.3	296	ePn	8:39:51.50	7.94
			eSn	40:11.50	3.68
PKSM	220.0	256	iPnD	8:39:46.58	0.94
			eSn	40:09.40	-2.13

11.

1998-04-13 time: 17:08:25.29 UTC ML= 1.4
lat: 47.409N lon: 18.310E h= 4.7 km
erh=13.7km erz= 6.1km
nr= 5 gap=299 rms=0.16
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	10.1	108	iPgC	17:08:27.20	-0.08
			iSg	08:28.90	0.07
PKS2	123.0	146	eSn	17:09:04.00	-0.05
PKSM	135.5	169	ePnC	17:08:48.80	0.18
			eSn	09:05.10	-1.72

Hypocentre Parameters

12.

1998-04-15 time: 10:28:00.46 UTC ML= 1.5
lat: 47.475N lon: 18.524E h= 10.0 km
erh=13.5km erz= 4.7km
nr= 5 gap=325 rms=0.70
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	12.4	212	iPgC	10:28:03.20	-0.10
			iSg	28:04.90	-0.62
PKS9	100.5	191	iPgC	10:28:19.60	1.11
			eSg	28:33.10	0.54
PKSM	140.8	176	iSn	10:28:41.10	-0.84

13.

1998-04-22 time: 1:36:39.15 UTC ML= 1.7
lat: 46.168N lon: 20.180E h= 10.0 km
erh= 7.0km erz= 3.2km
nr= 10 gap=279 rms=0.77
Locality: Tiszasziget
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS2	82.7	296	iPgC	1:36:54.00	-0.02
			eSg	37:05.10	-0.52
PKSM	118.9	272	iPnC	1:36:58.80	-0.93
			iSn	37:15.60	-0.18
PKS7	125.1	321	iSn	1:37:16.50	-0.65
PKS8	139.8	304	eSn	1:37:20.20	-0.22
PKS9	153.5	288	iPnD	1:37:05.40	1.36
			iSn	37:25.30	1.84
PSZ	195.8	354	ePn	1:37:10.00	0.69
			iSn	37:33.30	0.46

14.

1998-04-23 time: 10:27:48.81 UTC ML= 1.4
lat: 47.313N lon: 18.386E h= 1.6 km
erh= 8.9km erz= 3.9km
nr= 5 gap=216 rms=0.40
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	8.5	27	iPgC	10:27:50.00	-0.35
PKSM	123.9	171	Pg	10:28:11.10	0.16
			eSg	28:28.00	-0.20
PSZ	131.9	59	iPnD	10:28:12.70	0.62
			iSn	28:29.90	-0.33

15.

1998-05-05 time: 11:32:36.61 UTC ML= 1.6
lat: 48.148N lon: 18.256E h= 10.0 km
erh= 5.0km erz= 4.3km
nr= 6 gap=331 rms=0.39
Locality: Slovakia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	86.4	171	iPgC	11:32:52.20	0.06
			iSg	33:04.20	-0.05
BUD	93.6	142	ePg	11:32:54.00	0.58
			Sg	33:06.00	-0.53
PKS8	144.6	167	ePn	11:33:00.00	-0.40
			eSn	34:13.60	-5.35

16.

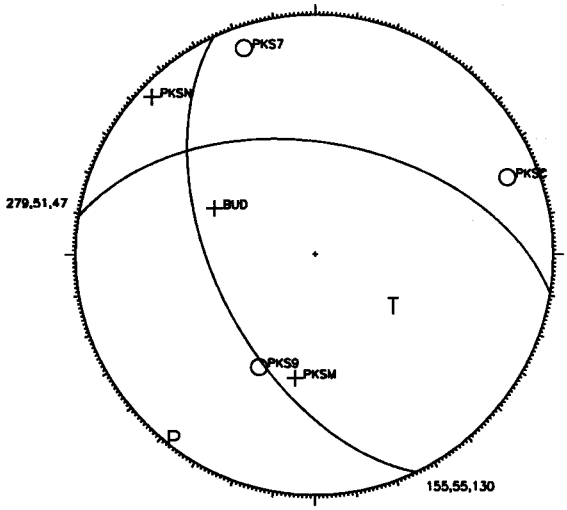
1998-05-06 time: 0:23:16.79 UTC ML= 0.6
lat: 47.627N lon: 18.625E h= 2.6 km
erh= 4.4km erz=33.9km
nr= 6 gap=271 rms=0.37
Locality: Bajna
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	30.9	207	iPgC	0:23:22.30	-0.03
			iSg	23:26.50	-0.15
SRO	31.2	311	eSg	0:23:34.50	7.74
BUD	34.0	118	ePg	0:23:22.30	-0.58
			eSg	23:28.00	0.38
PKS8	83.3	177	iPgC	0:23:32.20	0.52
			iSg	23:43.10	-0.19

17.

1998-05-08 time: 4:06:54.16 UTC ML= 2.0
lat: 47.513N lon: 18.930E h= 10.0 km
erh= 2.9km erz= 1.5km
nr= 12 gap=226 rms=0.47
Locality: Budakeszi
Comments: felt 3 EMS

sta	dist	azm	phase	hr mn sec	res
BUD	7.8	115	iPgC	4:06:56.30	-0.12
			iSg	06:57.40	-0.79
PKSC	40.0	248	iPgD	4:07:01.60	0.09
			iSg	07:07.50	0.25
PKS7	54.6	161	iPgD	4:07:04.80	0.72
			iSg	07:11.90	0.09
PKSN	98.7	134	iPgC	4:07:12.50	0.63
			iSg	07:25.80	0.12
PKS9	114.2	206	iPnD	4:07:14.00	-0.15
			eSn	07:28.70	-1.05
PKS2	115.5	169	iSn	4:07:29.70	-0.34
PKSM	146.3	189	iPnC	4:07:17.50	-0.66
			eSn	07:34.30	-2.57



18.

1998-05-08 time: 10:13:19.88 UTC ML= 1.3
lat: 46.159N lon: 19.795E h= 9.5 km
erh= ---km erz= ---km
nr= 4 gap=311 rms=0.00
Locality: Bokortanya
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSM	89.2	274	iPgC	10:13:35.90	0.00
			eSg	13:48.40	0.00
PKS9	126.0	292	ePn	10:13:41.40	0.00
PKSC	170.9	323	iPnC	10:13:47.00	0.00

19.

1998-05-12 time: 15:18:03.39 UTC ML= 3.2
lat: 46.033N lon: 16.642E h= 10.0 km
erh=****km erz=****km
nr= 17 gap=205 rms=1.33
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	140.3	64	iPnD	15:18:26.10	-0.54
PKSM	155.8	83	iPnC	15:18:28.60	0.03
			iSn	18:49.70	1.48
ARSA	160.1	328	iPnC	15:18:28.30	-0.81
			iSn	18:46.90	-2.28
PKS8	182.4	59	iPnC	15:18:30.60	-1.29
			iSn	18:56.00	1.88
PKSC	203.2	43	iPnC	15:18:33.60	-0.88
SRO	235.3	33	iPn	15:18:40.90	2.41
ZST	243.0	8	ePn	15:18:38.20	-1.24
			eSn	19:10.30	2.73
BUD	243.2	48	iPnC	15:18:43.80	4.34
			iSn	19:15.40	7.80
VKA	249.3	354	ePn	15:18:39.00	-1.23
			iSn	19:13.50	4.53
PKSN	265.7	69	eSn	15:19:22.30	9.69
MOA	271.1	318	iPnC	15:18:43.10	0.15
			iSn	19:12.80	-1.00
KBA	278.3	295	iPnC	15:18:43.80	-0.04
			iSn	19:24.60	9.21
KMR	294.9	320	iPn	15:18:47.00	1.08
			iSn	19:29.00	9.91
WTTA	406.9	290	iPnC	15:19:01.70	1.82
			iSn	20:05.50	21.56
WATA	413.7	290	iPnC	15:19:01.90	1.17
KHC	414.4	326	ePn	15:19:01.00	0.18
			eSn	19:43.00	-2.61
SQTA	436.5	288	iPnC	15:19:04.70	1.13
			iSn	20:15.50	24.98
MOTA	448.0	289	iPnD	15:19:05.90	0.89
			iSn	20:18.00	24.92
PRU	466.9	340	Pn	15:19:07.10	-0.26
			Sn	19:50.70	-6.55

20.

1998-05-13 time: 10:27:31.99 UTC ML= 2.2
lat: 47.442N lon: 18.529E h= 10.0 km
erh=16.2km erz= 6.0km
nr= 6 gap=304 rms=0.73
Locality: Vértesboglár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	9.8	226	iPgC	10:27:34.20	-0.29
			iSg	27:36.00	-0.43
PKS8	63.6	170	eSg	10:27:51.60	-0.86
PKS9	96.9	191	iPgC	10:27:50.60	1.20
			eSg	28:03.50	0.53
PKSM	137.0	176	eSn	10:28:12.20	-0.45

21.

1998-05-27 time: 12:35:45.46 UTC ML= 1.9
lat: 46.104N lon: 16.719E h= 10.0 km
erh=****km erz=****km
nr= 9 gap=207 rms=0.83
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	131.5	66	ePnC	12:36:07.70	0.09
PKSM	149.0	85	ePnC	12:36:10.00	0.22
			iSn	36:33.70	4.94
ARSA	156.9	324	iPnD	12:36:10.00	-0.77
			iSn	36:28.50	-2.02
PKS8	173.2	60	iPnC	12:36:12.20	-0.61
			eSn	36:37.50	3.36
PKSC	193.3	43	iPnC	12:36:15.20	-0.12
PKS7	214.5	61	eSn	12:36:50.00	6.69
BUD	233.4	49	ePn	12:36:28.00	7.69
			eSn	36:55.00	7.50
ZST	234.4	7	ePn	12:36:22.20	1.76
			eSn	36:51.10	3.38
VKA	242.1	353	iPnD	12:36:26.30	4.90
			iSn	36:55.10	5.66
MOA	269.3	316	iPnC	12:36:24.90	0.12
			iSn	36:54.10	-1.36
KBA	280.4	293	iPn	12:36:26.60	0.43
			iSn	37:06.50	8.57
KHC	411.1	325	eSn	12:36:42.50	-44.45

22.

1998-05-27 time: 18:45:27.44 UTC ML= 0.4
lat: 46.816N lon: 18.928E h= 14.6 km
erh= 2.4km erz=10.4km
nr= 10 gap=114 rms=0.60
Locality: Dunaföldvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS8	20.4	290	ePg	18:45:32.50	0.59
PKS7	31.2	35	iPgC	18:45:34.00	0.42
			eSg	45:38.70	0.32
PKS2	42.1	149	ePg	18:45:34.60	-0.80
			eSg	45:41.20	-0.41
PKS9	55.8	243	ePgC	18:45:38.20	0.46
			eSg	45:45.90	0.12
PKSM	70.7	198	ePgD	18:45:40.50	0.17
			eSg	45:49.80	-0.59
PKSC	73.0	329	eSg	18:45:49.80	-1.29

23.

1998-06-01 time: 13:07:46.60 UTC ML= 2.7
lat: 45.805N lon: 17.973E h= 9.3 km
erh= 2.6km erz= 1.3km
nr= 7 gap=259 rms=0.16
Locality: Vejti
Comments:

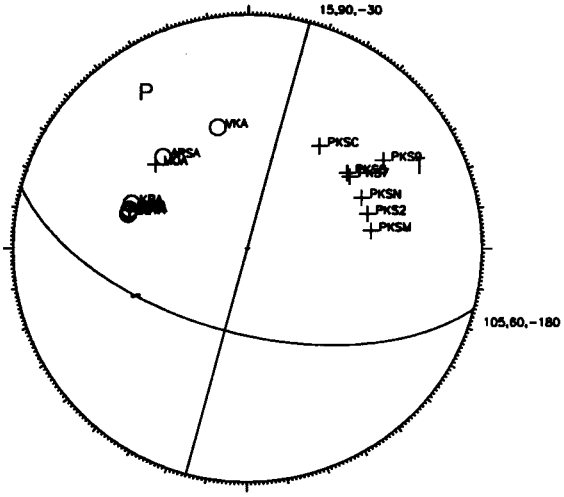
sta	dist	azm	phase	hr mn sec	res
PKSM	68.7	49	iPgD	13:07:59.00	0.02
			iSg	08:08.60	-0.04
PKS2	122.5	51	ePn	13:08:07.60	-0.12
			eSn	08:24.00	-0.19
PKSC	178.7	11	iPnD	13:08:15.00	0.28
ARSA	247.3	311	iPnC	13:08:23.00	-0.27
			iSn	08:52.00	0.12
MOA	362.9	309	iPnC	13:08:38.60	0.91
			iSn	09:18.50	0.97

Hypocentre Parameters

24.

1998-06-02 time: 18:02:57.06 UTC ML= 3.9
lat: 46.068N lon: 17.118E h= 10.0 km
erh= 2.1km erz= 7.7km
nr= 18 gap=178 rms=0.29
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn	sec	res
PKS9	106.4	57	iP*U	18:03:16.14		0.08
			eS*	03:29.41		-1.48
PKSM	118.8	82	iPnC	18:03:17.80		0.17
			eSn	03:33.70		0.02
CESS	128.5	265	iPn	18:03:18.70		-0.15
			eSn	03:34.50		-1.34
PKS8	149.9	53	iPnC	18:03:21.10		-0.41
			eSn	03:38.10		-2.47
VBY	157.7	247	iPnC	18:03:32.50		10.02
			eSn	03:43.50		1.20
BISS	166.2	293	iPn	18:03:23.50		-0.04
			iSn	03:42.20		-2.00
PKS2	168.3	74	iPnC	18:03:24.00		0.20
			eSn	03:48.00		3.35
PKSC	177.4	35	iPnU	18:03:25.12		0.18
			eSn	03:45.41		-1.28
ARSA	179.4	317	iPnD	18:03:25.30		0.11
			iSn	03:49.30		2.17
PKS7	190.8	55	iPnU	18:03:26.26		-0.35
LJU	200.5	269	ePn	18:03:27.60		-0.21
			eSn	03:56.10		4.30
CEY	212.0	260	ePn	18:03:29.20		-0.05
			eSn	04:00.00		5.64
BUD	214.4	43	ePn	18:03:29.10		-0.45
PKSN	230.4	66	iPnC	18:03:31.40		-0.15
			eSn	04:06.40		7.96
ZST	236.7	360	Pn	18:03:32.30		-0.02
			eSn	03:57.20		-2.63
VOY	249.6	269	ePn	18:03:33.80		-0.14
			eSn	04:05.50		2.80
VKA	251.7	346	iPnD	18:03:34.50		0.30
			iSn	04:12.80		9.63
MOA	293.9	312	iPnC	18:03:40.70		1.24
			iSn	04:11.40		-1.13
KBA	310.3	291	iPnD	18:03:41.80		0.29
			iSn	04:16.60		0.42
KHC	432.3	322	Pn	18:03:57.90		1.18
			eSn	04:42.00		-1.25
WTTA	440.1	288	iPnD	18:03:59.00		1.31
			iSn	04:46.20		1.22
WATA	446.6	288	iPnC	18:03:59.60		1.09
			iSn	04:46.60		0.16
SQTA	470.2	286	iPnD	18:04:02.90		1.45
			iSn	04:53.10		1.43
PRU	476.4	336	Pn	18:04:02.60		0.38
			eSn	04:50.40		-2.65
MOTA	481.3	287	iPnD	18:04:03.80		0.97
			iSn	04:54.90		0.76



25.

1998-06-28 time: 3:12:12.80 UTC ML= 0.5
lat: 47.503N lon: 18.924E h= 6.0 km
erh= 0.6km erz= 1.2km
nr= 6 gap=216 rms=0.05
Locality: Budakeszi
Comments:

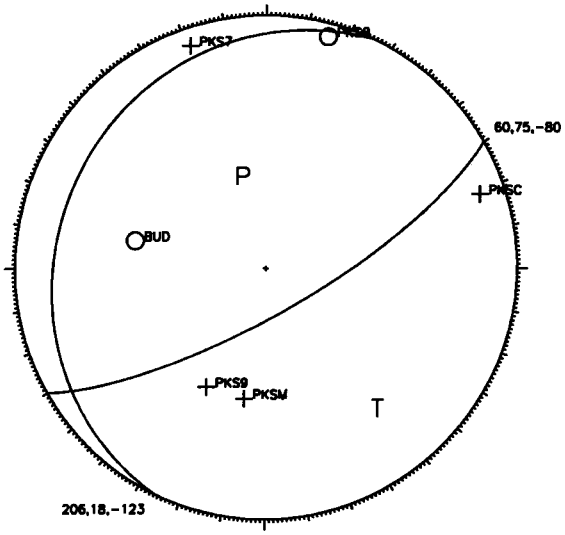
sta	dist	azm	phase	hr mn	sec	res
BUD	7.8	106	iPgC	3:12:14.60		0.04
			eSg	12:15.80		-0.13
PKSC	39.2	250	iPgD	3:12:19.90		0.02
			iSg	12:25.40		0.00
PKS7	53.7	161	iSg	3:12:30.00		0.02
PKS8	71.9	195	ePgD	3:12:25.60		-0.08
			eSg	12:35.10		-0.64

26.

1998-06-28 time: 12:19:40.48 UTC ML= 1.4
lat: 47.498N lon: 18.927E h= 7.7 km
erh= 2.5km erz= 1.5km
nr= 14 gap=211 rms=0.48
Locality: Budakeszi
Comments:

sta	dist	azm	phase	hr mn	sec	res
BUD	7.5	102	iPgD	12:19:42.30		-0.10
			iSg	19:43.50		-0.40
PKSC	39.2	251	iPgC	12:19:47.70		0.09
			iSg	19:53.10		-0.07
PKS7	53.1	161	iPgC	12:19:50.70		0.64
			iSg	19:57.80		0.26
PKS8	71.4	195	iPgD	12:19:53.30		0.00
			eSg	20:02.90		-0.40
PKSN	97.6	133	ePg	12:19:57.40		-0.57
PKS9	112.6	206	iPnC	12:20:00.00		-0.56
			eSn	20:13.20		-3.03
PKS2	113.9	169	ePn	12:20:01.60		0.87
			iSn	20:16.00		-0.52
PKSM	144.6	189	iPnC	12:20:05.30		0.75
			eSn	20:21.40		-1.93

Hypocentre Parameters



27.

1998-07-03 time: 9:56:07.69 UTC ML= 2.0
lat: 47.382N lon: 18.475E h= 8.4 km
erh=112 km erz=30.8km
nr= 6 gap=268 rms=0.89
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	2.8	266	iPgC	9:56:08.90	-0.38
			iSg	56:10.80	0.28
PKS9	89.7	190	iPgC	9:56:25.30	1.53
			iSg	56:35.80	-0.52
PKSM	130.7	174	ePn	9:56:29.90	-0.05
			iSn	56:46.00	-1.31

28.

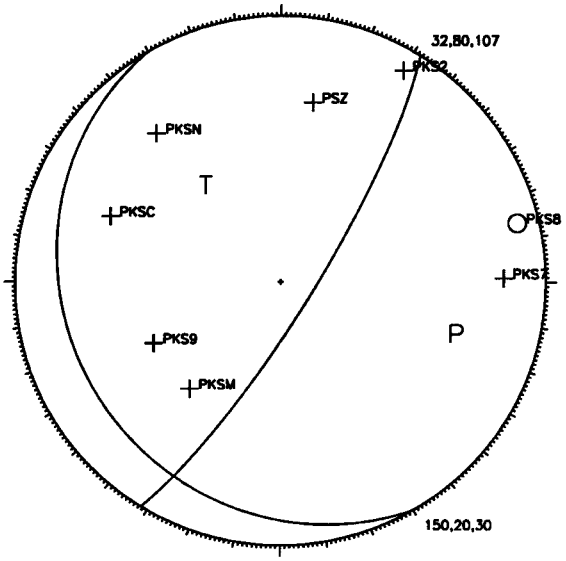
1998-07-03 time: 15:35:21.15 UTC ML= 2.1
lat: 46.933N lon: 19.042E h= 17.0 km
erh= 6.9km erz= 3.6km
nr= 6 gap=133 rms=0.53
Locality: Szalkszentmárton
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS7	15.6	35	iPgD	15:35:24.60	-0.66
			eSg	35:26.80	-1.68
PKS8	28.5	258	iPgD	15:35:27.30	0.23
			eSg	35:30.70	-0.99
PKSN	63.0	94	ePg	15:35:34.20	1.40
			iSg	35:43.80	1.91
PKS9	69.9	237	eP*C	15:35:34.50	0.57
			iS*	35:44.40	0.50
PKSM	85.9	201	iP*C	15:35:36.10	-0.26
			iS*	35:47.60	-0.63
PSZ	127.0	30	iPnC	15:35:41.80	-0.05
			eSn	35:56.40	-1.60

29.

1998-07-05 time: 3:43:12.98 UTC ML= 1.5
lat: 47.054N lon: 19.676E h= 11.9 km
erh= 1.6km erz= 1.3km
nr= 16 gap=130 rms=0.49
Locality: Nagykőrös
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSN	22.7	140	iPgC	3:43:17.80	0.24
			eSg	43:20.40	-0.73
PKS7	39.1	269	iPgC	3:43:20.80	0.52
			iSg	43:26.30	0.32
PKS2	71.7	210	iPgC	3:43:25.90	-0.06
			eSg	43:36.00	-0.09
PKS8	78.5	256	iPgD	3:43:26.80	-0.36
			eSg	43:37.60	-0.61
PSZ	97.6	10	iP*C	3:43:30.80	0.35
			iS*	43:43.60	-0.48
PKSC	100.6	291	iP*C	3:43:31.00	0.08
			iS*	43:44.70	-0.21
PKS9	118.5	244	iPnC	3:43:34.60	1.33
			iSn	43:49.40	0.30
PKSM	122.6	220	iPnC	3:43:33.00	-0.78
			iSn	43:49.40	-0.60



30.

1998-07-09 time: 23:21:28.69 UTC ML= 1.1
lat: 47.055N lon: 19.685E h= 13.4 km
erh= 2.4km erz= 1.6km
nr= 11 gap=201 rms=0.44
Locality: Nagykőrös
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS7	39.8	269	iPgD	23:21:36.20	0.01
			iSg	21:41.70	-0.35
PKS2	72.2	210	iPgC	23:21:41.30	-0.51
			iSg	21:53.40	1.36
PSZ	97.3	9	iP*C	23:21:46.30	0.33
			eS*	21:59.00	-0.46
PKSC	101.2	291	iP*C	23:21:47.10	0.53
			eS*	22:00.00	-0.52
PKS9	119.2	244	iPn	23:21:48.80	-0.07
			eSn	22:04.90	0.29
PKSM	123.2	220	iSn	23:22:05.10	-0.39

31.

1998-07-09 time: 23:31:29.66 UTC ML= 1.1
lat: 47.039N lon: 19.670E h= 14.3 km
erh= 2.7km erz= 3.1km
nr= 7 gap=200 rms=0.39

Hypocentre Parameters

Locality: Nagykőrös
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS7	38.7	271	ePg	23:31:37.80	0.78
			iSg	31:42.60	-0.17
PKS2	70.1	210	iPgC	23:31:42.20	-0.23
			eSg	31:52.50	0.11
PSZ	99.3	10	iP*D	23:31:47.50	0.34
			eS*	32:00.00	-0.82
PKSC	100.8	292	eS*	23:32:00.90	-0.34

32.

1998-07-17 time: 9:57:03.45 UTC ML= 2.2
lat: 47.495N lon: 18.388E h= 5.9 km
erh=36.8km erz=14.2km
nr= 5 gap=338 rms=0.85
Locality: Oroszlány
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	13.2	164	iPgC	9:57:05.80	-0.24
			iSg	57:07.30	-0.76
PKS8	71.9	162	Pg	9:57:18.20	1.86
PKS9	101.3	185	iPgC	9:57:22.30	0.73
PKSM	143.9	172	iPn	9:57:26.90	-0.78

33.

1998-08-06 time: 11:04:42.63 UTC ML= 0.6
lat: 47.271N lon: 18.624E h= 11.4 km
erh= ---km erz= ---km
nr= 4 gap=259 rms=0.26
Locality: Velencei mt
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	18.6	311	iPgD	11:04:46.30	-0.23
			eSg	04:50.00	0.43
BUD	38.4	52	iPg	11:04:50.00	0.22
			eSg	04:55.00	-0.36

34.

1998-08-10 time: 9:56:00.35 UTC ML= 1.9
lat: 47.434N lon: 18.556E h= 10.0 km
erh=10.2km erz= 5.1km
nr= 5 gap=301 rms=0.94
Locality: Bodmér
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	10.7	237	iPgC	9:56:02.60	-0.37
			iSg	56:03.90	-1.12
PKS9	96.5	193	iPgD	9:56:19.00	1.33
			iSg	56:31.70	0.52
PKSM	136.0	177	eSn	9:56:39.70	-1.08

35.

1998-08-14 time: 8:58:12.20 UTC ML= 2.1
lat: 47.378N lon: 18.435E h= 0.2 km
erh=69.3km erz=14.1km
nr= 6 gap=199 rms=1.16
Locality: Csákvár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	0.4	26	iPgC	8:58:11.30	-0.97
			iSg	58:12.90	0.58
PKS9	88.7	188	iPgC	8:58:27.80	-0.24
			eSg	58:40.30	-0.10
PKSM	130.6	173	iPn	8:58:37.30	1.81
			eSn	58:49.10	-4.56

36.

1998-08-26 time: 7:38:05.19 UTC ML= 1.6
lat: 47.052N lon: 18.208E h= 10.0 km
erh= 6.6km erz= 5.2km
nr= 7 gap=225 rms=0.71
Locality: Balatonfőkajár
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	40.5	25	iPgD	7:38:12.20	-0.43
			eSg	38:17.00	-1.44
PKS7	72.4	90	ePg	7:38:19.10	0.85
			eSg	38:28.40	-0.03
PKSM	99.1	160	iPgD	7:38:23.90	0.92
			iSg	38:36.20	-0.66
PKS6	115.1	116	eSn	7:38:40.80	-0.18

37.

1998-08-26 time: 10:22:15.06 UTC ML= 1.7
lat: 47.449N lon: 18.504E h= 7.2 km
erh= 7.2km erz= 2.8km
nr= 5 gap=322 rms=0.78
Locality: Vérteskozma
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	9.1	214	iPgC	10:22:16.90	-0.23
			iSg	22:17.90	-0.85
PKS9	97.3	190	iPgC	10:22:33.40	0.92
			iSg	22:46.70	0.63
PKSM	137.9	176	eSn	10:22:55.20	-1.34

38.

1998-09-15 time: 3:48:36.49 UTC ML= 2.1
lat: 46.016N lon: 17.063E h= 10.0 km
erh=****km erz=****km
nr= 8 gap=213 rms=0.99
Locality: Croatia
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	113.2	56	iPn	3:48:57.30	0.94
			Sn	49:13.40	1.54
PKSM	124.0	80	iPnC	3:48:57.60	-0.11
			iSn	49:18.10	3.85
PKS8	156.8	52	ePn	3:49:00.40	-1.40
			Sn	49:23.40	1.87
PKS2	174.1	72	Sn	3:49:32.20	6.83
ARSA	181.0	319	iPnD	3:49:03.90	-0.91
			iSn	49:20.40	-6.50
PKSC	184.6	35	ePn	3:49:05.30	0.03
			Sn	49:32.10	4.39
PKS6	203.4	71	Sn	3:49:40.70	8.83
MOA	294.8	314	iPnC	3:49:19.70	0.69
			iSn	49:48.30	-3.88
KBA	308.7	293	ePn	3:49:31.00	10.26
			eSn	50:05.00	9.75
KHC	434.4	323	ePn	3:49:37.50	1.08

39.

1998-09-21 time: 23:57:54.17 UTC ML= 1.0
lat: 47.497N lon: 18.925E h= 10.0 km
erh= 3.7km erz= 3.1km
nr= 10 gap=167 rms=0.80

Locality: Budaörs
Comments:

sta	dist	azm	phase	hr mn sec	res
BUD	7.6	101	iPgC	23:57:56.00	-0.41
			iSg	57:57.20	-0.96
PKSC	39.0	251	ePg	23:58:01.70	0.35
			eSg	58:06.90	-0.06
PKS7	53.1	160	iPgD	23:58:04.60	0.78
			iSg	58:11.70	0.36
PSZ	86.6	57	iPgC	23:58:10.60	0.87
			eSg	58:19.50	-2.36
PKS2	113.9	169	eSn	23:58:28.30	-1.39
PKSM	144.5	189	eSn	23:58:35.10	-1.38

40.

1998-09-23 time: 19:07:09.94 UTC ML= 0.9
lat: 47.107N lon: 18.351E h= 10.0 km
erh= 8.6km erz= 5.9km
nr= 10 gap=187 rms=1.04
Locality: Polgárdi
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	31.1	12	iPgC	19:07:15.30	-0.48
			iSg	07:20.50	0.17
PKS8	35.5	136	ePg	19:07:17.90	1.38
			eSg	07:24.30	2.65
PKS9	58.1	185	ePg	19:07:21.40	0.93
			eSg	07:29.70	1.02
PKSM	102.0	167	ePg	19:07:27.40	-0.84
			iSg	07:41.00	-1.51
PSZ	147.2	52	ePn	19:07:34.80	0.75
			eSn	07:51.60	-1.25

41.

1998-09-28 time: 9:41:10.91 UTC ML= 1.5
lat: 47.444N lon: 18.382E h= 2.1 km
erh= 6.2km erz=11.9km
nr= 6 gap=325 rms=0.83
Locality: Vértes mt.
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	8.2	150	iPgC	9:41:11.50	-0.92
			iSg	41:13.00	-0.60
PKS8	66.8	160	iPg	9:41:23.90	1.07
			Sg	41:33.50	1.37
PKS9	95.7	185	iPg	9:41:28.00	0.01
			Sg	41:40.70	-0.62

42.

1998-09-29 time: 11:41:56.99 UTC ML= 0.8
lat: 47.441N lon: 18.709E h= 12.8 km
erh= 0.8km erz= 0.8km
nr= 8 gap=167 rms=0.12
Locality: Etyek
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	21.6	252	iPgD	11:42:01.30	-0.17
			Sg	42:05.10	0.13
BUD	24.2	79	iPg	11:42:01.90	0.02
			eSg	42:05.60	-0.09
PKS8	62.5	182	ePg	11:42:08.50	0.11
			eSg	42:17.30	0.02
PSZ	103.6	59	iP*C	11:42:15.40	0.09
			eS*	42:29.30	-0.30

43.

1998-10-06 time: 8:30:49.21 UTC ML= 2.3
lat: 47.473N lon: 18.575E h= 10.0 km
erh=26.7km erz=14.8km
nr= 6 gap=277 rms=1.04
Locality: Vértes mt. (expl?)
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	14.6	225	iPgC	8:30:52.30	-0.07
			iSg	30:53.90	-0.94
PKS9	101.0	193	iPgC	8:31:08.80	1.46
			eSg	31:20.50	-0.98
PKS6	122.8	142	iSn	8:31:25.20	-1.51
PKSM	140.3	178	iSn	8:31:31.30	0.71

44.

1998-10-09 time: 8:52:04.52 UTC ML= 1.8
lat: 47.431N lon: 18.269E h= 10.0 km
erh=23.3km erz=12.6km
nr= 6 gap=306 rms=1.36
Locality: Vértes mt.
Comments: (expl?)

sta	dist	azm	phase	hr mn sec	res
PKSC	13.9	114	iPgC	8:52:06.80	-0.78
			iSg	52:08.70	-1.26
PKS8	68.8	153	iPgC	8:52:19.10	2.17
			eSg	52:24.90	-1.71
PKSM	138.5	168	iPnC	8:52:28.00	0.45
			eSn	52:44.20	-1.31

45.

1998-10-27 time: 9:22:50.20 UTC ML= 1.4
lat: 47.137N lon: 18.211E h= 14.6 km
erh=12.2km erz= 4.1km
nr= 7 gap=217 rms=0.88
Locality: Nádasladány
Comments:

sta	dist	azm	phase	hr mn sec	res
PKSC	32.0	32	iPgC	9:22:55.90	-0.59
			iSg	23:01.30	-0.10
PKS8	45.6	129	iPgD	9:22:58.80	0.05
PKS9	61.3	175	iSg	9:23:12.60	2.35
PKSM	108.0	162	iPnD	9:23:08.50	-0.33
			eSn	23:21.70	-1.66
PSZ	153.7	56	iSn	9:23:35.00	1.49

46.

1998-10-31 time: 20:01:15.10 UTC ML= 0.9
lat: 46.331N lon: 18.082E h= 5.5 km
erh= 2.2km erz= 1.7km
nr= 8 gap=281 rms=0.24
Locality: Szabadi
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS9	32.3	28	iPgC	20:01:21.10	0.15
			iSg	01:25.70	0.19
PKSM	45.1	107	iPgC	20:01:23.40	0.18
			iSg	01:29.40	-0.14
PKS8	76.1	37	iPg	20:01:28.20	-0.53
			eSg	01:39.30	-0.05
PKS2	88.8	78	iSg	20:01:43.40	0.01
PKS6	117.7	75	iSn	20:01:52.60	0.10

Hypocentre Parameters

47.

1998-11-02 time: 18:32:08.59 UTC ML= 1.1
lat: 46.410N lon: 17.764E h= 10.3 km
erh= 4.4km erz= 2.5km
nr= 7 gap=277 rms=0.39
Locality: Kaposvár
Comments:

sta	dist	azm	phase	hr mn	sec	res
PKS9	44.1	64	iPgD	18:32:17.10		0.42
			iSg	32:23.10		0.11
PKSM	71.1	108	iPgC	18:32:21.40		-0.02
			iSg	32:30.80		-0.62
PKS2	111.7	85	Sn	18:32:44.40		0.83
PKSC	119.4	25	iPn	18:32:29.10		-0.11
			iSn	32:44.90		-0.39

48.

1998-11-06 time: 9:19:26.27 UTC ML= 1.6
lat: 47.488N lon: 18.436E h= 10.0 km
erh=30.4km erz= 5.0km
nr= 7 gap=338 rms=1.01
Locality: Vértes mt.
Comments: (expl.)

sta	dist	azm	phase	hr mn	sec	res
PKSC	12.0	180	iPgC	9:19:28.70		-0.36
			iSg	19:30.20		-1.03
PKS8	70.2	165	ePg	9:19:41.10		2.17
PKS9	100.9	187	iPgC	9:19:45.20		0.82
			iSg	19:58.60		0.10
PKSM	142.8	174	ePn	9:19:50.00		0.17
			Sn	20:06.20		-2.00

49.

1998-11-19 time: 13:18:52.81 UTC ML= 1.2
lat: 46.139N lon: 18.852E h= 11.1 km
erh= 0.7km erz= 0.8km
nr= 6 gap=306 rms=0.03
Locality: Báta
Comments:

sta	dist	azm	phase	hr mn	sec	res
PKSM	18.2	297	iPgC	13:18:56.60		-0.02
			iSg	18:59.60		0.01
PKS9	66.6	318	iPgD	13:19:04.90		0.04
			eSg	19:14.20		-0.06
PKS8	83.4	351	iPg	13:19:07.80		-0.03
			Sg	19:19.60		0.05

50.

1998-11-22 time: 1:30:01.02 UTC ML= 0.9
lat: 47.683N lon: 19.345E h= 6.9 km
erh= ---km erz= ---km
nr= 4 gap=266 rms=0.13
Locality: Penc
Comments:

sta	dist	azm	phase	hr mn	sec	res
PENC	12.9	338	iPgU	1:30:03.82		0.19
			iSg	30:05.54		-0.13
PKSC	76.2	244	iPgD	1:30:14.58		-0.09
			iSg	30:25.39		0.06

51.

1998-11-22 time: 9:21:04.95 UTC ML= 1.3
lat: 47.699N lon: 19.307E h= 8.2 km
erh= ---km erz= ---km
nr= 4 gap=252 rms=0.04
Locality: Penc
Comments:

sta	dist	azm	phase	hr mn	sec	res
PENC	10.3	349	iPgU	9:21:07.34		0.03
			iSg	21:09.10		-0.04
PKSC	74.4	242	iPgD	9:21:18.28		-0.04
			iSg	21:28.81		0.05

52.

1998-11-25 time: 20:57:19.17 UTC ML= 0.2
lat: 47.429N lon: 18.976E h= 4.8 km
erh= ---km erz= ---km
nr= 4 gap=232 rms=0.09
Locality: Budaörs
Comments:

sta	dist	azm	phase	hr mn	sec	res
BUD	7.1	30	iPgU	20:57:20.74		0.03
			iSg	57:21.82		-0.08
PKSC	41.0	263	iPgD	20:57:26.66		0.11
			iSg	57:32.19		-0.11

53.

1998-12-06 time: 14:35:03.82 UTC ML= 2.6
lat: 47.206N lon: 17.828E h= 6.3 km
erh= 2.8km erz= 3.2km
nr= 12 gap=121 rms=0.53
Locality: Hárskút
Comments: felt 3.5 EMS

sta	dist	azm	phase	hr mn	sec	res
BUD	95.5	71	ePg	14:35:21.00		0.08
			iSg	35:34.30		0.05
ZST	122.9	334	iPn	14:35:25.40		0.02
			Sn	35:41.00		-1.19
PKSM	126.8	151	iPnC	14:35:25.00		-0.87
			eSn	35:40.00		-3.06
PKS6	148.5	117	iPnC	14:35:28.60		0.03
			iSn	35:48.30		0.43
ARSA	174.6	272	iPnD	14:35:32.10		0.27
			iSn	35:54.30		0.63
MOA	277.6	285	iPnC	14:35:45.40		0.72
			iSn	36:16.70		0.16
KHC	381.8	304	ePn	14:35:58.00		0.34

54.

1998-12-23 time: 21:25:24.37 UTC ML= 1.9
lat: 46.392N lon: 20.458E h= 10.0 km
erh= 8.5km erz= 3.8km
nr= 5 gap=330 rms=0.69
Locality: Hódmezővásárhely
Comments:

sta	dist	azm	phase	hr mn	sec	res
PKS6	72.4	289	iPg	21:25:37.90		0.48
			iSg	25:48.10		0.50
PKS2	96.3	277	iPgD	21:25:42.00		0.34
			iSg	25:54.20		-0.95
PKS7	123.1	306	iSn	21:26:00.60		-1.33

Hypocentre Parameters

55.

1998-12-26 time: 3:55:56.21 UTC ML= 1.2
lat: 46.605N lon: 20.188E h= 10.0 km
erh= 6.1km erz= 4.7km
nr= 6 gap=269 rms=0.22
Locality: Szentes
Comments:

sta	dist	azm	phase	hr mn sec	res
PKS6	47.8	269	iPgC	3:56:04.90	-0.02
			eSg	56:12.40	0.68
PKS2	75.8	260	ePgC	3:56:09.80	-0.06
			iSg	56:20.40	-0.12
PSZ	147.7	351	ePn	3:56:20.40	0.02
			eSn	56:37.40	-1.83

Hypocentre Parameters

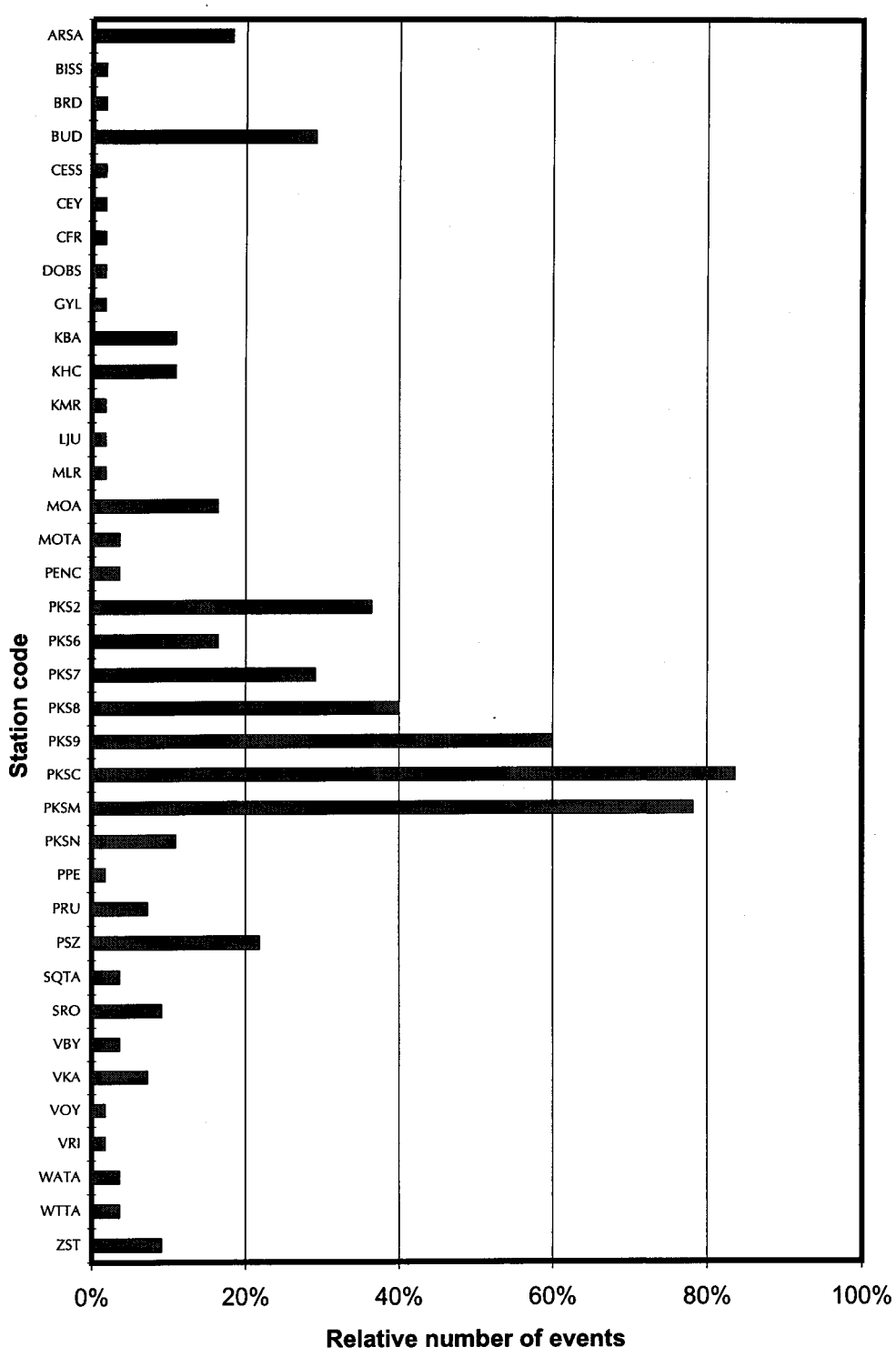


Figure 3.3. *Station contribution to the hypocentre determination.*

4.

SIGNIFICANT EARTHQUAKES IN 1998

(Earthquakes that was felt in Hungary)

12 January 1998	- Balatonfűzfő
12 April 1998	- Slovenia
8 May 1998	- Budakeszi
29 September 1998	- Serbia
6 December 1998	- Hárskút

METHOD USED FOR ESTIMATION OF INTENSITY

The earthquake effects (macroseismic observations) are usually gathered on questionnaires. Based on these reports the intensity values were estimated by a computer algorithm (Zsíros et al, 1990 and Zsíros 1994).

The assigned intensities correspond to the *European Macroseismic Scale 1992 (EMS)* edited by Grünthal (1993). (APPENDIX A)

12 January 1998 - Balatonfűzfő

HYPOCENTRE PARAMETERS

Date:	1998/01/12
Origin Time:	04:15:45.9 UTC
Latitude and Longitude:	47.050N 18.076E (S.D. 3.0km)
Depth:	4.2 km (S.D. 45.8km)
Magnitude:	2.0 ML
Maximum Intensity:	3.5

DISCUSSION

On January 12th, an earthquake with a magnitude of 2.0 ML was felt slightly at Balatonfűzfő and Berhida area, with a maximum intensity of 3-4 EMS.

The intensity distribution of the event is shown in Table 4.1. and Figure 4.2.

12 January 1998 - Balatonfűzfő

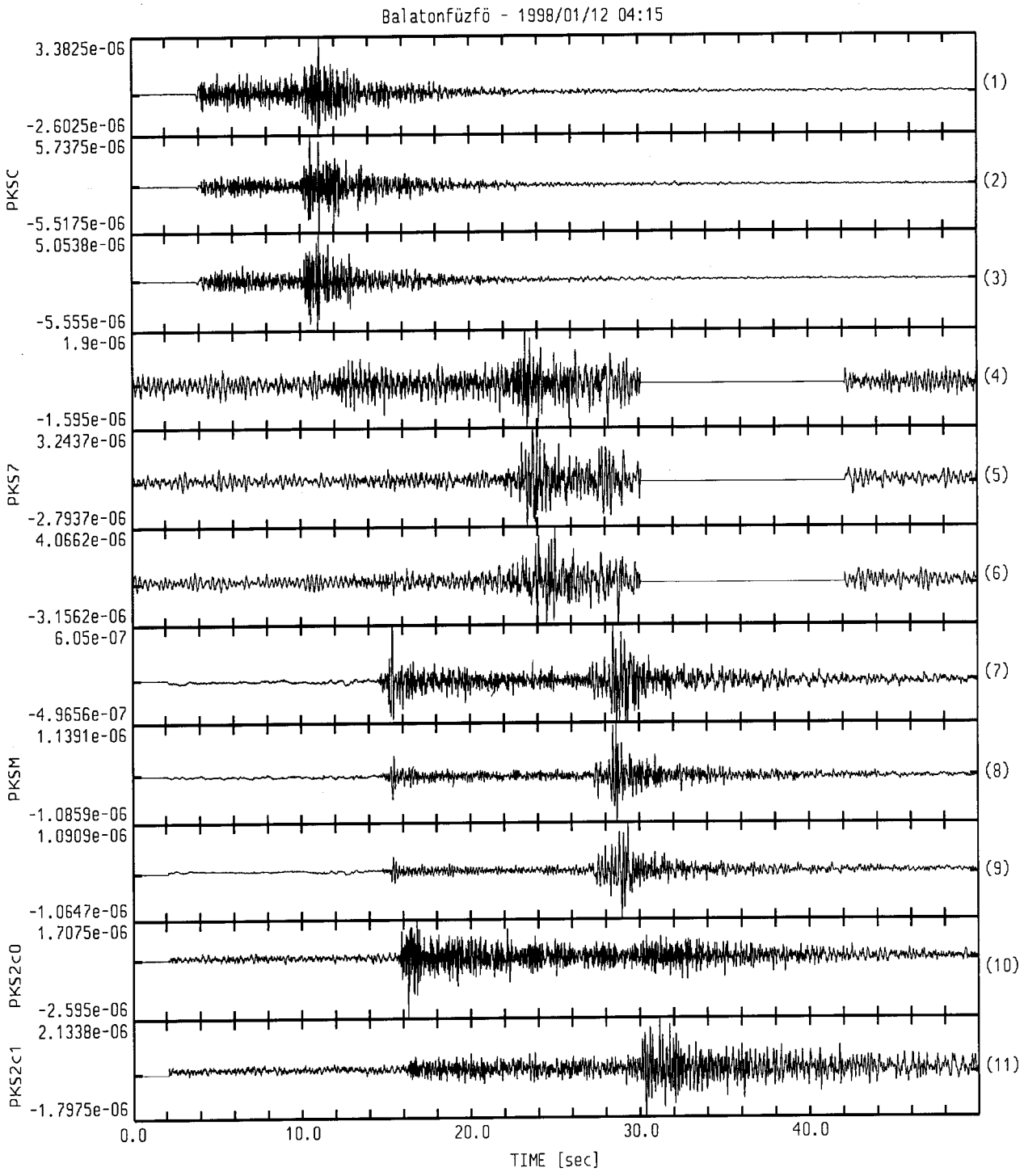


Figure 4.1. Seismograms of the Balatonfűzfő Earthquake 12th January 1998, 4:15:46 UTC. (PKSc, PKS7 and PKSm three components, PKS2 vertical and N-S components)
The vertical axis is ground velocity in m/s.

Table 4.1. *Intensity distribution of the Balatonfűzfő Earthquake 12th January 1998, 4:15:46 UTC*

	Location	Coordinates	I	R	N
1	Balatonalmádi	47.028 N 18.010 E	.0	0.%	2
2	Balatonfűzfő	47.066 N 18.045 E	3.5	40.%	2
3	Balatonvilágos	46.965 N 18.161 E	.0	0.%	1
4	Berhida	47.113 N 18.134 E	3.0	33.%	3
5	Csaják	47.044 N 18.188 E	.0	0.%	2
6	Felsőörs	47.017 N 17.959 E	.0	0.%	2
7	Ősi	47.141 N 18.188 E	.0	0.%	2
8	Sóly	47.130 N 18.034 E	.0	0.%	1
9	Veszprém	47.094 N 17.913 E	.0	0.%	2
10	Vilonya	47.112 N 18.067 E	.0	0.%	2

I - intensity
R - relative reliability
N - number of reports

12 January 1998 - Balatonfűzfő

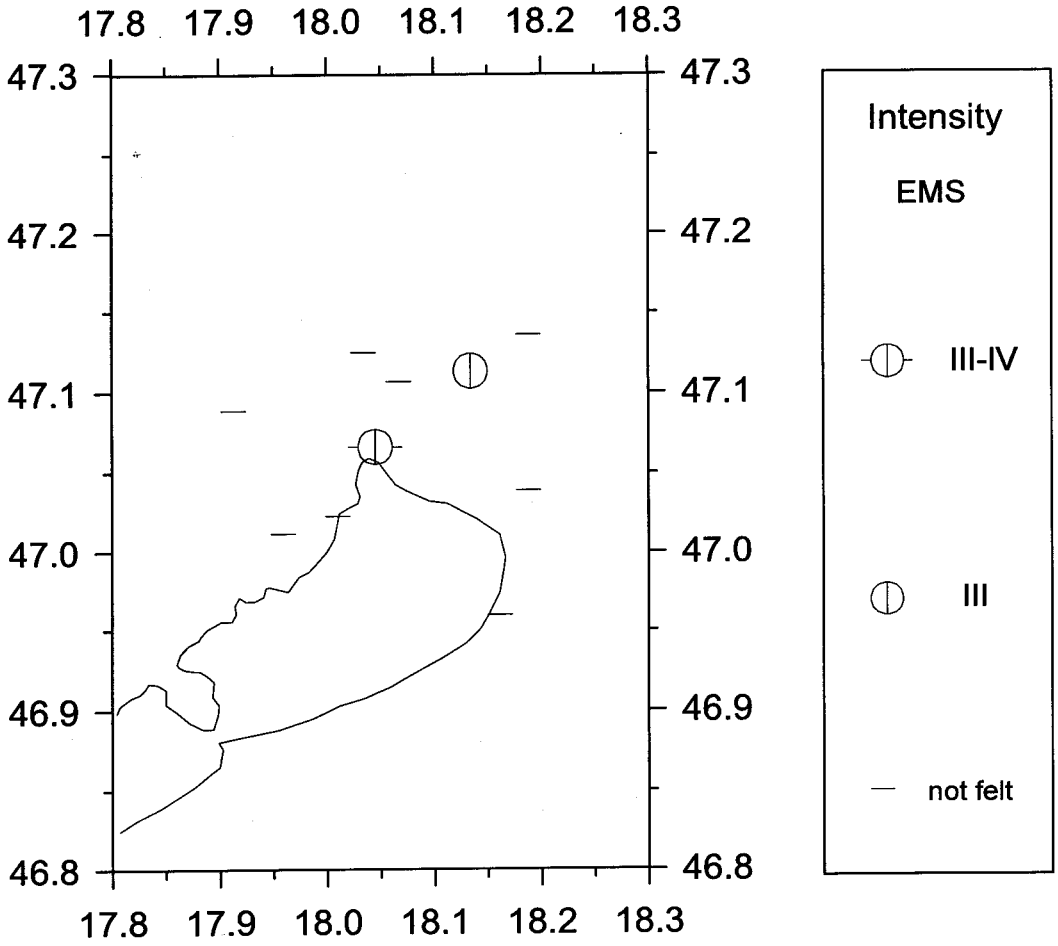


Figure 4.2. Intensity distribution of the Balatonfűzfő Earthquake 12th January 1998, 4:15:46 UTC

12 April 1998 - Slovenia

HYPOCENTRE PARAMETERS

Date:	1998/04/12
Origin Time:	10:55:32.5 UTC
Latitude and Longitude:	46.245N 13.632E (NEIC)
Depth:	10.0 km (NEIC)
Magnitude:	5.6 ML (VIE)
Maximum Intensity:	8 (3-4 in Hungary)

DISCUSSION

On April 12th, an earthquake with a magnitude of 5.6 ML occurred near to the Austrian - Slovenian border. One person died of a heart attack at Bovec, Slovenia. Maximum intensity (VIII) in the Bovec-Kobarid area, Slovenia, where damage to buildings and landslides left 700 people homeless. Minor damage at Arnoldstein, Austria. Felt strongly throughout Slovenia and northeastern Italy. Felt throughout Austria and in parts of Croatia, Germany and Hungary.

The intensity distribution of the event in Hungary is shown in Table 4.2. and Figure 4.4.

12 April 1998 - Slovenia

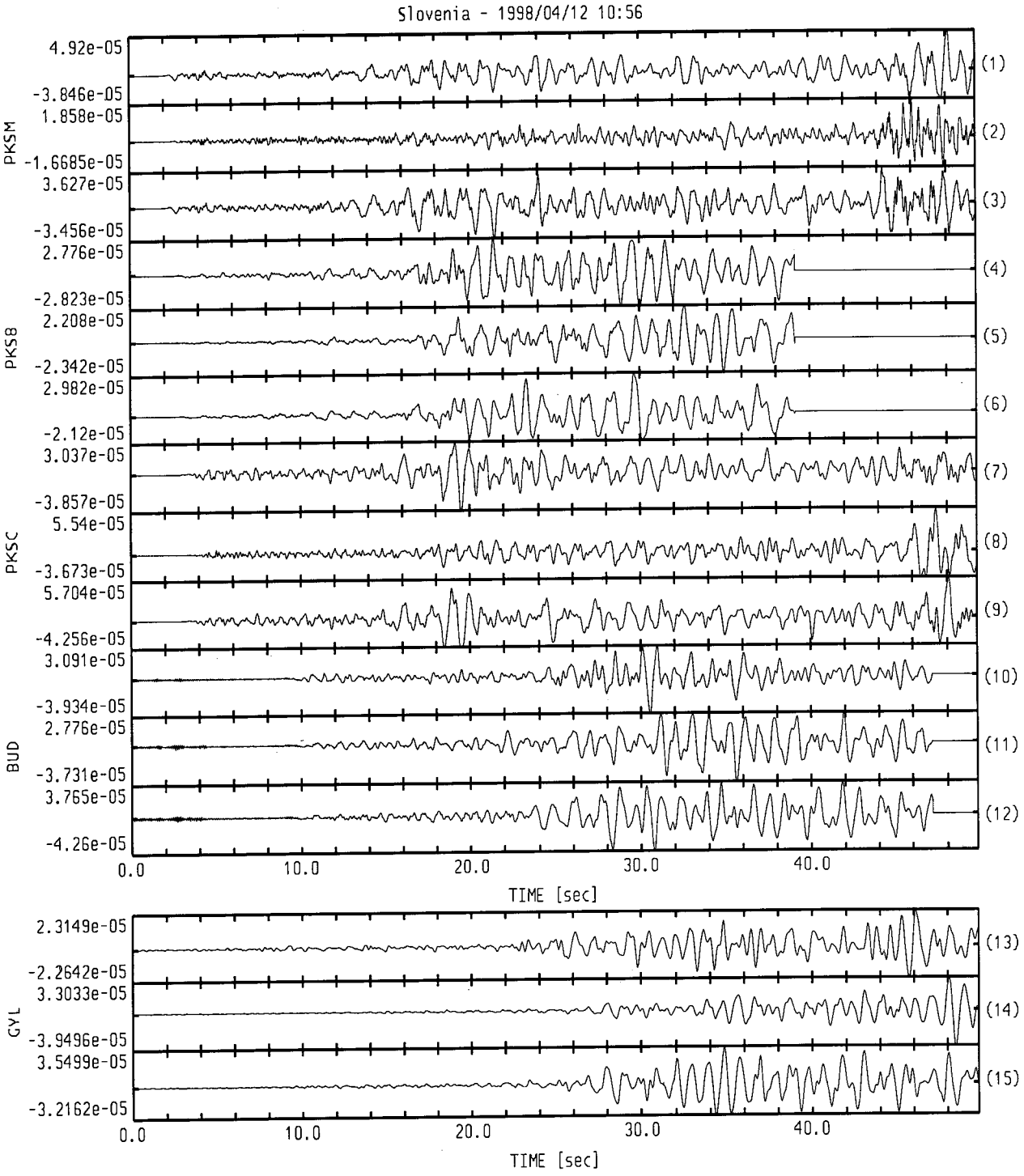


Figure 4.3. Seismograms of the Slovenia Earthquake 12th April 1998, 10:55:33 UTC (PKSM, PKS8, PKSC, BUD and GYL three components)
The vertical axis is ground velocity in m/s.

Table 4.2. *Intensity distribution of the Slovenia Earthquake 12th April 1998, 10:55:33 UTC*

	Location	Coordinates	I	R	N
1	Balatonalmádi	47.028 N 18.010 E	.0	0.%	2
2	Barcs	45.961 N 17.463 E	.0	0.%	2
3	Celldömölk	47.259 N 17.158 E	.0	0.%	2
4	Csesztreg	46.719 N 16.517 E	.0	0.%	1
5	Csurgó	46.262 N 17.103 E	.0	0.%	3
6	Gyékényes	46.242 N 17.013 E	.0	0.%	2
7	Győrvár	46.989 N 16.843 E	.0	0.%	1
8	Jánosháza	47.117 N 17.174 E	.0	0.%	1
9	Kaposvár	46.357 N 17.791 E	.0	0.%	3
10	Kapuvár	47.593 N 17.036 E	3.0	38.%	3
11	Keszthely	46.769 N 17.246 E	3.0	36.%	3
12	Kondorfa	46.898 N 16.402 E	.0	0.%	2
13	Körmend	47.017 N 16.601 E	.0	0.%	3
14	Kőszeg	47.390 N 16.548 E	.0	0.%	2
15	Lenti	46.630 N 16.545 E	3.5	39.%	3
16	Letenye	46.433 N 16.724 E	3.5	42.%	3
17	Marcali	46.584 N 17.414 E	.0	0.%	1
18	Mosonmagyaróvár	47.866 N 17.272 E	.0	0.%	3
19	Nagyatád	46.227 N 17.363 E	.0	0.%	1
20	Oszkó	47.045 N 16.879 E	.0	0.%	1
21	Őriszentpéter	46.842 N 16.423 E	4.0	41.%	1
22	Sárvár	47.255 N 16.935 E	.0	0.%	3
23	Sopron	47.682 N 16.593 E	.0	0.%	2
24	Sümeg	46.980 N 17.284 E	.0	0.%	2
25	Szentgotthárd	46.956 N 16.283 E	3.0	42.%	2
26	Szentpéterfa	47.096 N 16.488 E	.0	0.%	2
27	Szigetvár	46.051 N 17.793 E	.0	0.%	2
28	Szombathely	47.235 N 16.624 E	3.0	36.%	1
29	Tarany	46.183 N 17.307 E	.0	0.%	1
30	Zalaegerszeg	46.844 N 16.844 E	3.5	42.%	3
31	Zalalövő	46.850 N 16.594 E	.0	0.%	2
32	Zákány	46.281 N 16.946 E	.0	0.%	1

I - intensity
R - relative reliability
N - number of reports

12 April 1998 - Slovenia

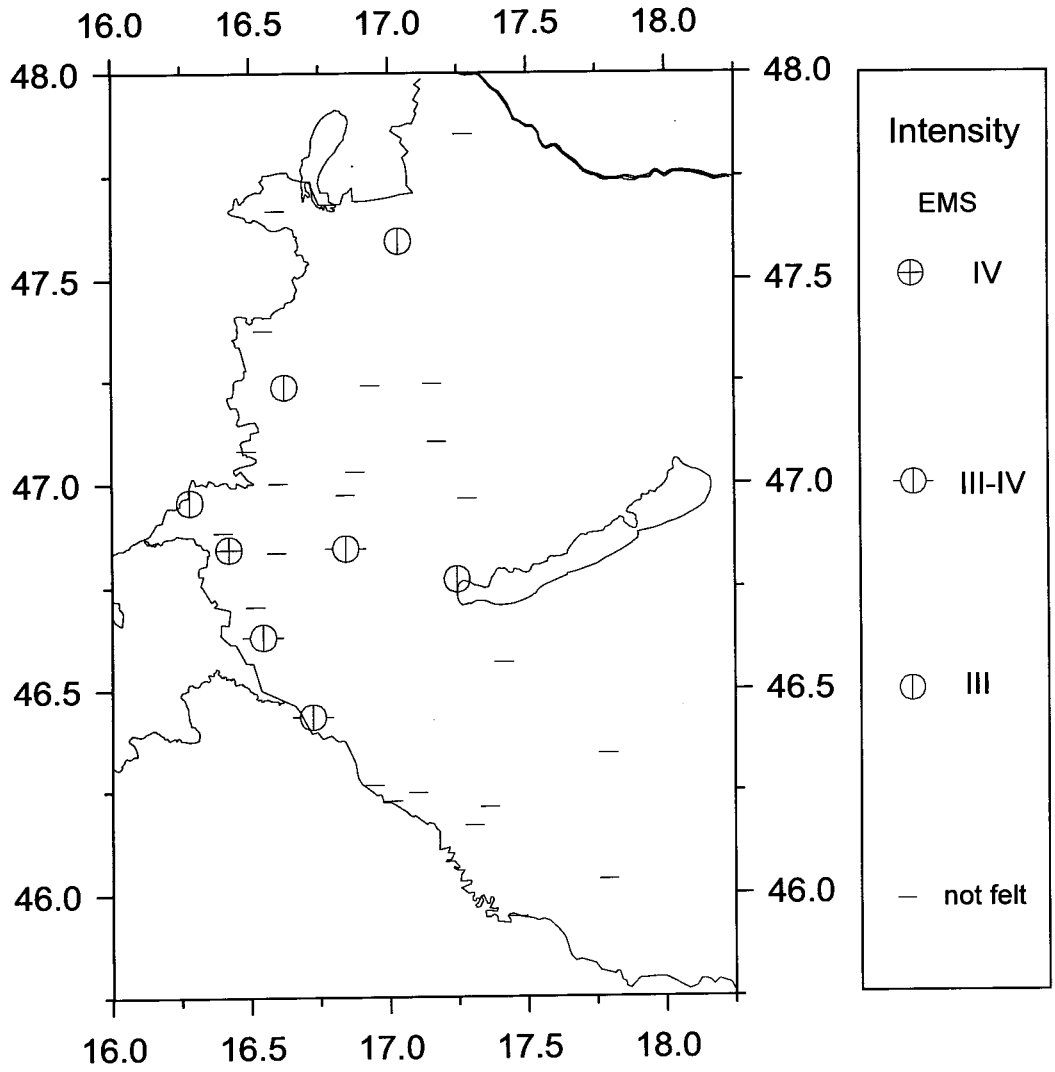


Figure 4.4. Intensity distribution of the Slovenia Earthquake 12h April 1998, 10:55:33 UTC

8 May 1998 - Budakeszi

HYPOCENTRE PARAMETERS

Date:	1998/05/08
Origin Time:	04:06:54.2 UTC
Latitude and Longitude:	47.513N 18.930E (S.D. 2.9km)
Depth:	10.0 km (S.D. 1.5km)
Magnitude:	2.0 ML
Maximum Intensity:	3

DISCUSSION

The Budakeszi earthquake of 8 May with a magnitude of 2.0 ML was slightly felt at the epicentre area. The macroseismic survey carried out at the time of the event resulted a maximum intensity of 3 at the epicentre.

The intensity distribution is shown in Table 4.3.

8 May 1998 - Budakeszi

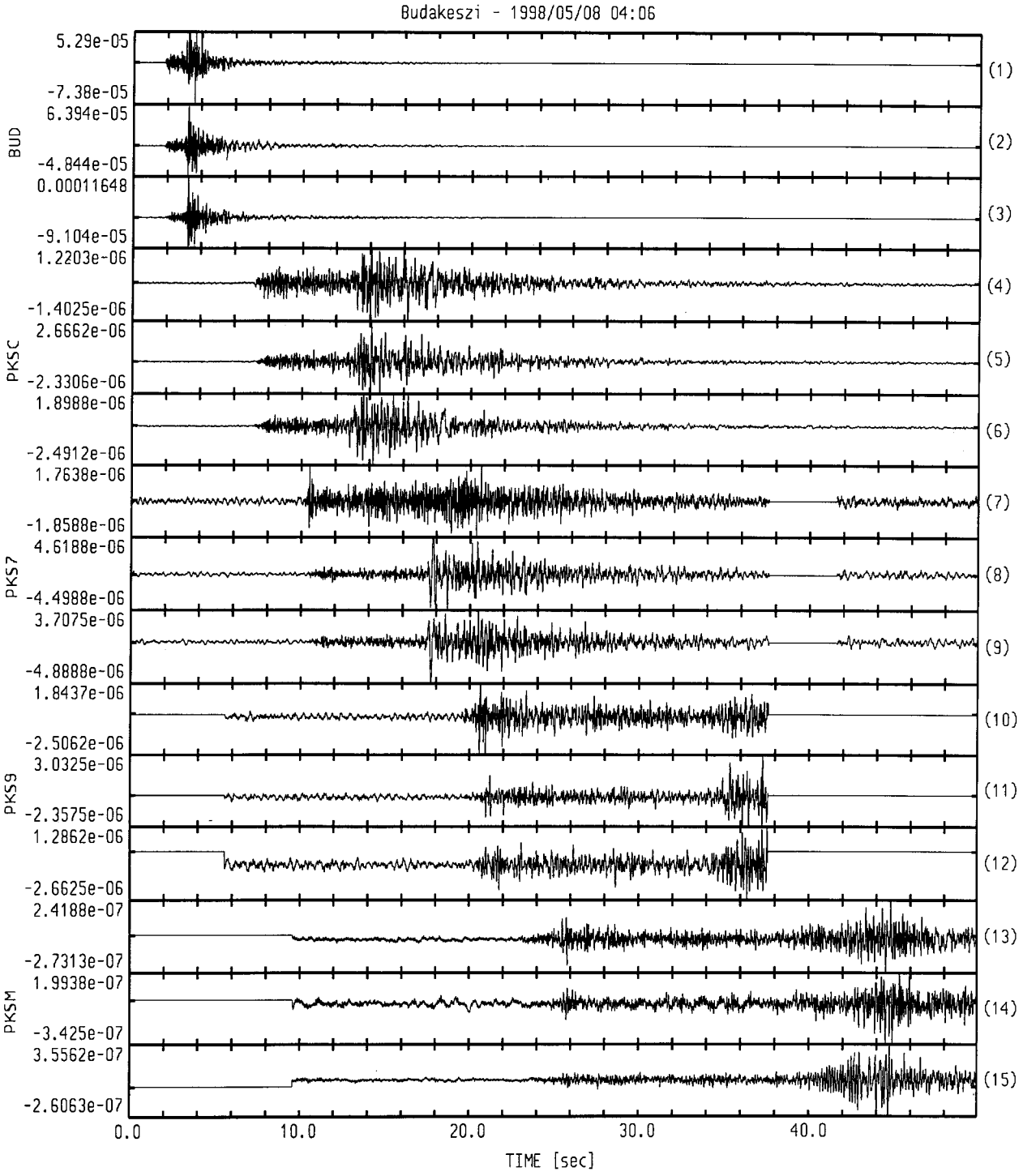


Figure 4.5. Seismograms of the Budakeszi Earthquake 8^{h} May 1998, 4:06:54 UTC (BUD, PKSC, PKS7, PKS9 and PKSM three components). The vertical axis is ground velocity in m/s.

Table 4.3. *Intensity distribution of the Budakeszi Earthquake 8th May 1998, 4:06:54 UTC*

	Location	Coordinates	I	R	N
1	Buda	47.508 N 18.989 E	3.0	35.%	2

I - intensity
R - relative reliability
N - number of reports

8 May 1998 - Budakeszi

29 September 1998 - Serbia

HYPOCENTRE PARAMETERS

Date:	1998/09/29
Origin Time:	22:14:49.7 UTC
Latitude and Longitude:	44.194N 20.037E (NEIC)
Depth:	10.0 km (NEIC)
Magnitude:	5.1 ML
Maximum Intensity:	8 (5 in Hungary)

DISCUSSION

The Serbia earthquake of 29 September had intensity about 8 at the epicentral area. One person died from a heart attack, 17 injured and damage in the Valjevo-Belgrade area, Yugoslavia. Felt in much of central Yugoslavia and in the Vidin area, Bulgaria. Also felt in the Sarajevo area, Bosnia and Herzegovina as well as in parts of Croatia, Hungary and northern Greece.

The event produced reports of intensity 5 EMS from the border region in Hungary.

The intensity distribution of the event (only in Hungary) is shown in Table 4.4. and Figure 4.7.

At a strong motion recorder site at Algyő (Szeged), 238 km from the epicentre, the peak acceleration on soft site was 4-5 mg on the horizontal components with 1.5-2.0 Hz spectral peaks. The macroseismic surveyresulted intensity 5 at that locality.

29 September 1998 - Serbia

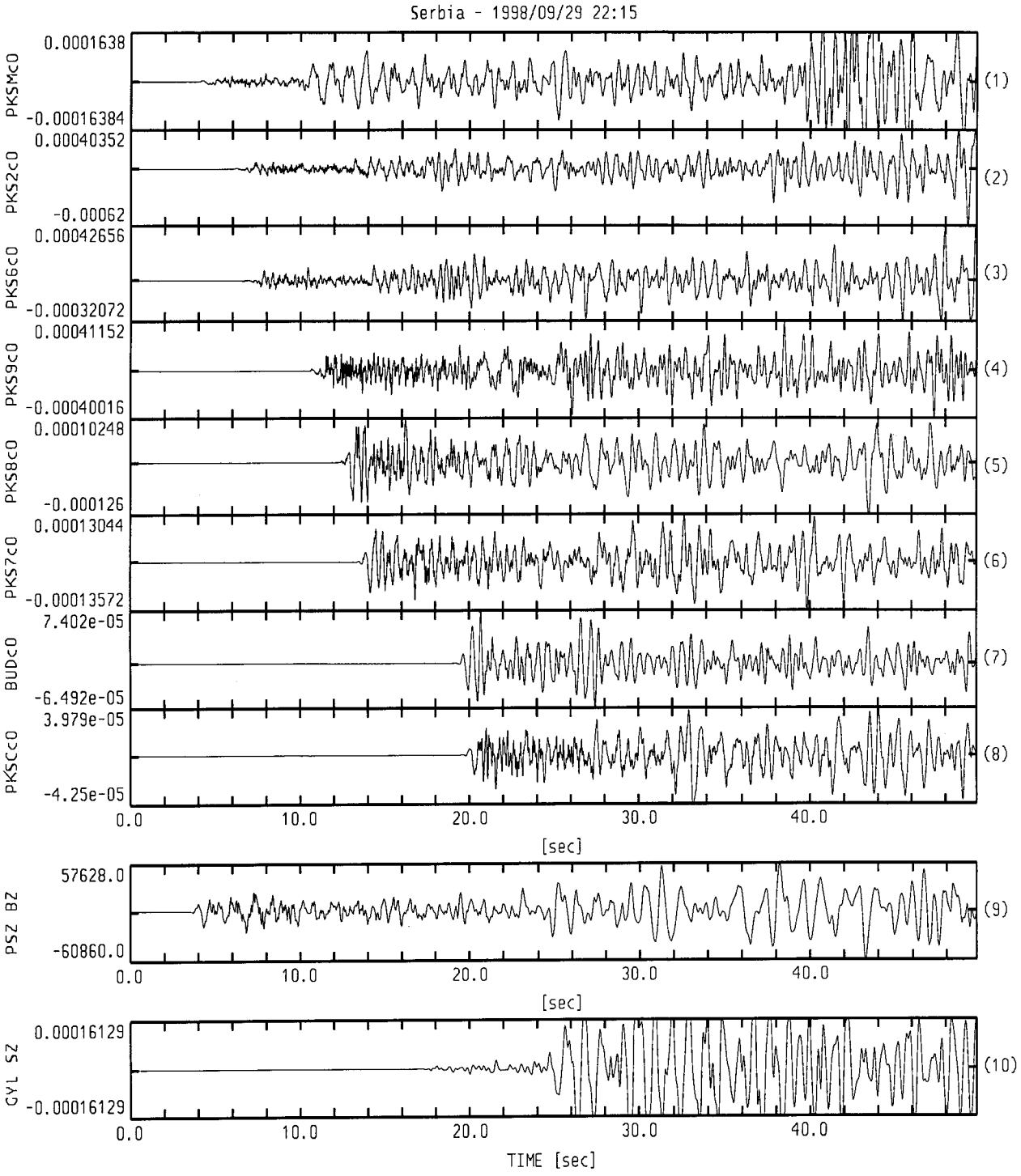


Figure 4.6. Seismograms of the Serbia Earthquake of 29h September 1998, 22:14:50 UTC (PKSM, PKS2, PKS6, PKS9, PKS8, PKS7, BUD, PKSC, PSZ and GYL vertical components).
The vertical axis is ground velocity in m/s.

Table 4.4. *Intensity distribution of the Serbia Earthquake 29th September 1998, 22:14:50 UTC*

	Location	Coordinates	I	R	N
1	Baja	46.182 N 18.958 E	3.5	35.%	2
2	Barcs	45.961 N 17.463 E	3.5	40.%	2
3	Bácsalmás	46.127 N 19.328 E	4.0	34.%	1
4	Békés	46.774 N 21.128 E	5.0	33.%	2
5	Békéscsaba	46.675 N 21.081 E	3.5	50.%	1
6	Budapest	47.500 N 19.051 E	3.0	63.%	3
7	Fegyvernek	47.252 N 20.521 E	.0	0.%	2
8	Hercegszántó	45.954 N 18.942 E	3.5	50.%	2
9	Hódmezővásárhely	46.420 N 20.312 E	4.0	36.%	1
10	Izsák	46.801 N 19.354 E	5.0	51.%	1
11	Jászkisér	47.460 N 20.212 E	.0	0.%	2
12	Kalocsa	46.527 N 18.987 E	.0	0.%	2
13	Kaposvár	46.357 N 17.791 E	.0	0.%	2
14	Kecskemét	46.909 N 19.693 E	4.0	28.%	3
15	Kiskőrös	46.622 N 19.287 E	.0	0.%	2
16	Kiskunhalas	46.426 N 19.486 E	3.5	45.%	2
17	Kunhegyes	47.374 N 20.634 E	.0	0.%	1
18	Makó	46.222 N 20.471 E	5.0	30.%	1
19	Marcali	46.584 N 17.414 E	.0	0.%	1
20	Mezőtúr	47.007 N 20.623 E	.0	0.%	2
21	Mohács	45.989 N 18.683 E	4.0	34.%	2
22	Mórahalom	46.220 N 19.883 E	.0	0.%	2
23	Nagyatád	46.227 N 17.363 E	.0	0.%	2
24	Paks	46.628 N 18.861 E	3.5	42.%	2
25	Pápa	47.331 N 17.467 E	.0	0.%	1
26	Pécs	46.088 N 18.245 E	3.5	33.%	2
27	Pilis	47.286 N 19.545 E	.0	0.%	2
28	Siklós	45.857 N 18.302 E	3.5	30.%	2
29	Siófok	46.904 N 18.055 E	.0	0.%	2
30	Solt	46.805 N 18.992 E	.0	0.%	2

Table 4.4. *Intensity distribution of the Serbia Earthquake 29th September 1998, 22:14:50 UTC* **(cont.)**

	Location	Coordinates	I	R	N
31	Szeged	46.259 N 20.152 E	5.0	47.%	3
32	Szeghalom	47.022 N 21.169 E	.0	0.%	1
33	Szekszárd	46.352 N 18.702 E	4.0	32.%	4
34	Székesfehérvár	47.196 N 18.423 E	2.5	42.%	2
35	Szentes	46.652 N 20.261 E	4.5	36.%	1
36	Szolnok	47.176 N 20.193 E	3.5	42.%	2
37	Szombathely	47.235 N 16.624 E	.0	0.%	1
38	Tamási	46.631 N 18.287 E	.0	0.%	2
39	Várpalota	47.199 N 18.145 E	.0	0.%	2
40	Veszprém	47.094 N 17.913 E	.0	0.%	2
41	Zalaegerszeg	46.844 N 16.844 E	.0	0.%	1

I - intensity
R - relative reliability
N - number of reports

29 September 1998 - Serbia

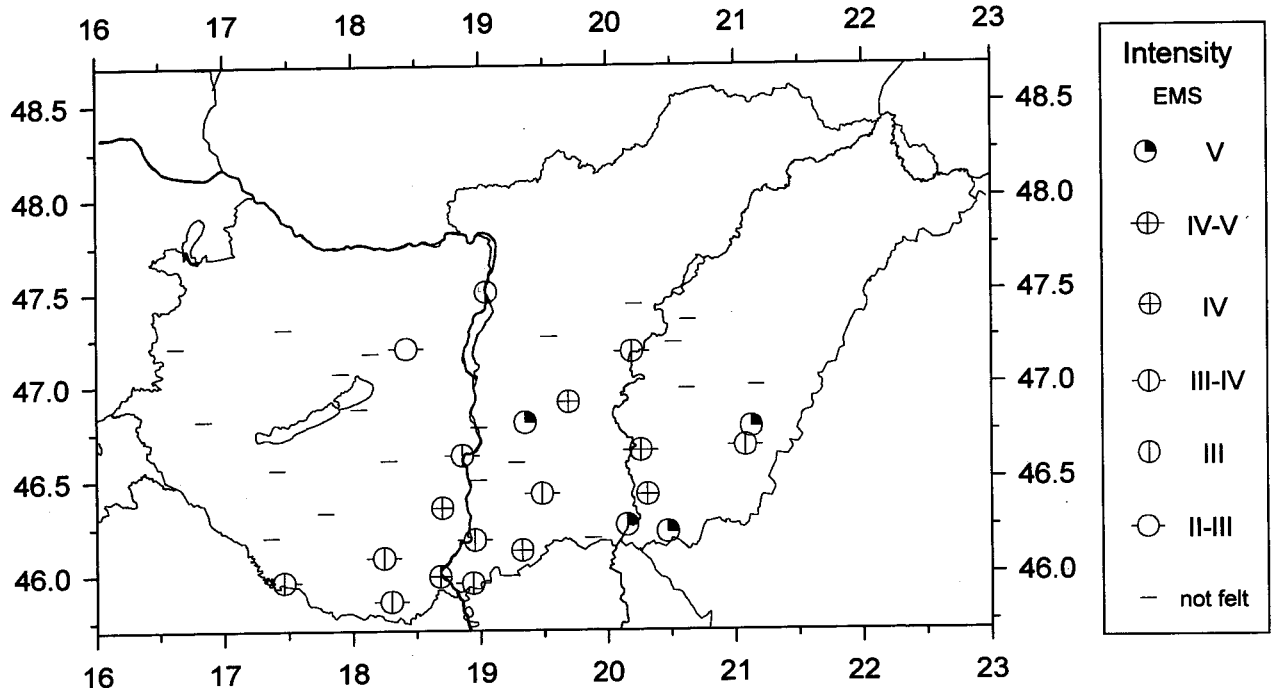


Figure 4.7. Intensity distribution of the Serbia Earthquake of 29th September 1998, 22:14:50 UTC

29 September 1998 - Serbia

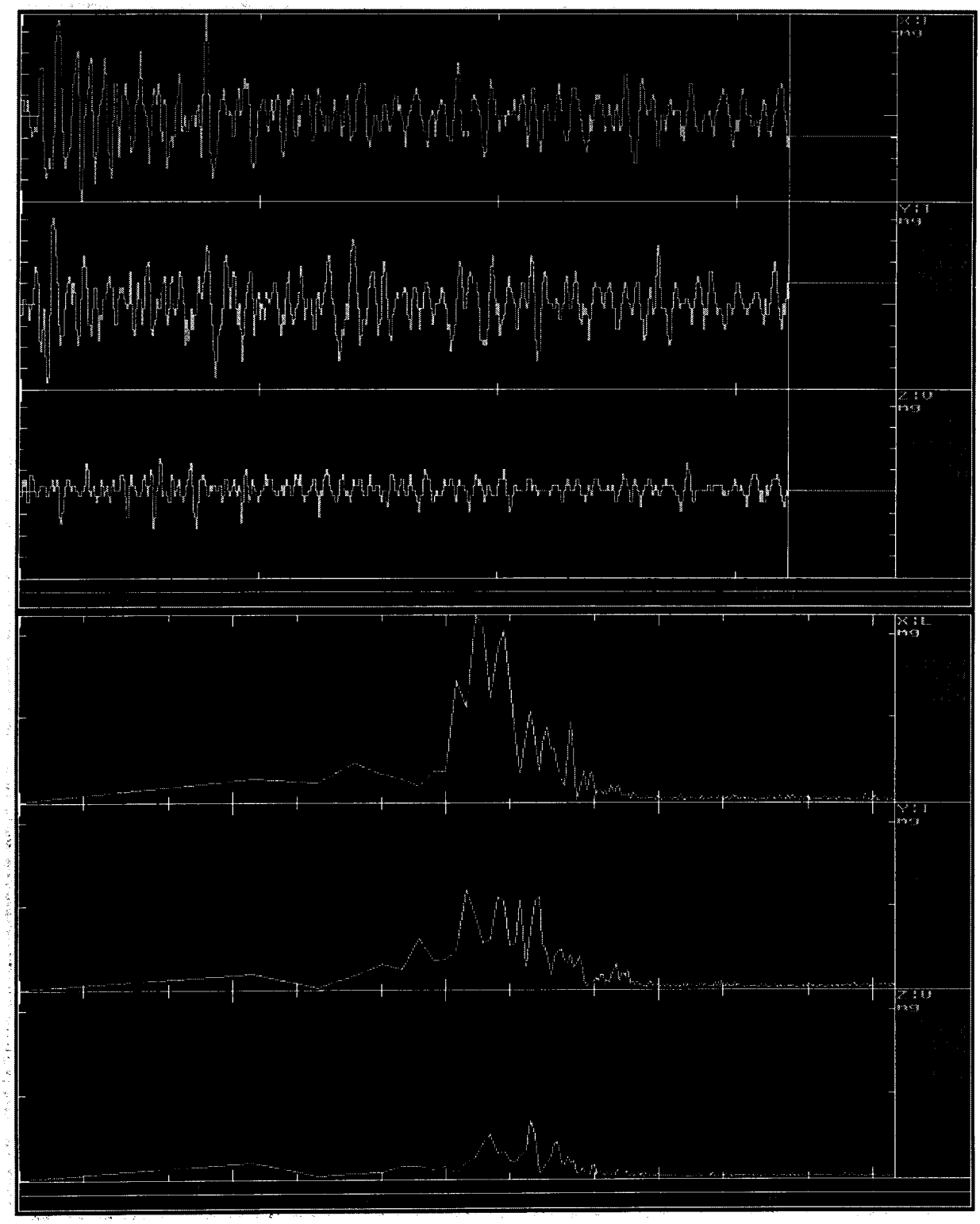


Figure 4.8. Strong motion accelerogram and its spectra of the Serbia Earthquake of 29th September 1998, 22:14:50 UTC (ML=5.1) recorded at Algyő (Szeged) at a distance of 238 km from the epicentre

6 December 1998 - Hárskút

HYPOCENTRE PARAMETERS

Date:	1998/12/06
Origin Time:	14:35:03.8 UTC
Latitude and Longitude:	47.206N 17.828E (S.D. 2.8km)
Depth:	6.3 km (S.D. 3.2km)
Magnitude:	2.6 ML
Maximum Intensity:	3-4

DISCUSSION

On December 6th, an earthquake with a magnitude of 2.6 ML was felt over a small area of 100-150 km^2 with a maximum intensity of 3-4 EMS.

The intensity distribution of the event is shown in Table 4.5. and Figure 4.10.

6 December 1998 - Hárskút

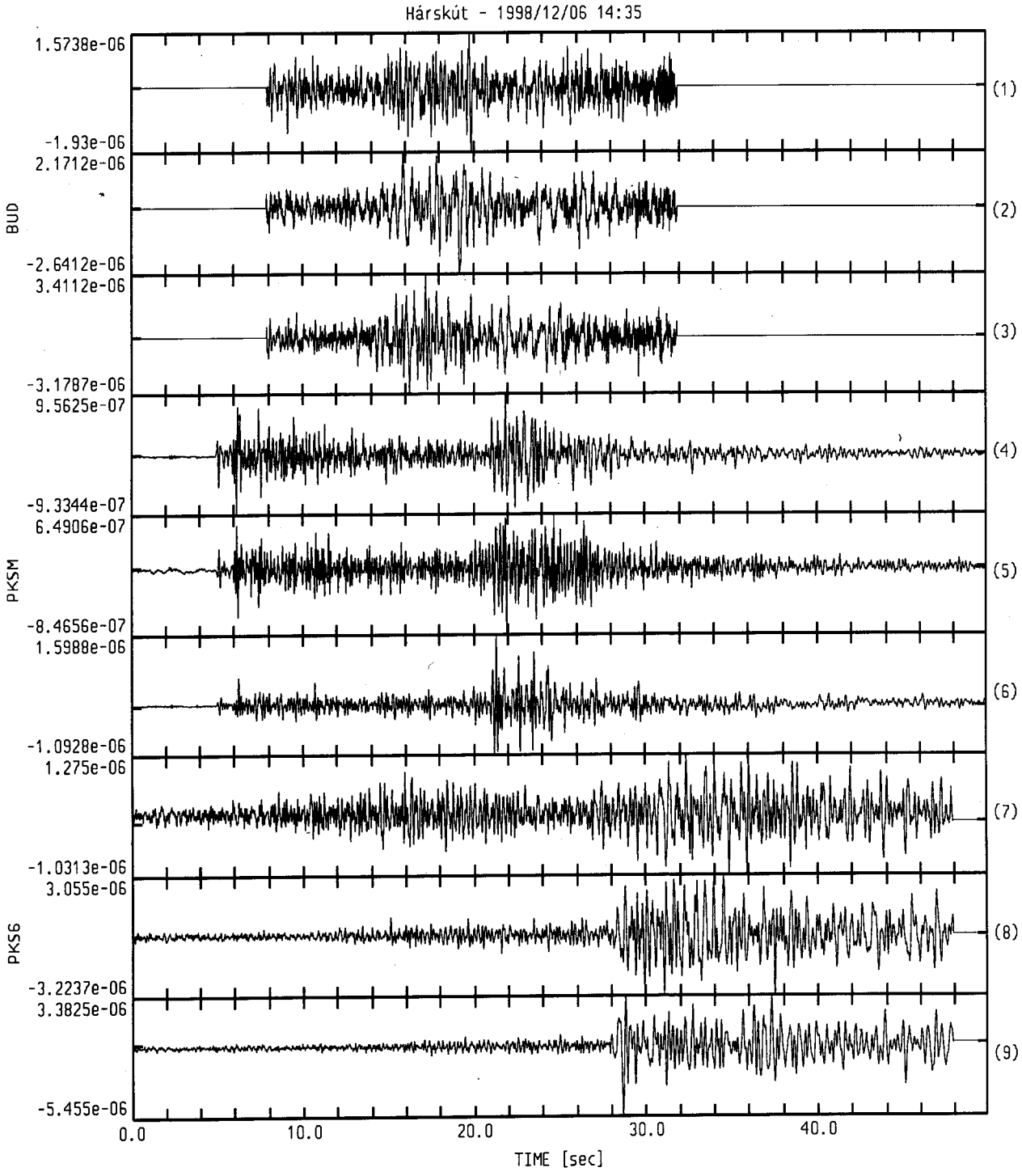


Figure 4.9. Seismograms of the Hárskút Earthquake 6th December 1998, 14:35:04 UTC (BUD, PKSM and PKS6 three components).
The vertical axis is ground velocity in m/s.

Table 4.5. *Intensity distribution of the Hárskút Earthquake 6th December 1998, 14:35:04 UTC*

	Location	Coordinates	I	R	N
1	Bánd	47.124 N 17.786 E	3.0	31.%	1
2	Borzavár	47.291 N 17.837 E	.0	0.%	1
3	Csehbánya	47.183 N 17.688 E	.0	0.%	1
4	Gyulafirátót	47.145 N 17.955 E	3.0	38.%	1
5	Hárskút	47.186 N 17.818 E	3.5	32.%	2
6	Herend	47.131 N 17.748 E	.0	0.%	1
7	Hidegkút	47.004 N 17.832 E	.0	0.%	2
8	Márkó	47.125 N 17.819 E	3.5	37.%	2
9	Szentkirályszabadja	47.060 N 17.977 E	.0	0.%	1
10	Úrkút	47.085 N 17.643 E	.0	0.%	2
11	Veszprém	47.094 N 17.913 E	.0	0.%	1

I - intensity
R - relative reliability
N - number of reports

6 December 1998 - Hárskút

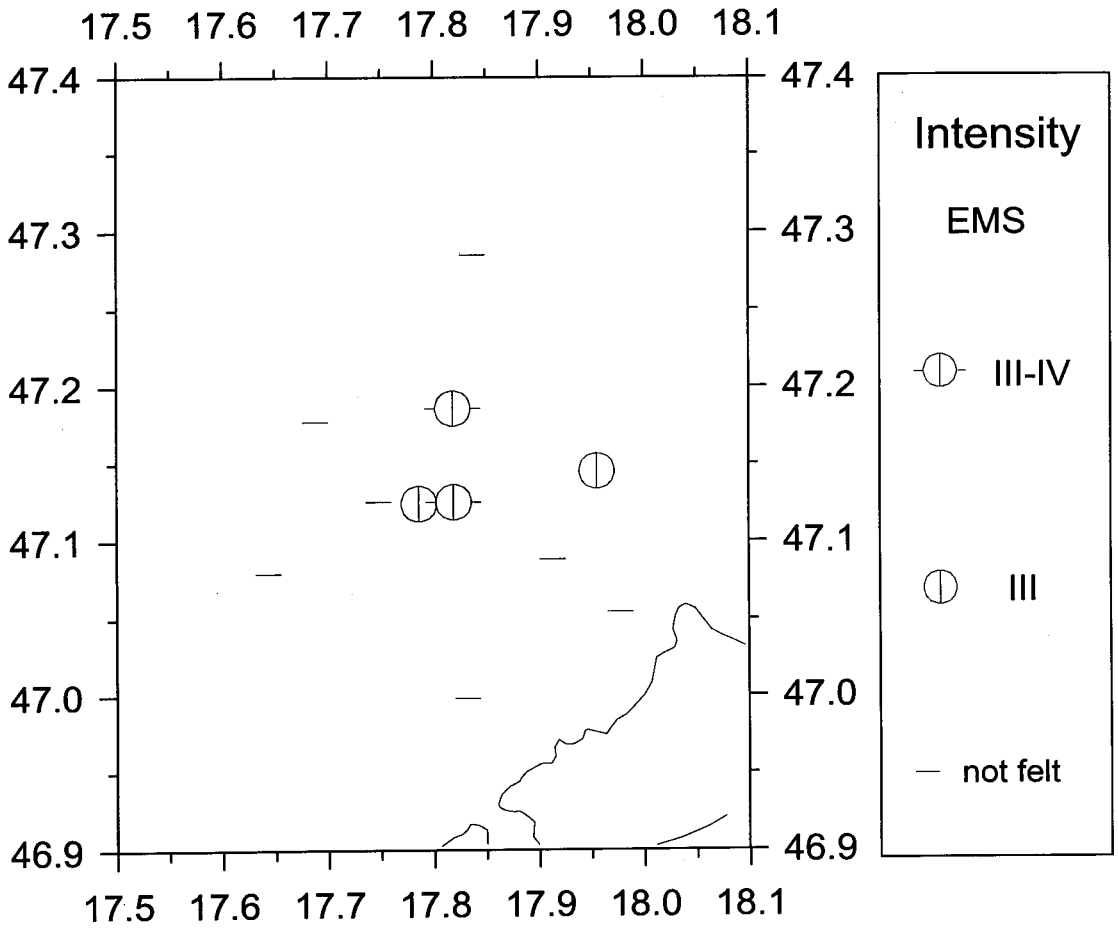


Figure 4.10. Intensity distribution of the Hárskút Earthquake 6th December 1998, 14:35:04 UTC

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APPENDIX A

EUROPEAN MACROSEISMIC SCALE (EMS)

EMS INTENSITY SCALE

1 ☞ **Not felt**

Not felt, even the most favourable circumstances.

2 ☞ **Scarcely felt**

Vibration is felt only by individual people at rest in houses, especially on upper floors of buildings.

3 ☞ **Weak**

The vibration is weak and is felt indoors by a few people. People at rest feel a swaying or light trembling.

4 ☞ **Largely observed**

The earthquake is felt indoors by many people, outdoors by very few. A few people are awakened. The level of vibration is not frightening. Windows, doors and dishes rattle. Hanging objects swing.

5 ☞ **Strong**

The earthquake is felt indoors by most, outdoors by few. Many sleeping people awake. A few run outdoors. Buildings tremble throughout. Hanging objects swing considerably. China and glasses clatter together. The vibration is strong. Top heavy objects topple over. Doors and windows swing open or shut.

6 ☞ **Slightly damaging**

Felt by most indoors and many outdoors. Many people in buildings are frightened and run outdoors. Small objects fall. Slight damage to many ordinary buildings eg. fine cracks in plaster and small pieces of plaster fall.

7 ☞ **Damaging**

Most people are frightened and run outdoors. Furniture is shifted and objects fall from shelves in large numbers. Many ordinary buildings suffer moderate damage: small cracks in walls, partial collapse of chimneys.

8 ☞ **Heavily damaging**

Furniture may be overturned. Many ordinary buildings suffer damage: chimneys fall, large cracks appear in walls and few buildings may partially collapse.

9 ☞ **Destructive**

Monuments and columns fall or are twisted. Many ordinary buildings partially collapse and few collapse completely.

10 ☞ **Very destructive**

Many ordinary buildings collapse.

11 ☞ **Devastating**

Most ordinary buildings collapse.

12 ☞ **Completely devastating**

Practically all structures above and below ground are heavily damaged or destroyed.

(For details see Grünthal, 1993)

APPENDIX B

SIGNIFICANT EARTHQUAKES OF THE WORLD

1998

Earthquakes of magnitude 6.5 or greater or ones that caused fatalities, injuries or substantial damage.

Source: U.S. Geological Survey
National Earthquake Information Center
(http://**wwwneic.cr.usgs.gov/neis/eqlists/eqlists.html**)

Significant Earthquakes of the World, 1998

January 5, 1999

DATE	ORIGIN TIME UTC HR MN SEC	GEOGRAPHIC COORDINATES LAT	LONG	DEPTH	MAGNITUDES GS MB	Msz	SD	NO. STA USED	REGION, CONTRIBUTED MAGNITUDES AND COMMENTS
JAN 01	06 11 22.6	23.913 N	141.907 E	96 D	6.4	5.8	0.9	388	VOLCANO ISLANDS REGION. Mw 6.4 (GS), 6.3 (HRV). Me 6.8 (GS). Es=3.4*10**14 Nm (GS). Mo=4.6*10**18 Nm (GS). Mo=3.6*10**18 Nm (HRV).
JAN 04	06 11 58.9	22.301 S	170.911 E	101 D	6.4		0.9	423	LOYALTY ISLANDS REGION. Mw 7.4 (GS), 7.4 (HRV). Me 7.3 (GS). Es=1.8*10**15 Nm (GS). Mo=1.2*10**20 Nm (GS). Mo=1.6*10**20 Nm (HRV).
JAN 10	03 50 41.5	41.083 N	114.500 E	30	5.8	5.7	0.9	401	NORTHEASTERN CHINA. Mw 5.8 (GS), 5.8 (HRV). Me 5.9 (GS). Es=1.6*10**13 Nm (GS). Mo=5.5*10**17 Nm (GS). Mo=6.1*10**17 Nm (HRV). Seventy people killed, about 11,500 injured, 44,000 families left homeless, extensive damage and fires in the Shangyi-Zhangbei area. Over 70,000 houses were damaged or destroyed. Damage to portions of the Great Wall of China in northwestern Hebei Province. Felt strongly at Zhangjiakou and as far as Beijing.
JAN 10	08 20 05.7	14.374 N	91.473 W	33 N	6.1	6.2	0.9	450	GUATEMALA. Mw 6.6 (GS), 6.6 (HRV). Me 6.6 (GS). Es=1.9*10**14 Nm (GS). Mo=9.8*10**18 Nm (GS). Mo=8.7*10**18 Nm (HRV). Mo=9.5*10**18 Nm (PPT). At least 16 people injured in Quezaltenango and 3 injured in San Marcos Departments. Five people injured in the Guatemala City area. Three people also injured in El Salvador. Damage and destruction to buildings, landslides and power outages occurred in Quezaltenango and San Marcos Departments. Several houses destroyed in Solola Department. Felt throughout southern and western Guatemala as far as Alta Verapaz and Zacapa Departments. Also felt in El Salvador and parts of southern Mexico.
JAN 12	10 14 07.6	30.985 S	71.410 W	35 D	5.8	6.2	1.0	230	NEAR COAST OF CENTRAL CHILE. Mw 6.6 (GS), 6.5 (HRV). Me 6.2 (GS). Es=3.9*10**13 Nm (GS). Mo=8.6*10**18 Nm (GS). Mo=7.3*10**18 Nm (HRV). Mo=1.2*10**19 Nm (PPT). Felt (VI) at Combarbala and Ovalle; (V) at Coquimbo, Illapel, La Serena, Los Andes and Los Vilos; (IV) at Rancagua, San Antonio and Valparaiso; (III) at Santiago.
JAN 12	16 36 20.2	15.848 S	179.376 W	23 D	5.8	6.7	1.2	277	FIJI ISLANDS REGION. Mw 6.7 (GS), 6.7 (HRV). Me 6.9 (GS). Es=5.7*10**14 Nm (GS). Mo=1.2*10**19 Nm (GS). Mo=1.1*10**19 Nm (HRV). Mo=2.3*10**19 Nm (PPT).
JAN 14	17 24 10.3	15.731 S	179.329 W	33 N	5.8	6.5	1.0	198	FIJI ISLANDS REGION. Mw 6.5 (GS), 6.5 (HRV). Mo=6.7*10**18 Nm (GS). Mo=7.3*10**18 Nm (HRV). Mo=1.3*10**19 Nm (PPT).
JAN 27	21 05 44.3	22.411 S	179.035 E	610 D	5.6		0.9	379	SOUTH OF FIJI ISLANDS. Mw 6.4 (GS), 6.5 (HRV). Mo=4.1*10**18 Nm (GS). Mo=5.4*10**18 Nm (HRV).
JAN 30	12 16 08.6*	23.913 S	70.207 W	42 G	6.3	6.5	1.1	385	NEAR COAST OF NORTHERN CHILE. Mw 7.0 (GS), 7.0 (HRV). Me 6.7 (GS). Es=2.9*10**14 Nm (GS). Mo=3.7*10**19 Nm (GS). Mo=3.9*10**19 Nm (HRV). Mo=4.2*10**19 Nm (PPT). One person suffered a heart attack at Antofagasta. Minor damage to older buildings at Antofagasta. Felt (VII) at Antofagasta, Calama and Collahuasi; (VI) at Maria Elena, Taltal and Tocopilla; (V) at Copiapo, Chanaral and San Pedro de Atacama; (IV) at Iquique; (III) at Caldera; (II) at La Serena.
FEB 03	03 02 00.2	15.883 N	96.298 W	33 N	6.0	6.2	1.0	430	NEAR COAST OF OAXACA, MEXICO. Mw 6.3 (GS), 6.3 (HRV). Me 6.0 (GS). MD 6.4 (UNM). Es=2.6*10**13 Nm (GS). Mo=3.1*10**18 Nm (GS). Mo=3.5*10**18 Nm (HRV). Moderate damage at San Agustin, San Francisco and Santa Maria Huatulco. Minor damage at Bahias de Huatulco, Oaxaca City, Puerto Angel and Puerto

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										Escondido. Landslides occurred on the highway between between San Pedro Pochulta and Santa Maria Tonameca. Felt in much of southern Mexico, including Mexico City.
FEB	04	14 33 21.2	37.075 N	70.089 E	33 N	5.6	6.1	1.0	300	AFGHANISTAN-TAJIKISTAN BORD REG. Mw 5.9 (GS), 6.0 (HRV). Mo=9.0*10**17 Nm (GS). Mo=9.6*10**17 Nm (HRV). At least 2,323 people killed, 818 injured, 8,094 houses destroyed, 6,725 livestock killed and landslides occurred in the Rostaq area, Afghanistan. Felt at Dushanbe, Tajikistan.
FEB	11	13 14 46.2	10.331 N	124.990 E	57 D	5.5		1.0	97	LEYTE, PHILIPPINE ISLANDS. Mw 5.6 (GS), 5.7 (HRV). Mo=2.7*10**17 Nm (GS). Mo=3.6*10**17 Nm (HRV). Six people injured, a fishing pier destroyed, at least 11 buildings damaged, roads cracked and water pipes damaged at Sogod. Felt (IV RF) at Tacloban and Palo. Also felt (III RF) at Cabagna-an, Negros and Lapu-Lapu, Mactan; (II RF) at Cebu, Cebu Island and Surigao, Mindanao.
FEB	16	23 53 19.5	52.666 N	33.665 W	10 G	6.2	6.5	0.9	222	NORTH ATLANTIC OCEAN. Mw 6.7 (GS), 6.8 (HRV). Me 6.8 (GS). Es=3.4*10**14 Nm (GS). Mo=1.4*10**19 Nm (GS). Mo=1.5*10**19 Nm (HRV).
FEB	19	14 14 51.1	4.476 S	129.082 E	33 N	6.1	6.4	0.9	378	BANDA SEA. Mw 6.5 (GS), 6.5 (HRV). Mo=6.9*10**18 Nm (GS). Mo=6.7*10**18 Nm (HRV). Felt strongly on Ambon, Indonesia.
FEB	20	12 18 06.2	36.479 N	71.086 E	236 D	5.8	5.7	1.1	419	AFGHANISTAN-TAJIKISTAN BORD REG. Mw 6.4 (GS), 6.3 (HRV). Mo=3.8*10**18 Nm (GS). Mo=3.7*10**18 Nm (HRV). One person killed and three injured at Yar Husain, six injured at Rawalpindi and two injured at Peshawar, Pakistan. An earthquake-induced avalanche destroyed 35 houses, including a mosque, left 300 people homeless and killed several dozen cattle and sheep in the Astor area, Kashmir. Damage occurred from Chitral to Swabi, Pakistan, in western Kashmir and in the Rostaq area, Afghanistan. Felt in much of northern Pakistan as far south as Lahore and in northeastern Afghanistan as far as Kabul and Mazar-e Sharif. Also felt in parts of Tajikistan.
FEB	21	00 55 42.3	37.222 N	138.684 E	33 N	5.3	4.5	0.8	234	NEAR WEST COAST OF HONSHU, JAPAN. One person injured in Niigata Prefecture. Felt (IV JMA) in central Niigata; (III JMA) in Gumma, northern Nagano and western Niigata Prefectures.
MAR	14	19 40 27.0	30.154 N	57.605 E	9 G	5.9	6.9	1.2	395	NORTHERN IRAN. Mw 6.6 (GS), 6.6 (HRV). Me 6.3 (GS). Es=7.3*10**13 Nm (GS). Mo=7.7*10**18 Nm (GS). Mo=9.6*10**18 Nm (HRV). Mo=1.3*10**19 Nm (PPT). Five people killed and 50 injured in Golbaf. Two thousand houses destroyed, 10,000 people left homeless. 1,200 livestock killed and water, electricity and communications disrupted in the Golbaf area. Felt at Baft and Kerman.
MAR	19	13 51 33.7	39.977 N	76.731 E	33 N	5.4	5.6	0.9	265	SOUTHERN XINJIANG, CHINA. Mw 5.6 (GS), 5.7 (HRV). Mo=2.6*10**17 Nm (GS). Mo=3.5*10**17 Nm (HRV). About 400 houses destroyed and some livestock killed 90 km northeast of Artux. Felt at Artux and Kashgar. Also felt at Almaty, Kazakhstan.
MAR	20	21 08 08.5	50.008 S	163.107 E	10 G	5.8	6.1	1.3	118	AUCKLAND ISLANDS REGION. Mw 6.4 (GS), 6.7 (HRV). Mo=5.0*10**18 Nm (GS). Mo=1.1*10**19 Nm (HRV).
MAR	25	03 12 25.0	62.877 S	149.527 E	10 G	6.6	8.0	1.1	418	BALLENY ISLANDS REGION. Mw 7.7 (GS), 8.1 (HRV). Me 8.3 (GS). Es=6.1*10**16 Nm (GS). Mo=4.6*10**20 Nm (GS). Mo=1.7*10**21 Nm (HRV). Mo=9.0*10**20 Nm (PPT).
MAR	25	12 17 22.5	63.612 S	147.937 E	10 G	5.8	6.1	0.9	225	SOUTH OF AUSTRALIA. Mw 6.5 (HRV). Mo=5.4*10**18 Nm (HRV).
MAR	26	16 26 11.5	43.255 N	12.969 E	10 G	5.4	4.8	1.3	377	CENTRAL ITALY. ML 5.6 (VIE), 5.5 (FBB), 5.5 (LDG), 5.0 (LJU), 5.0 (ROM). One person died of a heart attack at Perugia. Additional minor damage (VII) to buildings weakened by earthquakes of September 26, 1997 and their aftershocks. Damage occured at Camerino, Sant Ippolito and Urbino. Felt from Bologna to Rome. Felt (IV) at Ljubljana.

Slovenia and felt throughout Slovenia. Also felt in parts of Salzburg and Tirol, Austria.

MAR 29 19 48 16.2 17.552 S 179.092 W 537 D 6.5 1.0 553 FIJI ISLANDS REGION. Mw 7.2 (HRV), 7.1 (GS). Mo=4.6*10**19 Nm (GS). Mo=6.1*10**19 Nm (HRV). Mo=2.6*10**19 Nm (PPT).

APR 01 17 56 23.3 0.544 S 99.261 E 56 6.2 6.9 0.9 506 SOUTHERN SUMATERA, INDONESIA. Mw 6.9 (GS), 7.0 (HRV). Me 6.6 (GS). Es=1.7*10**14 Nm (GS). Mo=2.8*10**19 Nm (GS). Mo=3.8*10**19 Nm (HRV). Mo=1.0*10**19 Nm (PPT). Felt strongly at Padang. Felt in Singapore and in the Kuala Lumpur area, Malaysia.

APR 01 22 42 56.9 40.316 S 74.874 W 9 G 6.2 6.0 1.1 315 OFF COAST OF SOUTHERN CHILE. Mw 6.5 (GS), 6.7 (HRV). Me 6.6 (GS). Es=1.6*10**14 Nm (GS). Mo=7.2*10**18 Nm (GS). Mo=1.1*10**19 Nm (HRV). Felt (V) at Futrono, Panguipulli and Valdivia; (IV) at Castro, Osorno, Puerto Montt and Ranco; (III) at Corral and Temuco.

APR 02 17 56 14.7? 1.20 S 98.60 E 28 * 6.5 1.9 21 SOUTHERN SUMATERA, INDONESIA

APR 03 07 26 36.6& 43.164 N 12.701 E 10 5.1 4.8 368 CENTRAL ITALY. . ML 5.3 (VIE), 5.2 (FUR), 5.1 (STR), 5.0 (LDG), 5.0 (FBB). mbLg 5.2 (MDD). Five people slightly injured and 300 houses damaged or destroyed in the Gualdo Tadino-Nocera Umbra area. Additional damage to a castle at Foligno. Felt strongly at Assisi. Felt as far south as Rome. Also felt (IV) at Koper, Slovenia.

APR 03 22 01 48.2 8.148 S 74.238 W 165 D 6.1 5.6 0.8 248 PERU-BRAZIL BORDER REGION. Mw 6.6 (GS), 6.6 (HRV). Mo=8.7*10**18 Nm (GS). Mo=8.9*10**18 Nm (HRV). Mo=1.5*10**19 Nm (PPT). Felt (II) at Lima; also felt in many parts of northern Peru. Probably two events about 5 seconds apart.

APR 10 15 00 53.1 32.457 N 59.976 E 33 N 5.3 5.7 1.5 227 NORTHERN IRAN. Mw 5.6 (GS), 5.8 (HRV). Mo=2.5*10**17 Nm (GS). Mo=4.8*10**17 Nm (HRV). At least 12 people killed, 20 injured and more than 600 homes severely damaged in the area between Birjand and Gonabad.

APR 12 10 55 32.5 46.245 N 13.652 E 10 G 5.3 5.7 1.2 411 AUSTRIA. Mw 5.4 (GS), 5.8 (HRV), 6.0 (CSEM). ML 5.9 (LDG), 5.7 (ROM), 5.6 (CLL), 5.6 (STR), 5.6 (VIE), 5.5 (LJU). Mo=1.4*10**17 Nm (GS). Mo=5.8*10**17 Nm (HRV). Mo=1.1*10**18 Nm (CSEM). One person died of a heart attack at Bovec, Slovenia. Maximum intensity (VIII) in the Bovec-Kobarid area, Slovenia, where damage to buildings and landslides left 700 people homeless. Minor damage at Arnoldstein, Austria. Felt strongly throughout Slovenia and northeastern Italy. Felt throughout Austria and in parts of Croatia, Germany and Hungary.

APR 13 15 14 33.5 39.238 N 41.055 E 33 N 4.8 4.8 1.0 139 TURKEY. Eleven people injured and several buildings damaged or destroyed at Karliova.

MAY 03 23 30 21.9 22.306 N 125.308 E 33 N 6.4 7.3 1.0 458 SOUTHEAST OF TAIWAN. Mw 7.4 (GS), 7.5 (HRV). Me 7.5 (GS). Es=4.5*10**15 Nm (GS). Mo=1.5*10**20 Nm (GS). Mo=1.9*10**20 Nm (HRV). Mo=2.4*10**20 Nm (PPT). Minor local tsunami observed on Ishigaki-shima. Felt (III JMA) on Iriomote-shima, Ishigaki-shima, Miyako-shima and Yonaguni; (I JMA) on Amami O-shima, Kikai-shima, Okinawa and in the southern part of Kyushu. Also felt in parts of eastern Taiwan.

MAY 13 23 02 05.6 5.147 S 151.714 E 61 6.0 0.9 380 NEW BRITAIN REGION, P.N.G. Mw 6.5 (GS), 6.6 (HRV). Me 5.9 (GS). Es=1.5*10**13 Nm (GS). Mo=5.4*10**18 Nm (GS). Mo=8.7*10**18 Nm (HRV). Mo=5.5*10**18 Nm (PPT). Minor damage in the Kokopo area. Felt on most of New Britain and the nearby islands. Two events about 2.5 seconds apart.

MAY 16 02 22 03.2 22.227 S 179.519 W 586 D 6.1 1.0 598 SOUTH OF FIJI ISLANDS. Mw 6.8 (GS). Mo=1.9*10**19 Nm (GS). Mo=2.2*10**19 Nm (PPT).

MAY 21 05 34 25.5 0.207 N 119.584 E 33 N 6.2 6.3 1.0 303 MINAHASSA PENINSULA, SULAWESI. Mw 6.6 (GS), 6.6 (HRV). Mo=1.0*10**19 Nm (GS). Mo=9.4*10**18 Nm (HRV). Felt

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										at Donggala, Palu and Tolitoli.
MAY	22	04 48 50.4	17.731 S	65.431 W	24	G	5.9 6.6	1.4	226	CENTRAL BOLIVIA. Mw 6.5 (GS), 6.6 (HRV). Me 6.2 (GS). Es=3.8*10**13 Nm (GS). Mo=6.6*10**18 Nm (GS). Mo=7.6*10**18 Nm (HRV). Mo=1.1*10**19 Nm (PPT). At least 105 people killed and 150 injured in the Aiquile-Totora area. Eighty percent of the buildings at Aiquile and seventy percent at Totora were destroyed. Complex earthquake with at least two larger events occurring about 8 and 12 seconds after the onset.
MAY	28	18 33 28.1	31.401 N	27.667 E	10	G	5.5 5.0	1.0	394	EGYPT. Mw 5.5 (GS). Mo=2.2*10**17 Nm (GS). One person injured at Cairo. Felt in the Cairo area. Also felt at Elat, Israel.
MAY	28	21 11 44.1	37.388 N	78.843 E	33	N	5.2 5.6	1.0	246	SOUTHERN XINJIANG, CHINA. Mw 5.8 (GS), 5.6 (HRV). Mo=4.8*10**17 Nm (GS). Mo=2.9*10**17 Nm (HRV). Twenty-eight people injured and more than 2,000 buildings destroyed in the epicentral area. An additional 3,000 buildings damaged and 5,000 head of cattle killed.
MAY	30	06 22 28.9	37.106 N	70.110 E	33	N	5.9 6.9	1.0	465	AFGHANISTAN-TAJIKISTAN BORD REG. Mw 6.5 (GS), 6.6 (HRV). Mo=7.4*10**18 Nm (GS). Mo=8.2*10**18 Nm (HRV). At least 4,000 people killed, many thousands injured and homeless in Badakhshan and Takhar Provinces, Afghanistan. Felt strongly at Mazar-e Sharif, Afghanistan. Also felt at Kabul, Afghanistan; Islamabad, Peshawar and Rawalpindi, Pakistan; Dushanbe, Tajikistan.
JUN	01	05 34 03.5	52.889 N	160.067 E	44		6.2 6.3	0.9	515	OFF EAST COAST OF KAMCHATKA. Mw 6.5 (GS), 6.4 (HRV). Mo=5.6*10**18 Nm (GS). Mo=5.2*10**18 Nm (HRV). Mo=4.4*10**18 Nm (PPT). Felt (V) at Petropavlovsk-Kamchatskiy.
JUN	27	13 55 52.0	36.878 N	35.307 E	33	N	5.8 6.2	1.3	409	TURKEY. Mw 6.3 (GS), 6.3 (HRV). Me 6.3 (GS). Ms 6.3 (BRK). MD 6.3 (ISK). ML 5.9 (GII). Es=5.6*10**13 Nm (GS). Mo=3.3*10**18 Nm (GS). Mo=3.1*10**18 Nm (HRV). At least 145 people killed and more than 1,500 injured in the Adana and Ceyhan areas. At least 6 major buildings collapsed and about 17,000 houses destroyed in Adana Province. Felt in Cyprus, Israel and Syria. Complex earthquake, with at least one larger event occurring about 2.5 seconds after the onset.
JUL	04	02 15 44.3	36.897 N	35.157 E	10	G	5.0 4.5	1.1	171	TURKEY. ML 5.3 (GII). mbLg 5.1 (MDD). At least 500 people injured in the Adana-Geyhan area.
JUL	09	05 19 07.3	38.650 N	28.626 W	10	G	5.7 6.0	1.0	421	AZORES ISLANDS. Mw 6.2 (GS), 6.2 (HRV). Me 6.6 (GS). Es=1.8*10**14 Nm (GS). Mo=2.5*10**18 Nm (GS). Mo=2.0*10**18 Nm (HRV). Ten people killed, about 100 injured and 1,000 left homeless on Faial. Some damage on Pico and Terceira. Felt on Corvo and San Jorge.
JUL	09	14 19 18.4	38.717 N	48.507 E	26	G	5.9	1.0	442	ARMENIA-AZERBAIJAN-IRAN BORD REG. Mw 5.9 (GS), 6.0 (HRV). Me 5.7 (GS). Es=7.2*10**12 Nm (GS). Mo=8.6*10**17 Nm (GS). Mo=1.2*10**18 Nm (HRV). Extensive damage in the areas of Astara, Bilasuvar, Imisli, Lenkoran, Masally and Yardimli, Azerbaijan. Also felt at Baku, Azerbaijan. Felt (V) at Goris, Armenia and in the area of Astara, Iran.
JUL	09	14 45 39.9	30.487 S	178.994 W	130	D	6.2 6.2	1.1	483	KERMADEC ISLANDS, NEW ZEALAND. Mw 6.9 (GS), 6.9 (HRV). Me 6.4 (GS). Es=1.0*10**14 Nm (GS). Mo=2.6*10**19 Nm (GS). Mo=2.2*10**19 Nm (HRV). Mo=4.9*10**19 Nm (PPT).
JUL	16	11 56 36.4	11.040 S	166.160 E	110	D	6.4 6.7	0.9	297	SANTA CRUZ ISLANDS. Mw 7.1 (GS), 7.1 (HRV). Me 6.9 (GS). Es=5.9*10**14 Nm (GS). Mo=5.2*10**19 Nm (GS). Mo=5.4*10**19 Nm (HRV). Mo=4.0*10**19 Nm (PPT).
JUL	17	04 51 14.7	23.407 N	120.736 E	13		5.5 5.4	1.1	279	TAIWAN. Five people killed, 27 injured, damage (V JMA) and landslides occurred in Chia-i County. Felt (IV JMA) at Tai-nan; (III JMA) at Hua-lien, Kao-Hsiung and Tai-chung; (II JMA) at Cheng-kung and I-lan; (I JMA) at Taipei. Felt throughout Taiwan. Felt (II JMA) at Ma-kung, Peng-hu. Also felt along the coasts of Fujian and Zhejiang Provinces.

										China.
JUL	17	08 49 13.2	2.961 S	141.926 E	10	G	5.8 7.1	1.3	60	NEAR N COAST OF NEW GUINEA, PNG. Mw 7.1 (GS), 7.1 (HRV). Me 6.4 (GS). Es=9.9*10**13 Nm (GS). Mo=4.3*10**19 Nm (GS). Mo=5.2*10**19 Nm (HRV). Mo=3.4*10**19 Nm (PPT). At least 2,183 people killed, thousands injured, about 9,500 homeless and about 500 missing as a result of a tsunami generated in the Sissano area. Maximum wave heights estimated at 10 meters. Several villages were completely destroyed and others extensively damaged. Maximum recorded wave heights from selected tide stations (one-half peak-to-trough, in cm) were as follows: 20 on Miyake-jima; 15 at Tosa-Shimuzu, Shikoku; 13 at Muroto, Shikoku; 12 at Naze, Amami O-shima; 10 on Tanega-shima; 10 at Kushimoto, Honshu. Other recorded wave heights (peak to trough, in cm) were as follows: 6 at Jackson Bay and 4.7 at Kaikoura, New Zealand; 5 on Yap. Felt along much of the northern Papua New Guinea coast.
JUL	28	04 51 43.9	41.793 N	81.460 E	33	N	5.3 4.7	0.9	231	SOUTHERN XINJIANG, CHINA. Several people injured and 19 houses destroyed in Baicheng County.
JUL	29	07 14 24.0	32.312 S	71.286 W	51	D	6.3	0.9	359	NEAR COAST OF CENTRAL CHILE. Mw 6.5 (GS), 6.5 (HRV). Me 6.5 (GS). Es=1.1*10**14 Nm (GS). Mo=6.7*10**18 Nm (GS). Mo=5.4*10**18 Nm (HRV). Two people died of heart attacks at Santiago. Several dozen people slightly injured in the Santiago area. Four miners injured when trapped underground at the Boton de Oro gold mine. Felt (VI) at La Ligua, Los Andes, Los Vilos, Quillota, San Antonio, San Felipe and Valparaiso; (V) at Illapel, Ovalle, Rancagua and Santiago; (III) at Coquimbo, La Serena and Talca. Landslide occurred along the Trans-Andean road near Portillo.
JUL	29	18 00 29.9	2.693 S	138.901 E	33	N	5.9 6.7	0.9	248	IRIAN JAYA, INDONESIA. Mw 6.5 (GS), 6.6 (HRV). Me 6.2 (GS). Es=4.1*10**13 Nm (GS). Mo=6.3*10**18 Nm (GS). Mo=1.0*10**19 Nm (HRV). Felt at Jayapura, Sarmi and Wamena.
AUG	02	04 40 46.4	39.573 N	76.999 E	69	D	5.6	0.9	382	SOUTHERN XINJIANG, CHINA. Mw 5.6 (GS), 5.6 (HRV). Mo=3.2*10**17 Nm (GS). Mo=2.6*10**17 Nm (HRV). At least two people injured and several homes destroyed in Jiashi County.
AUG	04	18 59 20.1	0.593 S	80.393 W	33	N	6.2 7.1	0.9	412	NEAR COAST OF ECUADOR. Mw 7.1 (GS), 7.1 (HRV). Me 7.0 (GS). Es=7.1*10**14 Nm (GS). Mo=4.3*10**19 Nm (GS). Mo=5.0*10**19 Nm (HRV). Mo=4.5*10**19 Nm (PPT). Three people killed and forty injured in the Bahia de Caraquez-Canoa area. Approximately sixty percent of the buildings at Canoa severely damaged. Electricity, telephone and water services disrupted and most buildings with three or more stories damaged at Bahia de Caraquez. Considerable damage in many other parts of western Manabi Province. Landslides blocked a road between Bahia de Caraquez and Canoa. Felt strongly at Guayaquil and Quito. Felt throughout most of Ecuador and also at Cali, Colombia. Complex earthquake. A small event is followed by a larger one about 3 seconds later.
AUG	12	14 10 25.1&	36.755 N	121.464 W	9		4.8 5.0		160	CENTRAL CALIFORNIA. . Mw 5.2 (HRV), 5.1 (BRK). ML 5.3 (GM). Mo=7.8*10**16 Nm (HRV). Mo=5.3*10**16 Nm (BRK). Two people injured in southern Santa Cruz County. Some damage to a church at San Juan Bautista. Damage to several mobile homes and minor cracking of highway 101 in San Benito County. Considerable loss from items falling from store shelves in the epicentral area. Felt in Alameda, Contra Costa, Marin, Monterey, San Benito, San Francisco, Santa Clara, Santa Cruz and San Mateo Counties. Felt as far north as Rohnert Park, east to Turlock and south to Big Sur and King City.
AUG	20	06 40 55.8	28.932 N	139.329 E	441		6.1	0.9	488	BONIN ISLANDS REGION. Mw 7.0 (GS), 7.0 (HRV). Mo=3.8*10**19 Nm (GS). Mo=3.7*10**19 Nm (HRV). Felt (III JMA) on Chichi-jima and at Tateyama, Honshu. Felt (II JMA) in the Tokyo-Yokohama area, Honshu.

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AUG	23	13 56 15.3	11.663 N	88.038 W	55	5.7	6.3	1.0	449	OFF COAST OF CENTRAL AMERICA. Mw 6.5 (GS), 6.7 (HRV), Me 6.8 (GS). Es=3.2*10**14 Nm (GS). Mo=6.8*10**18 Nm (GS). Mo=1.3*10**19 Nm (HRV). Felt at Managua and along the Pacific coast of Nicaragua.
AUG	27	09 03 36.6	39.660 N	77.343 E	33 N	5.6	6.4	1.0	369	SOUTHERN XINJIANG, CHINA. Mw 6.3 (GS), 6.3 (HRV). Mo=2.7*10**18 Nm (GS). Mo=3.4*10**18 Nm (HRV). At least 3 people killed and 7 injured, more than 3,000 houses destroyed and another 18,000 damaged in Jiashi County.
AUG	28	23 46 43.9	35.522 N	139.879 E	76 D	5.2		1.0	244	NEAR S. COAST OF HONSHU, JAPAN. One person slightly injured at Tokyo and another injured at Yokohama.
SEP	02	08 37 29.9	5.410 N	126.764 E	50 G	6.6	6.7	1.0	424	MINDANAO, PHILIPPINE ISLANDS. Mw 6.8 (GS), 6.8 (HRV). Me 6.8 (GS). Es=4.1*10**14 Nm (GS). Mo=2.1*10**19 Nm (GS). Mo=2.0*10**19 Nm (HRV). Mo=3.3*10**19 Nm (PPT). Items knocked from shelves (IV RF) at General Santos. Felt (IV RF) on Samal; (III RF) at Butuan, Davao and Kidapawan; (II RF) at Bislig, Cagayan de Oro and Cotabato; (I RF) at Zamboanga. Felt in much of Mindanao.
SEP	03	07 58 21.1	39.716 N	140.760 E	38	5.7	5.7	0.8	361	EASTERN HONSHU, JAPAN. Mw 5.9 (GS), 5.9 (HRV). Mo=7.7*10**17 Nm (GS). Mo=7.2*10**17 Nm (HRV). Mo=2.2*10**18 Nm (PPT). Eleven people slightly injured, items knocked from shelves (VI JMA) and power outages at Shizukuishi. Felt (IV JMA) in Akita; (III JMA) in Aomori, Miyagi, Niigata and Yamagata Prefectures. Two roads blocked by landslides in the epicentral area.
SEP	03	17 37 58.2	29.450 S	71.715 W	27 G	6.2	6.6	0.9	384	NEAR COAST OF CENTRAL CHILE. Mw 6.5 (GS), 6.5 (HRV). Me 6.4 (GS). Es=9.3*10**13 Nm (GS). Mo=5.4*10**18 Nm (GS). Mo=6.4*10**18 Nm (HRV). Mo=6.5*10**18 Nm (PPT). Two people injured at La Serena. Felt (VI) at Andacollo, Coquimbo, Hurtado, La Higuera, La Serena, Monte Patria, Paihuano, Punitaqui, Talahuen and Vicuna; (V) at Alto del Carmen, Combarbala and Ovalle; (IV) at Copiapo, El Palqui, Freirina, Huasco, Illapel, Los Molles, Salamanca, Tierra Amarilla and Vallenar; (III) at Caldera, Papudo, Quillota, Quintero and Valparaiso; (II) at Santiago. Felt (III) at San Juan and (II) at Mendoza, Argentina. Also felt at Cordoba, Argentina.
SEP	09	11 27 59.3	40.035 N	15.980 E	10 G	5.2	5.2	1.0	385	SOUTHERN ITALY. Mw 5.4 (GS), 5.7 (HRV), 5.9 (CSEM). Mo=1.6*10**17 Nm (GS). Mo=3.4*10**17 Nm (HRV). Mo=7.4*10**17 Nm (CSEM). One person killed by falling rock and another person died from a heart attack. At least 12 people injured and many buildings damaged in the Castelluccio-Lauria area. Felt from Naples to Calabria.
SEP	28	13 34 29.7	8.181 S	112.465 E	153 D	6.3		1.0	123	JAWA, INDONESIA. Mw 6.5 (GS), 6.5 (HRV). Mo=5.8*10**18 Nm (GS). Mo=7.0*10**18 Nm (HRV). Mo=5.9*10**18 Nm (PPT). One person killed, 200 homeless, 38 buildings collapsed and 62 damaged in the Malang area. Felt in central and eastern Jawa. Also felt on Bali, Lombok and Sumbawa.
SEP	29	22 14 49.7	44.194 N	20.037 E	10 G	5.2	5.3	1.4	270	NORTHWESTERN BALKAN REGION. ML 5.4 (PDG), 5.1 (ROM), 5.1 (THE). One person died from a heart attack, 17 injured and damage in the Valjevo-Belgrade area, Yugoslavia. Felt in much of central Yugoslavia and (IV) in the Vidin area, Bulgaria. Also felt in the Sarajevo area, Bosnia and Herzegovina as well as in parts of Croatia and in northern Greece.
SEP	30	23 42 54.3	41.936 N	20.418 E	10 G	4.8	5.1	1.0	137	ALBANIA. ML 5.0 (ROM), 4.6 (THE). At least 100 houses damaged in the Kukes area. Felt (V) in the Peshkopi area and (IV) in the Elbasan-Tirana area.
OCT	05	02 20 33.9	33.199 N	47.225 E	39 D	5.3	4.9	1.1	295	WESTERN IRAN. At least 100 houses damaged in the Darreh Shahr area and minor damage in the Pol-e-Dokhtar area.
OCT	18	14 20 19.1*	12.013 N	86.455 W	100 G	4.3		1.3	27	NICARAGUA. Three people injured, 2 houses destroyed and 45 others severely damaged in the Ticuantepe area. Largest of a swarm of over 200 quakes on October 18 and 19.

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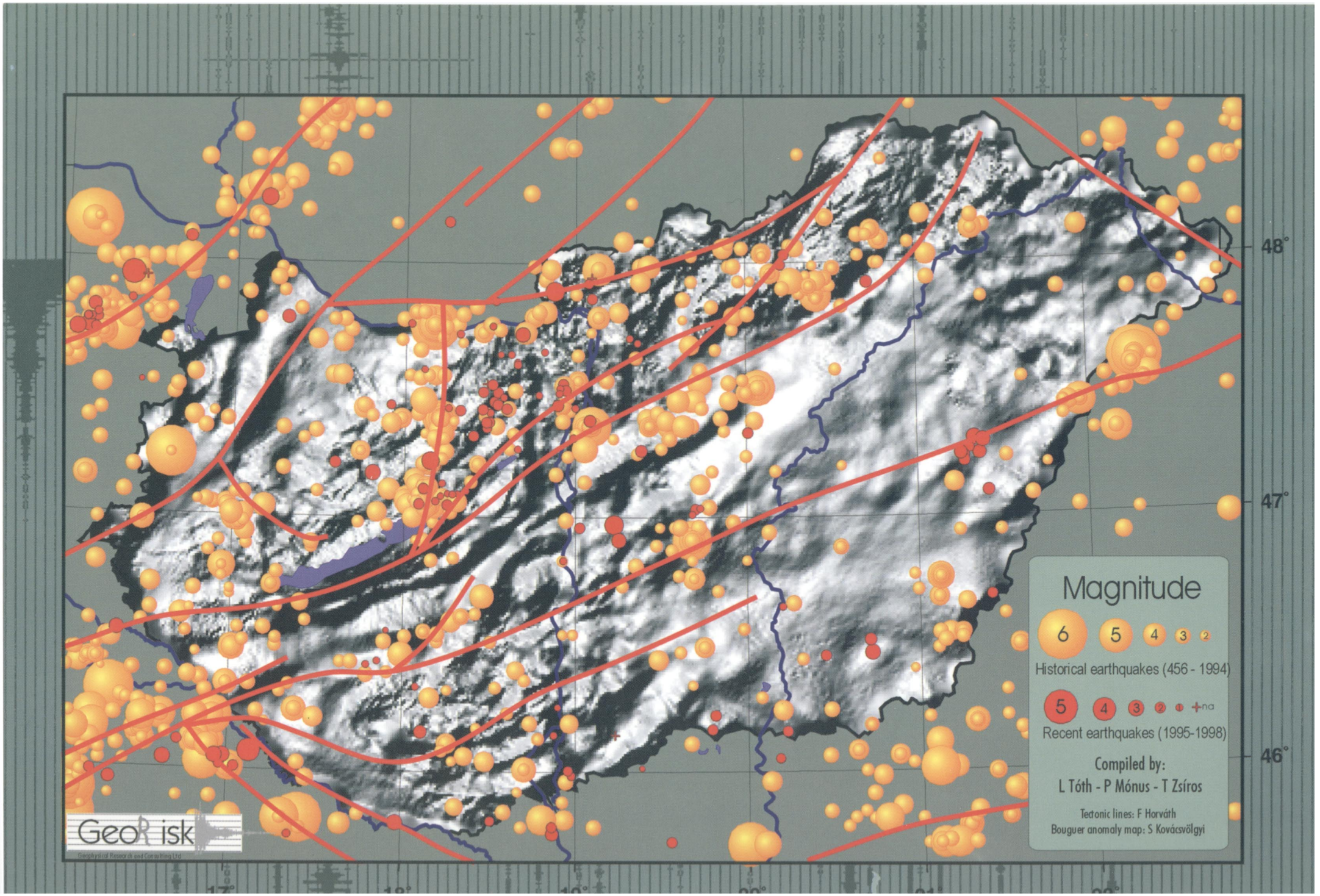
OCT 26	20 01 43.1?	27.25 N	100.89 E	33 N	4.7		1.3	17	YUNNAN, CHINA. Twenty-eight people injured and more than 700 buildings damaged in the Lijiang area.
OCT 28	16 25 03.8	0.839 N	125.966 E	33 N	6.2	6.2	1.1	326	NORTHERN MOLUCCA SEA. Mw 6.6 (GS), 6.6 (HRV). Mo=8.1*10**18 Nm (GS). Mo=7.8*10**18 Nm (HRV). Mo=1.3*10**19 Nm (PPT). Felt at Manado and Ternate, Indonesia.
NOV 09	05 30 14.4	6.954 S	129.022 E	33 N	6.1		1.0	277	BANDA SEA. Mw 6.6 (GS), 6.7 (HRV), Me 6.6 (GS). Es=1.9*10**14 Nm (GS). Mo=8.1*10**18 Nm (GS). Mo=1.3*10**19 Nm (HRV). Felt strongly at Ambon, Indonesia and Darwin, Australia.
NOV 09	05 38 44.2	6.920 S	128.946 E	33 N	6.4	7.0	1.1	241	BANDA SEA. Mw 7.0 (GS), 7.0 (HRV), Me 7.3 (GS). Es=1.8*10**15 Nm (GS). Mo=3.1*10**19 Nm (GS). Mo=3.8*10**19 Nm (HRV). Felt strongly at Ambon, Indonesia and Darwin, Australia.
NOV 13	13 01 10.5	27.791 N	53.608 E	33 N	5.3	5.1	1.0	278	SOUTHERN IRAN. Five people killed, 105 injured and at least 850 houses damaged by the earthquake and landslides in the Bigherd-Khonj area.
NOV 19	11 38 14.7	27.270 N	100.970 E	33 N	5.2	5.6	1.0	70	YUNNAN, CHINA. Three people killed, at least 1,543 people injured and extensive damage to houses and roads in Huaping, Ninglang and Yongsheng Counties. Landslides blocked a river in the epicentral area.
NOV 29	14 10 31.4	2.051 S	124.925 E	33 N	6.5	7.7	1.2	119	CERAM SEA. Mw 7.8 (GS), 7.7 (HRV), Me 8.1 (GS). Es=3.0*10**16 Nm (GS). Mo=4.8*10**20 Nm (GS). Mo=3.9*10**20 Nm (HRV). Mo=6.9*10**20 Nm (PPT). At least 34 people killed on Mangole and 153 people injured on Mangole and Taliabu. Seven people killed, 8 injured and several buildings damaged at Manado, Sulawesi. A timber factory sustained extensive damage and dozens of houses destroyed on Mangole. Landslides blocked a highway on Mangole. Felt (VI) at Luwuk and (I) at Palu, Sulawesi. Also felt (IV) on Ternate and (III) on Ambon.
DEC 01	07 37 56.6*	26.444 N	104.034 E	10 G	4.5		1.0	11	SOUTHEASTERN CHINA. At least 4 people injured and over 1,400 houses damaged at Xuanwei.
DEC 06	00 47 13.5	1.302 N	126.253 E	33 N	6.3	6.2	0.9	72	NORTHERN MOLUCCA SEA. Mw 6.4 (GS), 6.6 (HRV). Me 6.5 (GS). Es=1.3*10**14 Nm (GS). Mo=5.3*10**18 Nm (GS). Mo=8.7*10**18 Nm (HRV). Mo=1.2*10**19 Nm (PPT). Felt (V) at Bitung and Tonado and (IV) at Manado, Sulawesi. Also felt (III) at Galela, Halmahera and on Ternate.
DEC 11	20 16 24.0	36.520 N	71.015 E	222 D	5.1		1.0	97	AFGHANISTAN-TAJIKISTAN BORD REG. Mw 5.7 (GS), 5.6 (HRV). Mo=4.6*10**17 Nm (GS). Mo=3.3*10**17 Nm (HRV). Five people killed, seven injured and some damage at Kabul.
DEC 14	13 06 09.8	38.950 N	35.762 E	10 G	4.5	3.9	1.0	49	TURKEY. Two people injured, 20 houses collapsed and 118 houses damaged at Kayseri.
DEC 27	00 38 26.8	21.497 S	176.412 W	144 D	6.1		0.7	144	FIJI ISLANDS REGION. Mw 6.9 (GS), 6.8 (HRV), Me 6.6 (GS). Es=1.6*10**14 Nm (GS). Mo=2.2*10**19 Nm (GS). Mo=1.9*10**19 Nm (HRV).

Compiled by Waverly J. Person


48°
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Magnitude
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Historical earthquakes (456 - 1994)
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Recent earthquakes (1995-1998)
Compiled by:
L Tóth - P Mónus - T Zsíros
Tectonic lines: F Horváth
Bouguer anomaly map: S Kovácsvölgyi
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