Hungarian Earthquake Bulletin
1995

GeoRisk

Geophysical Research and Consulting Ltd.

HUNGARIAN EARTHQUAKE BULLETIN

1995

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CONTENTS

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Ministry of Environment
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MOL Rt.
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Data interchange with a number of seismic stations from the neighbouring countries contributed to the accuracy of locations of the events. Those are *Austria (KBA, KMR, SQTA, VKA, WATA, WTTA), Croatia (HVAR, PTJ, ZAG), Czech Republic (VRAC, OKC), Germany (GEC2, TNS), Romania (BMR, CEI, CMP, GZR, MLR), Slovakia (HRB, KHC, KOS, MOD, SPC, SRO, VYH, ZST), Slovenia (LJU, VBY, VOY).*

INTRODUCTION

The instrumentation for seismology has improved markedly over the last two-three decades. By now, the background noise from natural and man-made sources sets the minimum detection levels for seismic signals.

In Hungary, the first high quality digital seismograph station (Piszkés, PSZ) was installed in 1992. One isolated seismological station, however advanced its equipment may be, can do a little to solve the problem of adequately monitoring local seismicity and has also of limited value of most seismological research projects.

In 1995, there has been substantial progress with development of the Hungarian earthquake monitoring network. With considerable investment, the *Paks Nuclear Power Plant Ltd.* established a local microseismic monitoring network (MMN). The detection capability of this network of eleven modern high quality digital seismograph stations supplemented by the existing ones is less than 2.0 ML in most part of the country. This means, that for the first time in the history of Hungarian instrumental seismology, it is very unlikely that felt earthquakes go undetected.

Also for the first time it was possible to calculate the hypocentre parameters of local origins and produce our own 'local bulletin' what is believed to be superior to those calculated and distributed by international agencies.

This bulletin is based on all available earthquake related data provided by different organisations. The geographic region covered is bounded by latitudes 45.5-49.0N and longitudes 16.0-23.0E.

1.

SUMMARY OF 1995 SEISMICITY

1995 was an average year for Hungarian seismicity. There were 9 earthquakes ($1.6 \leq ML \leq 3.7$) located within Hungary. Five earthquakes were reported as felt, of those one in Croatia, some causing slight damage. The highest magnitude (ML) assigned to a shock was 3.7 for an earthquake at Szabadszállás and to another one in the Börzsöny mountain area.

The highest intensity reported during the year was 5-6 EMS. No more serious earthquake damage than smaller cracks in walls and fallen of parts of chimneys were reported.

Reviewing the more notable earthquakes of the year in chronological order, a shock of ML 2.2 on 23rd January produced reports of intensity 4 from Berhida vicinity. The area in which it was felt was about 250-300 km^2. In February 5th an earthquake of ML 3.7 was felt over an area of about 8000 km^2 with a maximum intensity of 5-6 at Szabadszállás. In August an earthquake (ML 4.8) in Croatia gave rise to reports of intensity 5 from southern parts of Hungary. September was quite a busy month, with two earthquakes of similar strength that not only had magnitudes of 3.5 and 3.7 ML but also produced reports of intensity 5-6. The first of these was a very shallow shock at Várpalota being felt at a restricted area. The second was felt from southern Slovakia to Budapest with highest intensity 5-6 in the Börzsöny mt. area.

2.

SEISMOGRAPH STATIONS IN HUNGARY

In 1995, there has been substantial progress with development of the Hungarian earthquake monitoring network. With considerable investment, the *Paks Nuclear Power Plant Ltd.* established a local network of modern, high quality digital seismographs with a primary goal of monitoring the NPP site vicinity in accordance with the *International Atomic Energy Agency (IAEA)* guides and recommendations.

The Microseismic Monitoring Network (MMN) has been designed and constructed through a contract between *Paks Nuclear Power Plant Ltd.* and *GeoRisk Geophysical Research and Consulting Ltd.* Complete seismic instrumentation has been purchased from *Lennartz Electronic, Germany*. The siting of the seismograph stations were preceded by an extensive field survey and careful investigation of noise background. The installation of the network has been completed.

There is now considerable improvement both with number of stations and their geographical coverage.

In addition to the information from the eleven station PAKS MMN, data is contributed by three stations operated by the *Seismological Observatory, Institute of Geodesy and Geophysics (GGKI)*. Of those, one belongs to the *Ministry of Foreign Affairs* and is operated in global cooperation for nuclear test ban monitoring purposes. Another station was partially available on adhoc basis for origin determination belonging to *Mecseki Ércbányászati Vállalat (MÉV)* and operated by *GEOS BT.*

Data interchange with stations from the neighbouring countries and international data centres were utmost important.

The detection capabilities of the present network depend upon station distribution and background noise levels. With average noise conditions the typical detection threshold is around 1.5-2.0 ML, somewhat lower in the middle of the country and a little higher towards the border regions. (See Fig. 2.3) This means that in most part of the country it is very unlikely that felt events go undetected.

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

Seismograph Stations

Table 2.1. *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	47.5580	21.1958	92	sand	3C SP	SS-1	D - E	GGKI
MEV	46.1128	18.1123	400	limestone	3C SP	SS-1	D - E	GEOS
PKS0	46.5743	18.8449	100	sand	3C SP	LE-3D	D - E	GR
PKS1	46.5940	18.5786	200	loess	3C SP	LE-3D	D - E	GR
PKS2	46.4920	19.2131	106	sand	3C SP	LE-3D	D - E	GR
PKS3	46.7869	19.0663	105	loess	3C SP	LE-3D	D - E	GR
PKS4	46.2340	18.4635	220	limestone	3C SP	LE-3D	D - E	GR
PKS5	46.8092	19.5547	110	sand	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
PSZ	47.91843	19.89448	940	andesite	3C BB	STS-2	D - C	GGKI
SOP	47.6833	16.5583	260	gneiss	3C SP	SS-1	D - E	GGKI
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) 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) GEOS - GEOS BT., GGKI - Institute of Geodesy and Geophysics, GR - GeoRisk Ltd., PART - Paks Nuclear Power Plant Ltd.

Seismograph Stations

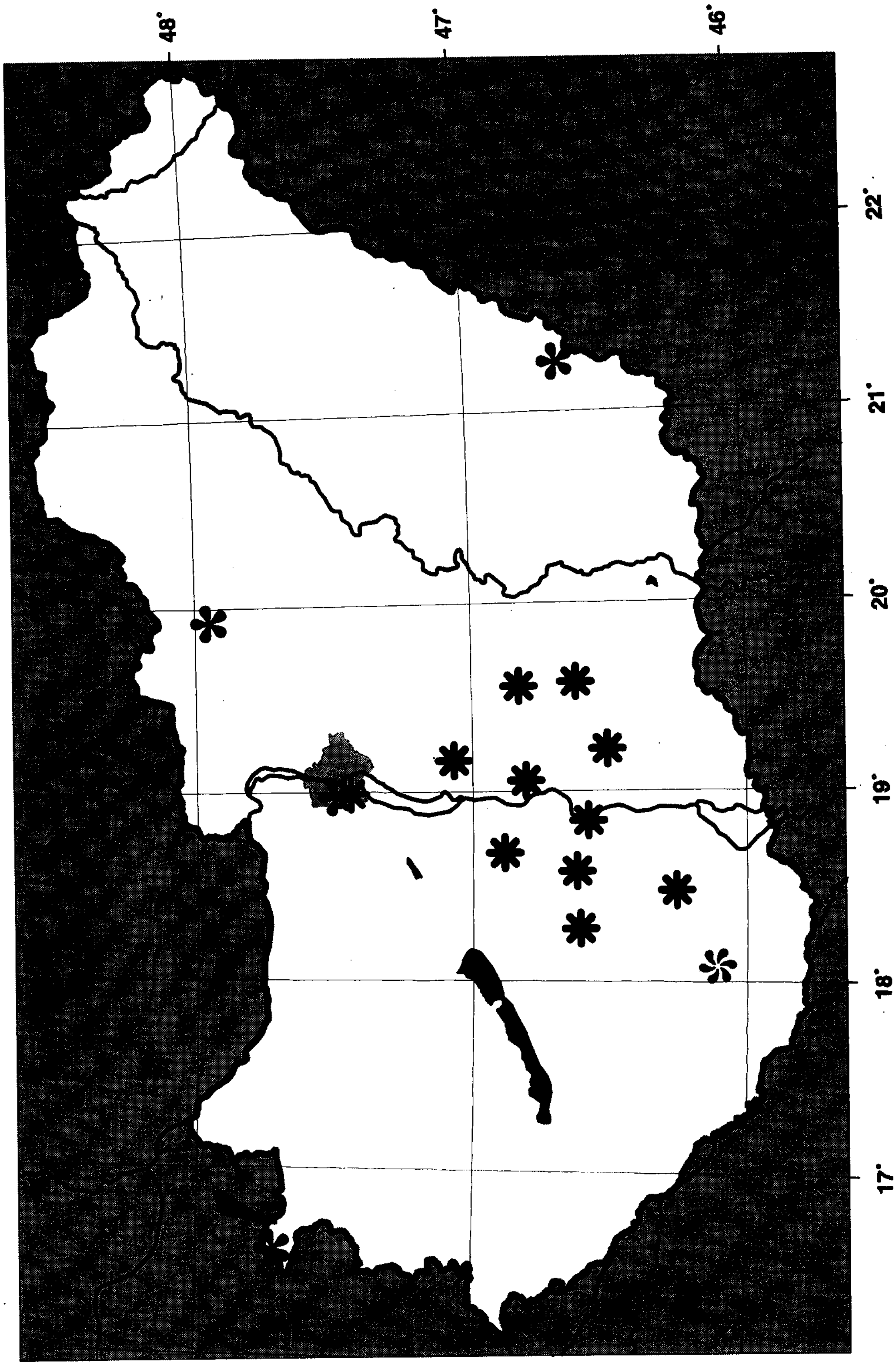


Figure 2.1. *Seismograph stations in Hungary*
(See Table 2.1. for details)

Seismograph Stations

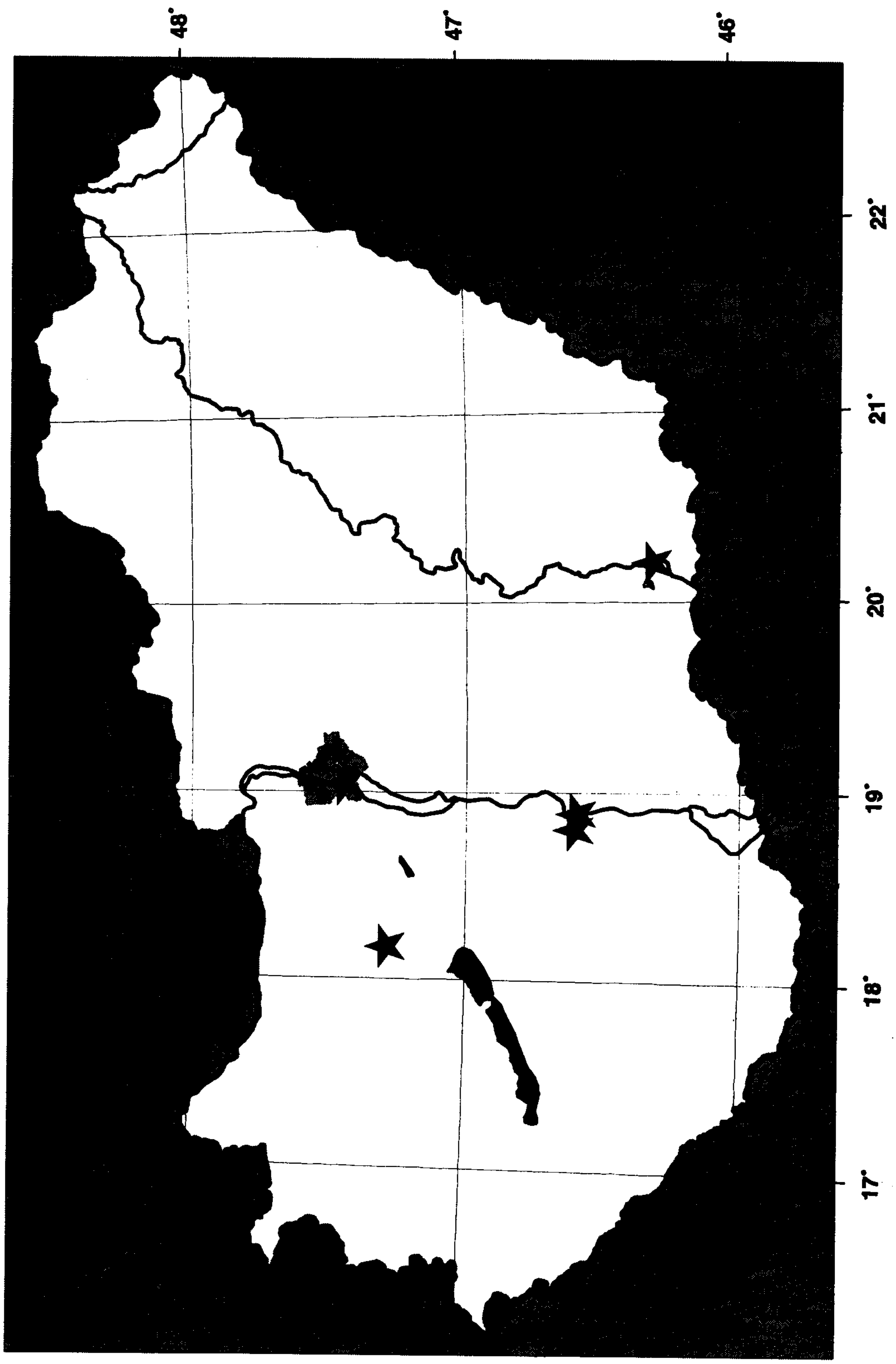


Figure 2.2. *Strong motion accelerograph stations in Hungary*

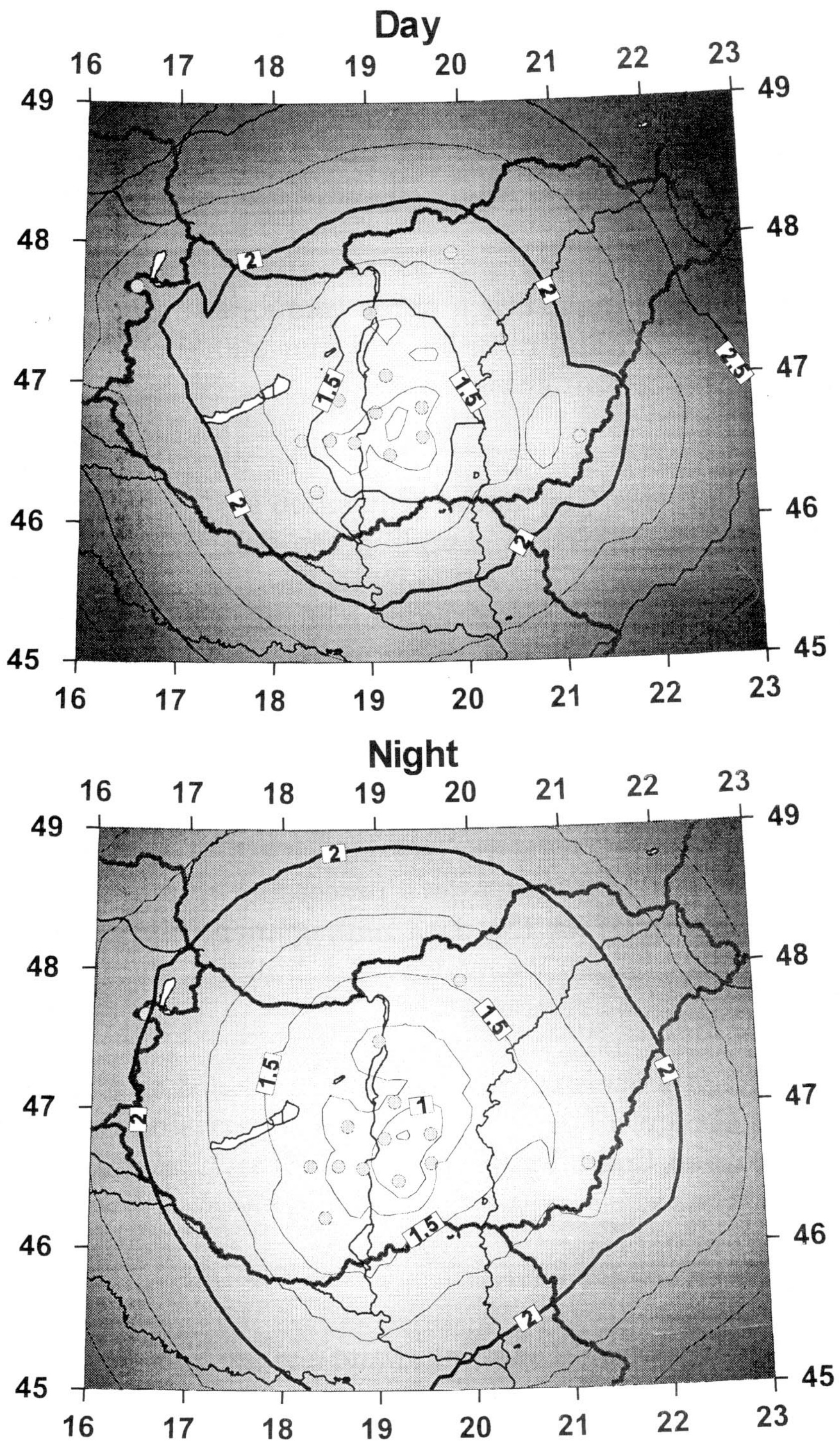


Figure 2.3. *Detection capability with average noise conditions. Contour values are Richter local magnitude (ML).*

Seismograph Stations

PAKS MICROSEISMIC MONITORING NETWORK (MMN)

The system comprises of a network of ten seismometer stations located within a radius of about 50 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 being analysed.

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 1Hz 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 3GB 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. Both waveform and bulletin data are available over INTERNET for authorised remote users.

The MMN is currently operated and its data processed and analysed by *GeoRisk Ltd.* The *British Geological Survey* have been supervising the network operation through the European Community's PHARE research programme.

STATIONS OPERATED BY GGKI

During 1995 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 triaxial Streckeisen STS-2 broad-band seismometer and Quanterra's data acquisition system with 24 bit, 80 Hz high resolution digitizer. Three component continuous data streams are recorded in circular buffers on magnetic disks and archived on EXABYTE 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 via INTERNET or PSDN (X.25) communications channels. A menu driven software (DRM) serves a powerful and easy tool for data access, extraction of data segments at different sampling rates, filtering, communication, system control and station operation. In 1995, PSZ participated in GSETT-3 as a Beta station and 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.

MÉV STATION

Six vertical short period seismometers are installed on different levels in a uranium ore mine near to Pécs (south of Hungary). Event data are recorded by Teledyne PDAS-100 recorder. There is no formal arrangement to access this station, we received data only on adhoc informal basis.

STRONG MOTION STATIONS

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

During 1995 we had access to all of these stations.

Seismograph Stations

3.

LIST OF ORIGINS / HYPOCENTRE PARAMETERS

Hypocentre Parameters

METHOD FOR HYPOCENTRE PARAMETER DETERMINATION

HYPO71PC (Lee and Lahr, 1975) was used for the calculation of hypocentre parameters. The program was slightly modified in order to implement a routine for Richter local magnitude calculation for the instruments used. For the magnitude calculations the method of 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 during the calculations: data from stations with an epicentral distance greater than 450 km have got a weight of 0. In some cases, when enough P readings were available, S phase readings were not used in the calculations.

CRUSTAL VELOCITY MODEL

The 3 layer crustal velocity model used in the hypocenter calculations has been derived from crustal phase travel times of several hundreds of local earthquakes (Mónus, 1995).

The velocity model was the following:

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	∞	

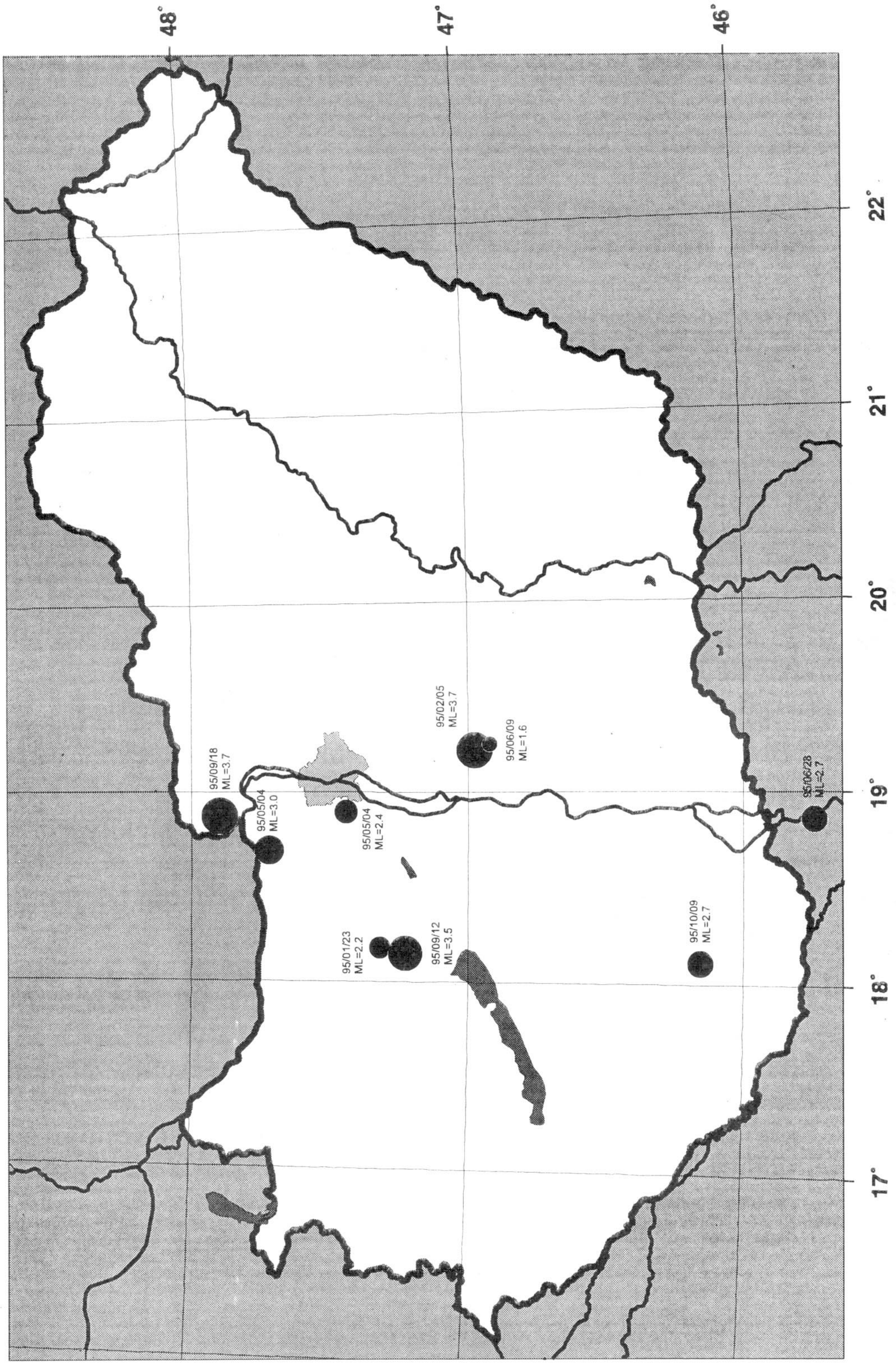


Figure 3.1. *Epicentres of Hungarian earthquakes located in 1995.*

Hypocentre Parameters

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 town.
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.

1995-01-23 time: 19:43:07.72 UTC ML= 2.2

lat: 47.316N lon: 18.173E h= 14.6 km
erh= 4.8km erz= 3.5km
nr= 10 gap=165 rms= .65
Locality: Berhida
Comments: Felt 4

sta	dist	azm	phase	hr mn sec	res
SRO	56.3	11	ePg	19:43:18.90	.79
ZST	126.6	321	iPn	19:43:28.10	-.57
			eSn	43:44.80	-.20
SOP	128.3	289	ePn	19:43:28.30	-.58
			eSn	43:46.00	.61
PSZ	145.8	63	iPnD	19:43:30.40	-.66
			iSn	43:49.90	.63
PTJ	229.9	227	ePn	19:43:42.70	1.15
VRAC	250.6	332	ePn	19:43:44.90	.76
			eSn	44:13.00	.46
VBY	301.4	228	ePn	19:43:44.90	.76
GEC2	374.1	297	ePn	19:43:44.90	.76
KHC	396.6	301	ePn	19:43:44.90	.76

1995-02-05 time: 13:45:36.21 UTC ML= 3.7

lat: 46.974N lon: 19.230E h= 15.0 km
erh= 3.1km erz= 2.2km
nr= 10 gap=169 rms= .26
Locality: Szabadszállás
Comments: Felt 5-6

sta	dist	azm	phase	hr mn sec	res
BUD	58.8	345	iPg	13:45:47.09	.05
			iSg	45:57.00	1.51
SRO	116.2	323	iPn	13:45:56.20	.38
PSZ	116.5	26	iPnC	13:45:55.39	-.47
			iSn	46:10.60	-.58
GYL	156.2	106	iPnC	13:46:00.92	.12
			iSn	46:21.60	1.61
ZST	209.9	310	iPnC	13:46:07.30	-.21
			iSn	46:11.80	-20.12
SOP	216.8	291	iPnC	13:46:08.24	-.12
			iSn	46:38.50	5.06

CEI	256.6	72	iPnC	13:46:08.24	-.12
VKA	261.7	303	iPnC	13:46:13.90	-.07
			iSn	46:55.50	12.08
PTJ	276.8	245	iSn	13:46:55.40	8.63
ZAG	279.5	243	iSn	13:46:57.30	9.94
VRAC	325.4	323	iPnC	13:46:21.90	.00
			iSn	46:55.90	-1.64
GZR	325.4	123	iPnC	13:46:20.50	-1.40
OKC	328.2	346	PnC	13:46:22.80	.54
BMR	331.8	76	PnC	13:46:22.80	.54
VBY	347.3	242	ePn	13:46:22.40	-2.23
			iSn	47:05.80	3.40
KMR	402.4	287	ePn	13:46:22.40	-2.23
KBA	447.5	271	iPnC	13:46:37.00	-.13
CMP	487.4	113	iPnC	13:46:37.00	-.13
MLR	543.5	108	iPnC	13:46:37.00	-.13
WTTA	577.2	273	iPnC	13:46:54.80	1.50
WATA	581.8	274	iPnC	13:46:54.70	.82
SQTA	609.6	273	iPnC	13:46:58.10	.76
TNS	873.5	294	ePnD	13:47:29.80	-.44

1995-04-22 time: 10:26:17.97 UTC ML= 3.3

lat: 45.004N lon: 19.909E h= 10.0 km

erh=21.8km erz=****km

nr= 5 gap=286 rms= .20

Locality: Serbia

sta	dist	azm	phase	hr mn sec	res
PKS4	177.2	320	ePnN	10:26:45.97	.15
PKS6	179.4	351	ePnU	10:26:46.27	.17
			iSn	27:31.82	23.79
PKS5	202.5	352	iPnU	10:26:48.80	-.18
			eSn	27:37.14	23.97
SRO	335.5	339	ePn	10:27:05.20	-.36
VBY	369.4	279	ePn	10:27:09.50	-.29
ZST	415.0	329	ePn	10:27:18.80	3.33
LJU	436.1	285	ePn	10:27:27.00	8.90
			eSn	28:38.00	33.00
VOY	483.7	284	ePn	10:27:22.00	-2.04
			eSn	28:17.60	2.02

1995-05-04 time: 5:54:31.84 UTC ML= 2.4
lat: 47.437N lon: 18.903E h= 12.5 km
erh= 2.2km erz= 1.2km
nr= 11 gap=214 rms= .32
Locality: Budaörs

sta	dist	azm	phase	hr mn sec	res
BUD	10.5	60	iPg	5:54:34.50	-.26
PKS7	47.5	156	iPgD	5:54:40.66	.04
			iSg	54:47.74	.28
PKS8	64.4	195	iSg	5:54:52.36	-.33
PKS3	73.3	170	iSg	5:54:56.03	.54
PKS5	85.5	145	iPg	5:54:47.04	-.24
			iSg	54:59.16	-.16
PKS9	105.7	207	iPn	5:54:50.71	.25
			iSn	55:04.70	-.28
PKS6	105.8	152	eSn	5:55:04.81	-.18
PKS4	137.9	194	Pn	5:54:55.87	1.40
			iSn	55:14.56	2.45

1995-05-04 time: 6:55:56.71 UTC ML= 3.0
lat: 47.716N lon: 18.692E h= 19.1 km
erh= 5.8km erz= 3.6km
nr= 8 gap=213 rms= .55
Locality: Esztergom

sta	dist	azm	phase	hr mn sec	res
SRO	30.4	291	ePg	6:56:03.40	.28
PKS8	93.1	181	iS*	6:56:25.67	.26
PKS3	107.1	165	iSn	6:56:28.15	-.51
PKS5	120.1	147	iPnU	6:56:16.22	-.06
			iSn	56:31.19	-.35
ZST	130.2	294	ePn	6:56:16.00	-1.54
			eSn	56:33.80	.02
PKS6	140.6	152	eSn	6:56:37.20	1.11

1995-06-01 time: 0:19:13.37 UTC ML= 3.8
lat: 44.371N lon: 19.230E h= 10.0 km
erh=41.4km erz=34.7km
nr= 6 gap=297 rms= .39
Locality: Bosnia

Hypocentre Parameters

sta	dist	azm	phase	hr mn sec	res
PKS2	235.7	360	Pn-	0:19:48.84	.32
			Sn	20:16.31	.38
PKS3	268.8	357	PnD	0:19:52.27	-.37
			Sn	20:22.90	-.37
SRO	389.1	350	iPnD	0:20:06.70	-.95
LJU	413.6	297	ePn	0:20:16.00	5.30
			Sn	20:56.00	.59
ZST	455.7	339	ePn	0:20:12.10	-3.85
VOY	458.1	294	ePn	0:20:15.70	-.55
SPC	541.1	8	ePn	0:20:28.60	2.00

1995-06-09 time: 15:57:01.82 UTC ML= 1.6

lat: 46.923N lon: 19.264E h= 12.3 km
erh= .5km erz= 1.1km
nr= 12 gap=149 rms= .12
Locality: Szabadszállás

sta	dist	azm	phase	hr mn sec	res
PKS7	15.9	330	iPgU	15:57:05.48	.08
			iSg	57:08.24	.05
PKS3	21.4	225	iPgU	15:57:06.17	-.05
			iSg	57:09.59	-.06
PKS5	25.6	120	ePgU	15:57:06.82	-.07
			eSg	57:10.70	-.14
PKS6	42.7	147	ePgU	15:57:09.84	.09
PKS8	45.0	264	ePg	15:57:09.97	-.18
PKS2	48.1	185	Pg	15:57:11.07	.38
			iSg	57:17.84	.24
PKS9	84.0	244	ePg	15:57:16.84	-.14
			iSg	57:28.98	.17

1995-06-28 time: 16:32:22.58 UTC ML= 2.7

lat: 45.748N lon: 18.867E h= 12.2 km
erh= 3.4km erz= 1.7km
nr= 10 gap=300 rms= .40
Locality: Croatia

sta	dist	azm	phase	hr mn sec	res
PKS4	62.4	330	PgU	16:32:34.17	.24
			Sg	32:42.79	.00

PKS2	86.9	18	Pg	16:32:37.68	-.57
			Sg	32:50.67	.19
PKS6	108.9	30	Pn+	16:32:41.58	-.05
			Sn	32:56.39	-.10
PKS8	126.5	353	PnD	16:32:43.33	-.49
			Sn	33:00.40	.00
PKS5	129.3	24	Pn+	16:32:45.08	.91
VBY	282.8	265	Pn	16:33:14.90	11.59
ZST	303.5	334	Pn	16:33:05.40	-.49

1995-06-28 time: 22:21:29.80 UTC ML=--
lat: 44.603N lon: 19.331E h= 22.5 km
erh=****km erz=****km
nr= 5 gap=299 rms= .53
Locality: Serbia

sta	dist	azm	phase	hr mn sec	res
PKS4	193.6	339	Pn	22:21:59.45	1.25
PKS9	235.3	340	Pn+	22:22:03.01	-.39
			Sn	22:29.18	-.42
PKS8	258.0	349	Pn	22:22:06.36	.13
VBY	336.2	287	ePn	22:22:15.80	-.18
			Sn	22:46.80	-5.21
SRO	365.4	348	ePn	22:22:15.80	-.18
ZST	434.6	337	ePn	22:22:15.80	-.18

1995-08-25 time: 9:27:22.12 UTC ML= 5.0
lat: 45.418N lon: 17.750E h= 10.0 km
erh=16.2km erz= 9.7km
nr= 12 gap=276 rms=1.27
Locality: Croatia
Comments: Felt 5 (SW Hungary)

sta	dist	azm	phase	hr mn sec	res
MEV	82.2	20	iPg	9:27:37.00	.09
PKS4	106.3	31	iP*U	9:27:41.45	.35
PKS9	136.2	18	ePnD	9:27:44.74	-.12
PKS2	164.7	44	ePnU	9:27:48.34	-.07
PKS8	177.4	24	ePnD	9:27:49.37	-.63
			iSn	28:15.48	3.74
PKS5	208.3	42	iPnD	9:27:53.52	-.32

Hypocentre Parameters

BUD	249.6	23	iPn	9:27:58.45	-.55
			eSn	28:24.20	-3.56
SOP	267.9	340	iPn	9:28:01.72	.44
			eSn	28:30.52	-1.30
GYL	296.9	64	iPn	9:28:05.29	.39
			eSn	28:29.62	-8.65

1995-09-12 time: 22:14:05.30 UTC ML= 3.5
lat: 47.224N lon: 18.146E h= 7.5 km
erh= 1.6km erz= 1.5km
nr= 16 gap= 72 rms= .32
Locality: Várpalota
Comments: Felt 5-6

sta	dist	azm	phase	hr mn sec	res
PKS8	55.7	134	iPgU	22:14:15.33	.00
			iSg	14:22.46	-.69
SRO	66.8	11	ePg	22:14:16.90	-.40
			iSg	14:27.70	1.05
BUD	72.4	66	iPg	22:14:18.11	-.18
			eSg	14:27.95	-.48
PKS1	77.4	155	iPg	22:14:19.34	.16
			eSg	14:30.74	.73
PKS7	79.5	104	iPgU	22:14:19.74	.19
			eSg	14:32.42	1.75
PKS2	115.1	135	ePnU	22:14:25.62	-.10
			iSn	14:40.61	-1.04
PKS5	116.6	113	iPnU	22:14:25.65	-.27
			iSn	14:41.90	-.10
MEV	123.5	181	iPn	22:14:24.00	-2.78
PKS6	128.4	123	ePnU	22:14:27.22	-.17
			eSn	14:45.91	1.29
SOP	130.2	293	iPn	22:14:27.00	-.60
			eSn	14:44.00	-1.00
ZST	133.5	324	iPn	22:14:27.90	-.12
			iSn	14:44.30	-1.44
PSZ	152.6	60	iPn	22:14:31.00	.59
			eSn	14:50.57	.58
VKA	179.4	310	iPnD	22:14:34.40	.66
			iSn	15:05.00	9.07
PTJ	221.6	229	iPnD	22:14:39.00	-.01
			iSn	15:20.90	15.60

ZAG	226.5	227	ePnD	22:14:39.50	-.11
SPC	268.5	36	ePn	22:14:45.40	.55
KBA	364.5	267	iPnD	22:14:57.50	.68
			iSn	15:59.30	22.29
HVAR	469.0	197	iPnC	22:15:11.20	1.35
WTTA	492.9	271	iPnC	22:15:14.70	1.87
			iSn	16:08.00	2.50
WATA	497.2	271	iPnC	22:15:15.80	2.43
			iSn	16:05.70	-.77
SQTA	525.4	270	iPnC	22:15:18.40	1.51
			iSn	16:06.20	-6.53

1995-09-18 time: 8:26:10.81 UTC ML= 3.7
lat: 47.894N lon: 18.879E h= 11.8 km
erh= 1.1km erz= 1.0km
nr= 17 gap= 69 rms= .26
Locality: Börzsöny mt.
Comments: Felt 5-6

sta	dist	azm	phase	hr mn sec	res
SRO	43.3	258	iPg	8:26:19.00	.18
BUD	46.9	167	ePgU	8:26:19.28	-.17
			iSg	26:24.42	-1.76
HRB	51.4	267	ePgU	8:26:19.28	-.17
VYH	66.8	357	ePg	8:26:23.34	.42
			iSg	26:31.22	-1.15
PSZ	76.0	88	iPgU	8:26:24.32	-.22
			iSg	26:35.12	-.13
PKS7	96.5	167	iP*U	8:26:28.23	.10
			iS*	26:39.88	-1.76
PKS8	113.9	188	ePnU	8:26:30.44	-.10
			iSn	26:43.34	-2.58
MOD	130.6	294	ePn	8:26:32.42	-.20
			eSn	26:48.26	-1.37
PKS5	131.0	157	ePn	8:26:33.08	.42
			iSn	26:47.63	-2.08
ZST	136.6	284	iPnD	8:26:33.26	-.11
			iSn	26:48.71	-2.26
PKS1	146.3	189	ePnU	8:26:35.37	.79
PKS0	146.7	181	eSn	8:26:53.64	.43
PKS6	153.0	160	eSn	8:26:56.13	1.54
PKS2	157.9	171	iPn	8:26:36.14	.12

			iSn	26:57.07	1.38
SOP	175.5	262	iPn	8:26:38.03	-.18
			iSn	27:02.27	2.69
SPC	175.8	35	ePn	8:26:37.40	-.85
			iSn	26:57.50	-2.16
VKA	195.2	282	iPnC	8:26:40.50	-.17
			iSn	27:04.30	.33
KOS	200.4	61	ePn	8:26:41.49	.17
			eSn	27:07.78	2.67
PTJ	312.6	225	iPn	8:26:55.00	-.31
			iSn	27:41.40	11.38
KBA	426.8	258	iPnC	8:27:10.00	.45
			iSn	27:56.20	.82
HVAR	557.5	200	iPnC	8:27:27.20	1.36
			iSn	28:23.70	-.67

1995-10-09 time: 11:59:01.20 UTC ML= 2.7

```
  lat: 46.160N  lon: 18.104E  h=  1.0 km
                erh= ---km    erz= ---km
  nr=  3        gap=353       rms= .25
  Locality: Mecsek mt.
```

sta	dist	azm	phase	hr mn sec	res
PKS4	29.0	74	ePgD	11:59:06.39	.02
			eSg	59:10.08	-.33
PKS2	93.1	67	iSg	11:59:31.12	.34

4.

SIGNIFICANT EARTHQUAKES IN 1995

23 January 1995	- Berhida
5 February 1995	- Szabadszállás
25 August 1995	- Požega area (Croatia)
12 September 1995	- Várpalota
18 September 1995	- Börzsöny mt.

METHOD USED FOR ESTIMATION OF INTENSITY

The earthquake effects (macroseismic observations) are usually gathered on questionaires. Based on these reports the intensity values are 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).

23 January 1995 - Berhida

HYPOCENTRE PARAMETERS

Date:	1995/01/23
Origin Time:	19:43:07.7 UTC
Latitude and Longitude:	47.316N 18.173E (S.D. 4.8km)
Depth:	14.6 km (S.D. 3.5km)
Magnitude:	2.2 ML
Maximum Intensity:	4

DISCUSSION

The Berhida earthquake of 23 January with a magnitude of 2.2 ML was felt over a relatively small area of 250-300 km^2. The macroseismic survey carried out at the time of the event resulted a maximum intensity of 4 at two localities and intensity of 3-4 at four additional localities. The intensity distribution is shown in Table 4.1. and Figure 4.2.

The most significant event at the same site, just ten years ago, was the 15th August 1985 earthquake with a magnitude of 4.7 mb (with epicentral intensity 7) preceded by three foreshocks and followed by more than 20 major aftershocks within a year.

23 January 1995 - Berhida

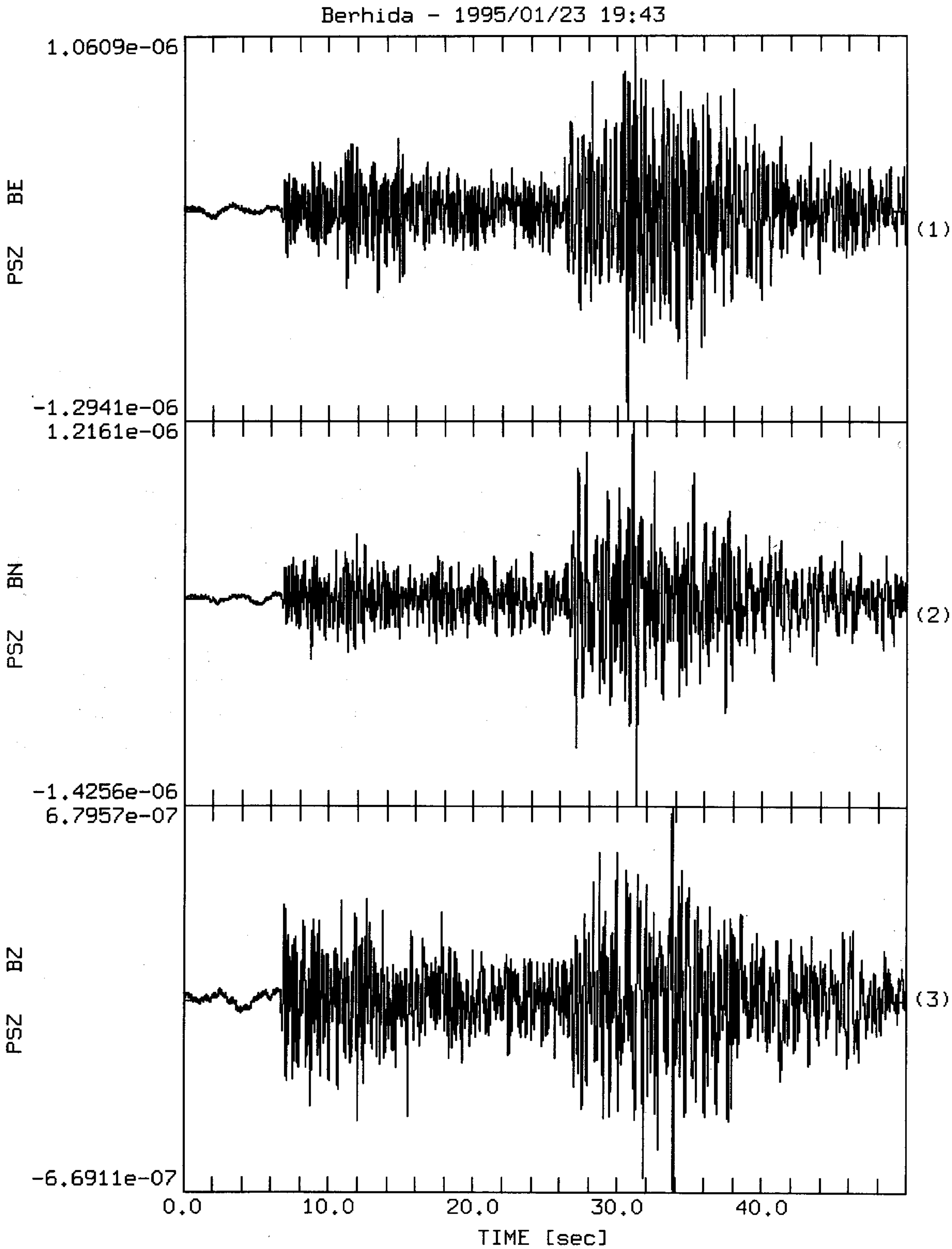


Figure 4.1. Seismogram of the Berhida Earthquake 23rd January 1995, 19:43:07 UTC (three components)

23 January 1995 - Berhida

Table 4.1. *Intensity distribution of the Berhida Earthquake 23rd January 1995, 19:43:07 UTC*

	Location	Coordinates	I	R	N
1	Balatonfüzfő	47.066 N 18.045 E	3.5	32.%	1
2	Balatonkenese	47.036 N 18.109 E	3.5	38.%	2
3	Berhida	47.113 N 18.134 E	3.5	34.%	4
4	Csajág	47.044 N 18.188 E	3.0	29.%	1
5	Csór	47.203 N 18.262 E	.0	0.%	1
6	Hajmáskér	47.146 N 18.023 E	.0	0.%	1
7	Jenő	47.105 N 18.254 E	.0	0.%	1
8	Királyszentistván	47.109 N 18.044 E	.0	0.%	1
9	Küngös	47.066 N 18.177 E	3.0	32.%	2
10	Litér	47.100 N 18.013 E	.0	0.%	1
11	Ősi	47.141 N 18.188 E	.0	0.%	2
12	Öskü	47.162 N 18.072 E	.0	0.%	2
13	Papkeszi	47.084 N 18.083 E	4.0	35.%	2
14	Sárszentmihály	47.155 N 18.339 E	4.0	21.%	1
15	Sóly	47.130 N 18.034 E	.0	0.%	1
16	Várpalota	47.199 N 18.145 E	2.5	50.%	1
17	Veszprém	47.094 N 17.913 E	.0	0.%	2
18	Vilonya	47.112 N 18.067 E	3.5	35.%	2

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

23 January 1995 - Berhida

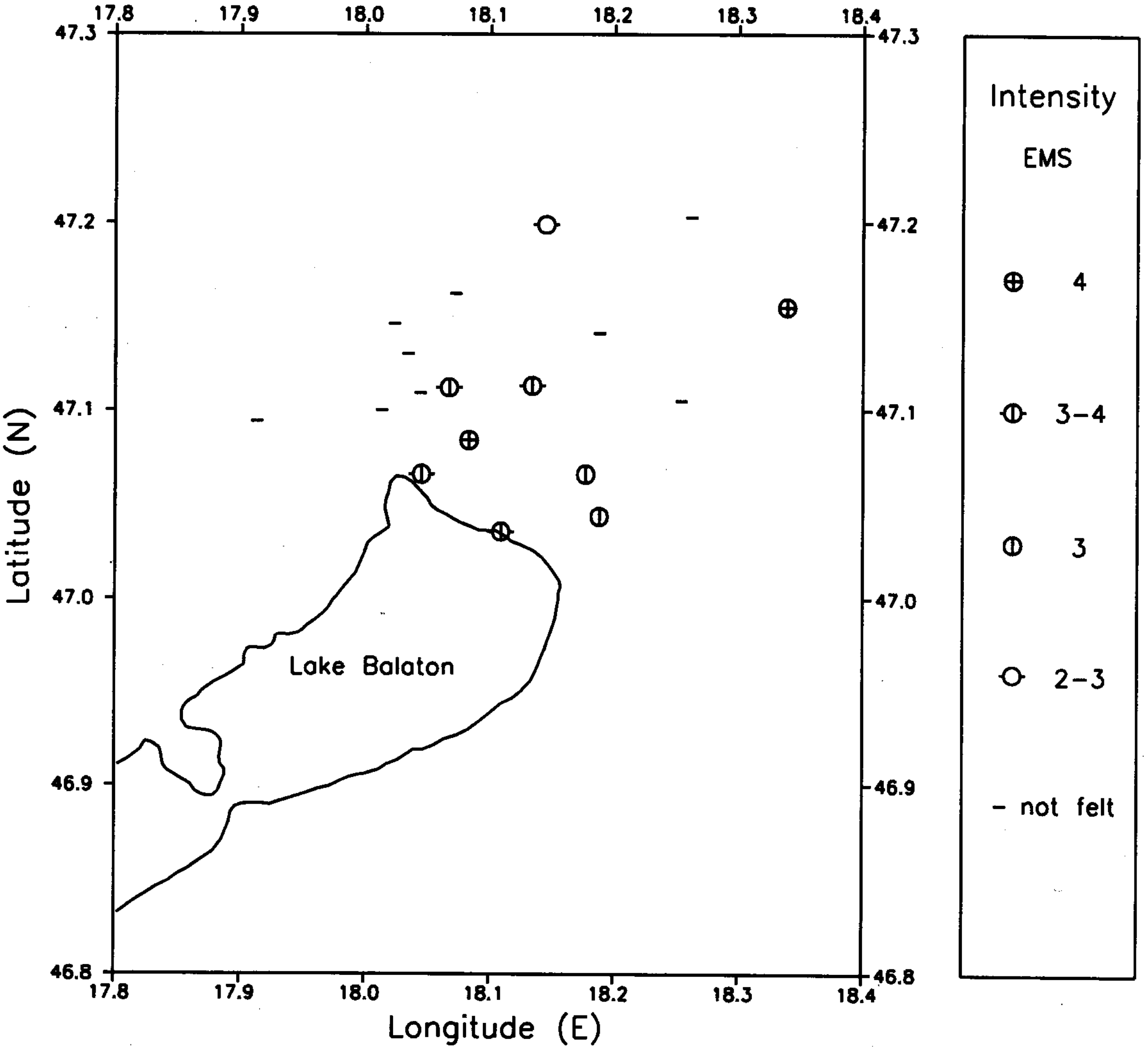


Figure 4.2. Intensity distribution of the Berhida Earthquake 23rd January 1995, 19:43:07 UTC

5 February 1995 - Szabadszállás

HYPOCENTRE PARAMETERS

Date:	1995/02/05
Origin Time:	13:45:36.2 UTC
Latitude and Longitude:	46.974N 19.230E (S.D. 3.1km)
Depth:	15.0 km (S.D. 2.2km)
Magnitude:	3.7 ML
Maximum Intensity:	5-6

DISCUSSION

The Szabadszállás earthquake of 5 February with a magnitude of 3.7 ML was felt over an area of about 7500-8000 km^2 locating from SE of Budapest down to Kecskemét. Some slight damage (plaster cracks in walls, fallen parts of chimneys) were reported from the epicentral area. The macroseismic survey carried out at the time of the event resulted a maximum intensity of 5-6 at few localities near to the epicentre. The area of intensity 4 is about 500-600 km^2. The intensity distribution is shown in Table 4.2. and Figure 4.5.

The earthquake was followed by an aftershock at the following day.

A fault plane solution was attempted but due to the incomplete station coverage at the time no reliable solution could be obtained.

5 February 1995 - Szabadszállás

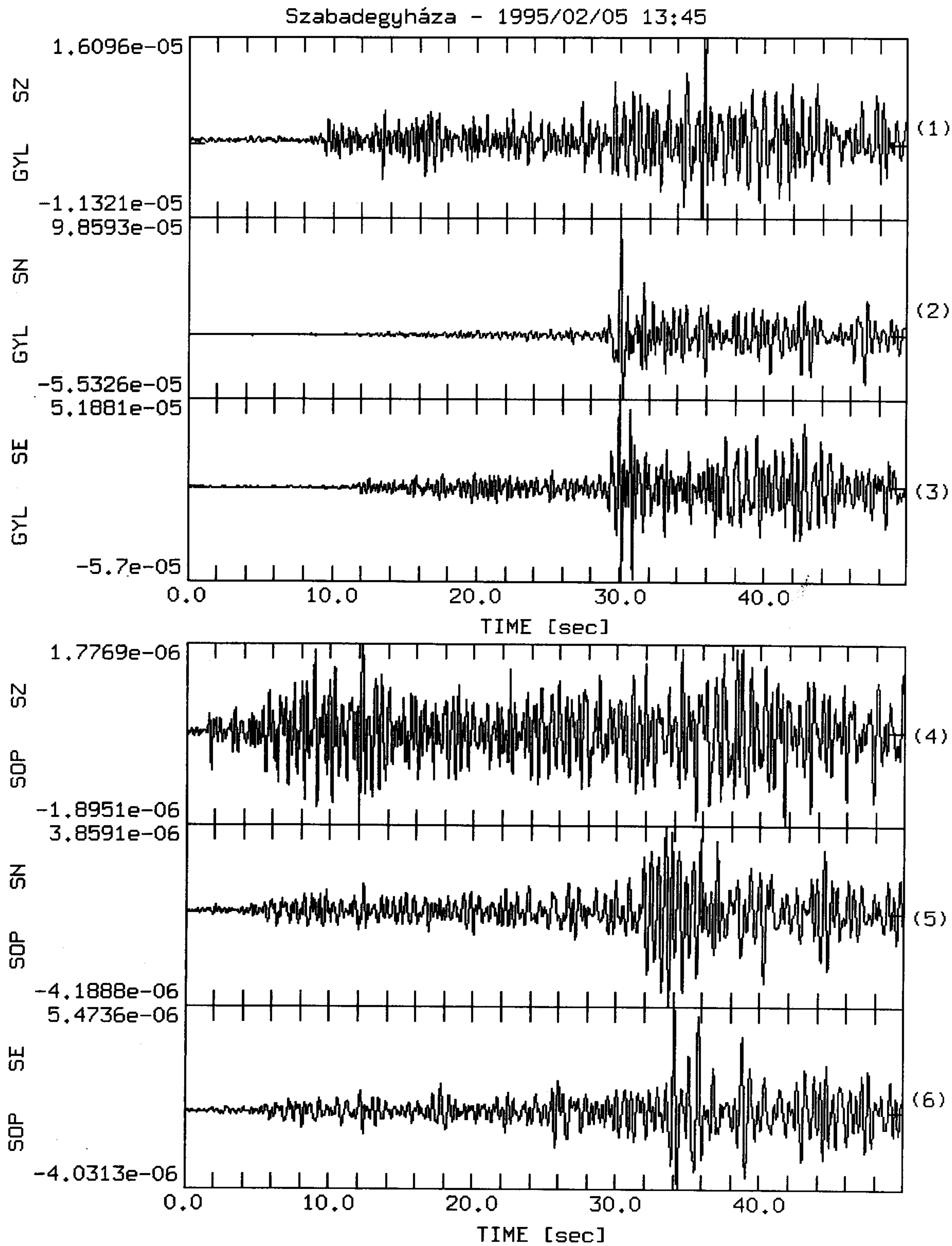


Figure 4.3. Seismograms of the Szabadszállás Earthquake 5th February 1995, 13:45:36 UTC (three components)

5 February 1995 - Szabadszállás

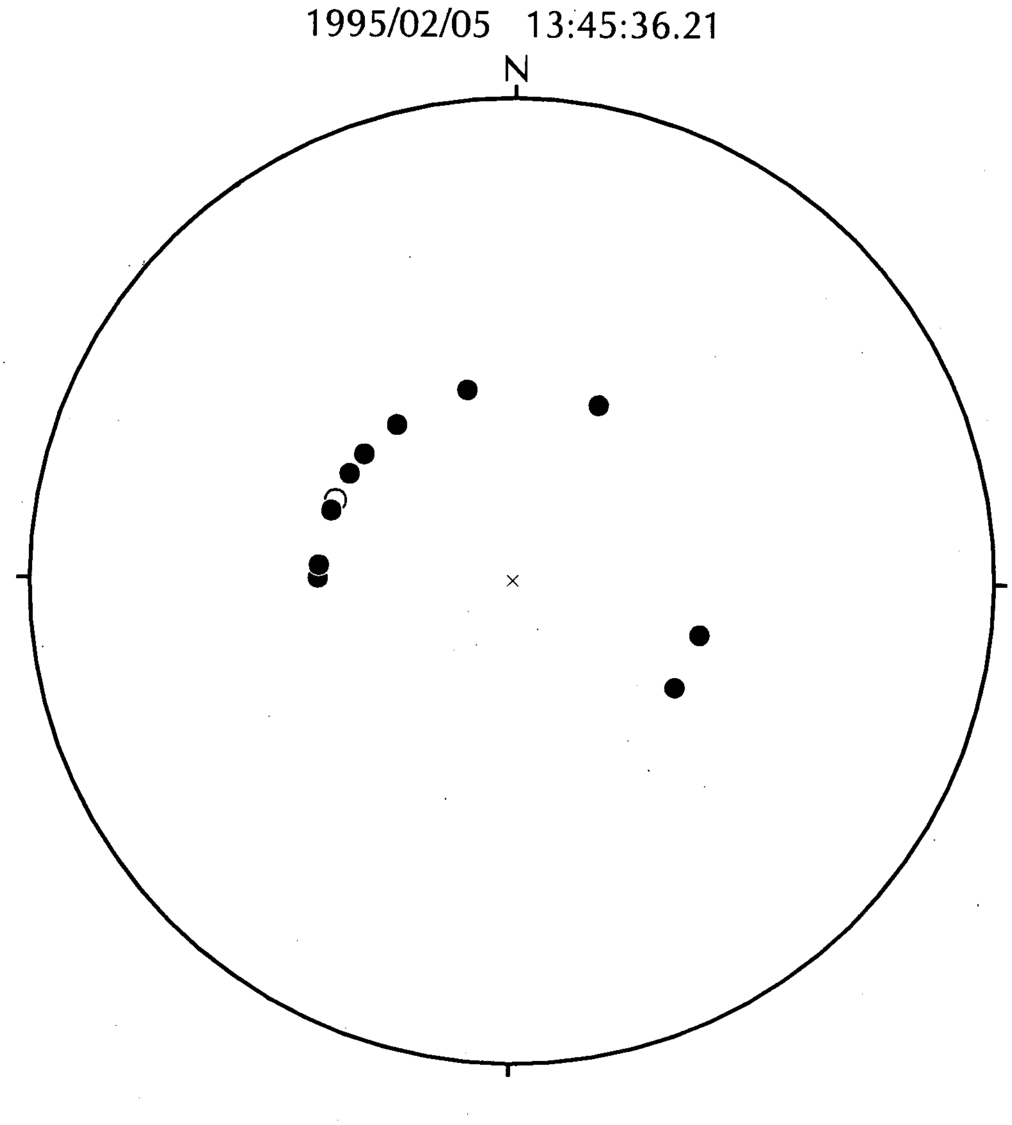


Figure 4.4. Stereographic projection of the lower focal hemisphere for the Szabadszállás Earthquake 5th February 1995, 13:45:36 UTC.

5 February 1995 - Szabadszállás

Table 4.2. *Intensity distribution of the Szabadszállás Earthquake 5th February 1995, 13:45:36 UTC*

	Location	Coordinates	I	R	N
1	Ágasegyháza	46.840 N 19.445 E	3.0	33.%	2
2	Akasztó	46.695 N 19.204 E	3.5	39.%	2
3	Alap	46.809 N 18.686 E	.0	0.%	2
4	Ballószög	46.860 N 19.569 E	3.5	38.%	2
5	Bugac	46.693 N 19.688 E	.0	0.%	2
6	Csengőd	46.714 N 19.269 E	3.5	39.%	1
7	Dömsöd	47.096 N 19.010 E	2.5	50.%	2
8	Dunaújváros	46.974 N 18.928 E	3.0	35.%	2
9	Dunavecse	46.916 N 18.976 E	3.5	40.%	1
10	Fülöpháza	46.892 N 19.436 E	4.0	45.%	1
11	Fülöpszállás	46.822 N 19.238 E	4.5	37.%	3
12	Harta	46.701 N 19.025 E	.0	0.%	1
13	Helvécia	46.835 N 19.618 E	3.0	27.%	2
14	Izsák	46.801 N 19.354 E	5.5	31.%	5
15	Jakabszállás	46.757 N 19.603 E	.0	0.%	1
16	Kaskantyú	46.673 N 19.387 E	4.0	34.%	2
17	Kecskemét	46.909 N 19.693 E	3.5	37.%	2
18	Kerekegyháza	46.936 N 19.477 E	4.0	35.%	2
19	Kiskőrös	46.622 N 19.287 E	3.0	38.%	1
20	Kunadacs	46.958 N 19.291 E	5.0	33.%	2
21	Kunpeszér	47.066 N 19.277 E	3.5	34.%	1
22	Kunszentmiklós	47.030 N 19.126 E	3.0	24.%	1
23	Lajosmizse	47.027 N 19.551 E	.0	0.%	2
24	Nagyvenyim	46.960 N 18.853 E	.0	0.%	1
25	Németkér	46.717 N 18.768 E	.0	0.%	1
26	Nyárlőrinc	46.861 N 19.875 E	.0	0.%	2
27	Orgovány	46.749 N 19.469 E	3.0	25.%	2
28	Páhi	46.715 N 19.383 E	3.0	35.%	2
29	Sárbogárd	46.881 N 18.624 E	.0	0.%	2
30	Solt	46.805 N 18.992 E	3.0	41.%	2

Table 4.2. (cont.) *Intensity distribution of the Szabadszállás Earthquake 5th February 1995, 13:45:36 UTC*

	Location	Coordinates	I	R	N
31	Soltszentimre	46.773 N 19.286 E	5.0	45.%	3
32	Szabadszállás	46.874 N 19.223 E	5.5	34.%	4
33	Tabdi	46.681 N 19.305 E	3.5	30.%	3
34	Tatárszentgyörgy	47.087 N 19.370 E	3.5	42.%	1
35	Városföld	46.819 N 19.757 E	3.0	36.%	2

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

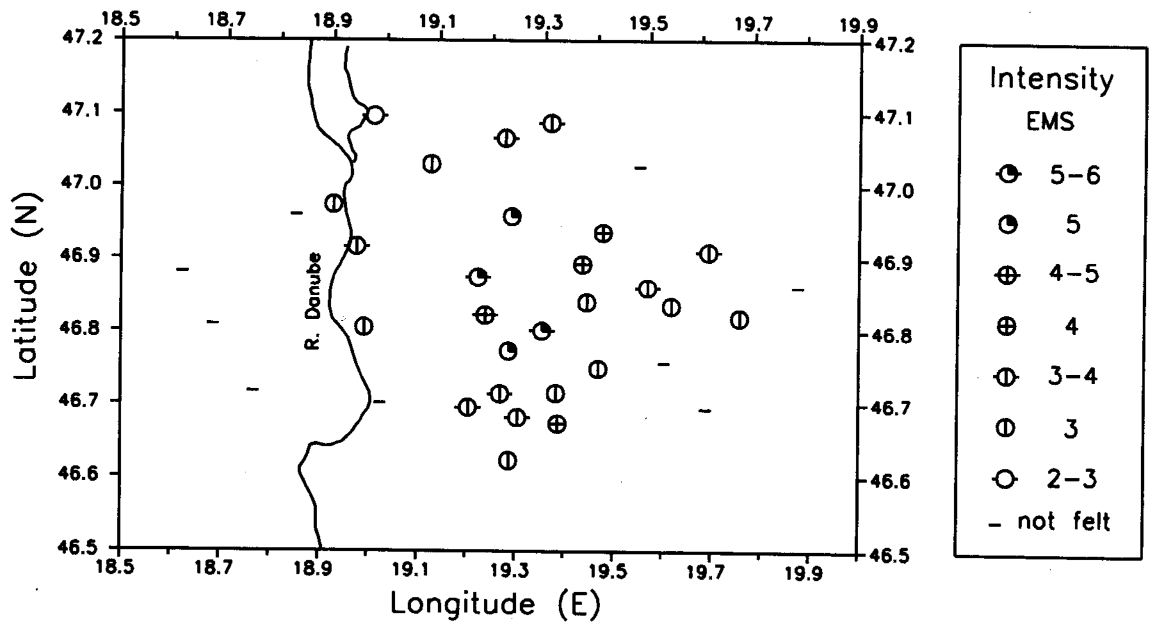


Figure 4.5. Intensity distribution of the Szabadszállás Earthquake 5th February 1995, 13:45:36 UTC

5 February 1995 - Szabadszállás

25 August 1995 - Požega area (Croatia)

HYPOCENTRE PARAMETERS

Date:	1995/08/25
Origin Time:	09:27:22.1 UTC
Latitude and Longitude:	45.418N 17.750E (S.D. 16.2km)
Depth:	10.0 km (S.D. 9.7km)
Magnitude:	5.0 ML
Maximum Intensity:	5 (in Hungary)

DISCUSSION

The Požega area (Croatia) earthquake caused moderate damage at the epicentral area and was felt over a large area, Zagreb (Croatia), Ljubljana, Maribor, Ptuj (Slovenia) and up to North as Lake Balaton in Hungary.

This event is a representing example of the significant contribution to the earthquake hazard expected in Hungary from earthquake sources outside of the territory of the country (Zsíros and Tóth, 1988).

The intensity distribution (only in Hungary) is shown in Table 4.3. and Figure 4.7.

25 August 1995 - Požega area (Croatia)

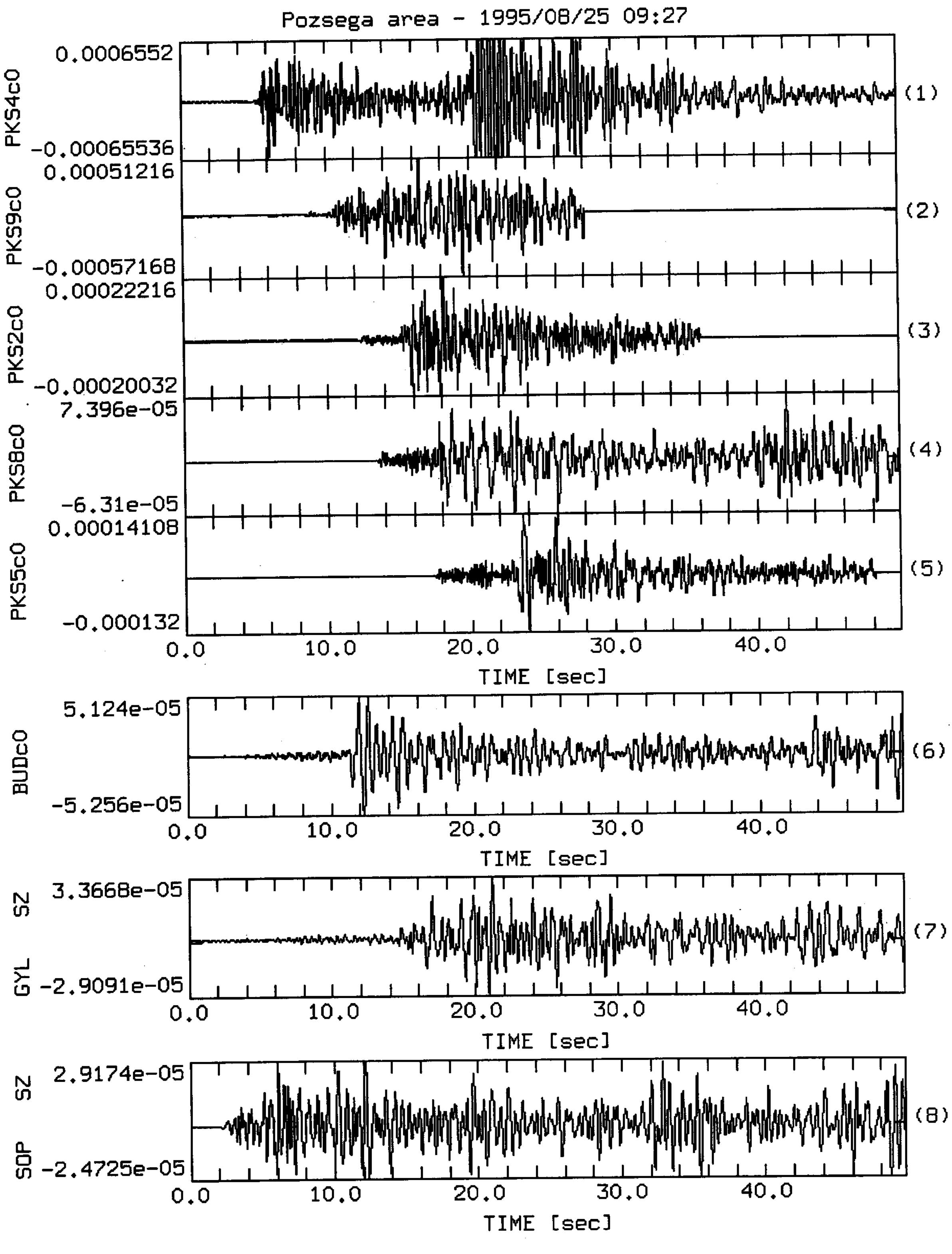


Figure 4.6. Seismograms of the Požega (Croatia) Earthquake 25th August 1995, 9:27:19 UTC (vertical components)

25 August 1995 - Požega area (Croatia)

Table 4.3. *Intensity distribution of the* Požega *area (Croatia) Earthquake 25th August 1995, 9:27:19 UTC*

	Location	Coordinates	I	R	N
1	Ajka	47.099 N 17.553 E	3.0	33.%	1
2	Aranyosgadány	46.008 N 18.121 E	5.0	50.%	1
3	Babócsa	46.041 N 17.349 E	5.0	27.%	2
4	Bácsalmás	46.127 N 19.328 E	.0	0.%	2
5	Baja	46.182 N 18.958 E	.0	0.%	2
6	Barcs	45.961 N 17.463 E	3.5	42.%	1
7	Beremend	45.792 N 18.436 E	.0	0.%	1
8	Bóly	45.968 N 18.519 E	3.0	30.%	2
9	Bonyhád	46.300 N 18.532 E	3.0	38.%	1
10	Budapest	47.500 N 19.051 E	2.5	50.%	1
11	Csurgó	46.262 N 17.103 E	.0	0.%	2
12	Dombóvár	46.380 N 18.142 E	3.5	44.%	1
13	Dunaújváros	46.974 N 18.928 E	.0	0.%	1
14	Felsőszentmárton	45.852 N 17.709 E	4.0	25.%	2
15	Fonyód	46.742 N 17.542 E	.0	0.%	2
16	Gyékényes	46.242 N 17.013 E	.0	0.%	2
17	Hahót	46.648 N 16.927 E	.0	0.%	1
18	Hajós	46.403 N 19.120 E	.0	0.%	2
19	Harkány	45.850 N 18.238 E	.0	0.%	1
20	Hercegszántó	45.954 N 18.942 E	.0	0.%	2
21	Kadarkút	46.232 N 17.620 E	.0	0.%	1
22	Kálmáncsa	46.070 N 17.617 E	4.5	38.%	1
23	Kalocsa	46.527 N 18.987 E	.0	0.%	2
24	Kaposvár	46.357 N 17.791 E	4.5	18.%	2
25	Kiskőrös	46.622 N 19.287 E	.0	0.%	2
26	Kiskunhalas	46.426 N 19.486 E	.0	0.%	1
27	Komló	46.190 N 18.265 E	3.5	45.%	1
28	Lenti	46.630 N 16.545 E	.0	0.%	2
29	Marcali	46.584 N 17.414 E	3.5	41.%	2
30	Nagyatád	46.227 N 17.363 E	3.5	42.%	2

25 August 1995 - Požega area (Croatia)

Table 4.3. (cont.) *Intensity distribution of the Požega area (croatia) Earthquake 25th August 1995, 9:27:19 UTC*

	Location	Coordinates	I	R	N
31	Nagykanizsa	46.459 N 16.990 E	3.5	45.%	1
32	Paks	46.628 N 18.861 E	.0	0.%	1
33	Pécs	46.088 N 18.245 E	4.5	34.%	3
34	Sárbogárd	46.881 N 18.624 E	.0	0.%	1
35	Sármellék	46.708 N 17.173 E	3.0	33.%	1
36	Sásd	46.254 N 18.103 E	4.0	26.%	3
37	Segesd	46.347 N 17.349 E	3.5	43.%	1
38	Sellye	45.874 N 17.850 E	4.0	54.%	2
39	Siklós	45.857 N 18.302 E	3.0	39.%	2
40	Siófok	46.904 N 18.055 E	.0	0.%	1
41	Somogyudvarhely	46.177 N 17.198 E	3.5	43.%	2
42	Székesfehérvár	47.196 N 18.423 E	.0	.0.%	1
43	Szekszárd	46.352 N 18.702 E	.0	0.%	1
44	Szentlőrinc	46.040 N 17.984 E	4.5	40.%	2
45	Szigetvár	46.051 N 17.793 E	3.5	41.%	2
46	Szulok	46.053 N 17.551 E	4.0	36.%	2
47	Tab	46.733 N 18.030 E	.0	0.%	2
48	Tamási	46.631 N 18.287 E	.0	0.%	2
49	Tapolca	46.885 N 17.446 E	.0	0.%	1
50	Újpetre	45.931 N 18.370 E	3.5	35.%	2
51	Vajszló	45.857 N 17.985 E	4.0	27.%	1
52	Veszprém	47.094 N 17.913 E	.0	0.%	1
53	Vízvár	46.093 N 17.238 E	4.0	40.%	2
54	Zalaegerszeg	46.844 N 16.844 E	.0	0.%	2
55	Zaláta	45.813 N 17.892 E	4.0	33.%	1

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

25 August 1995 - Požega area (Croatia)

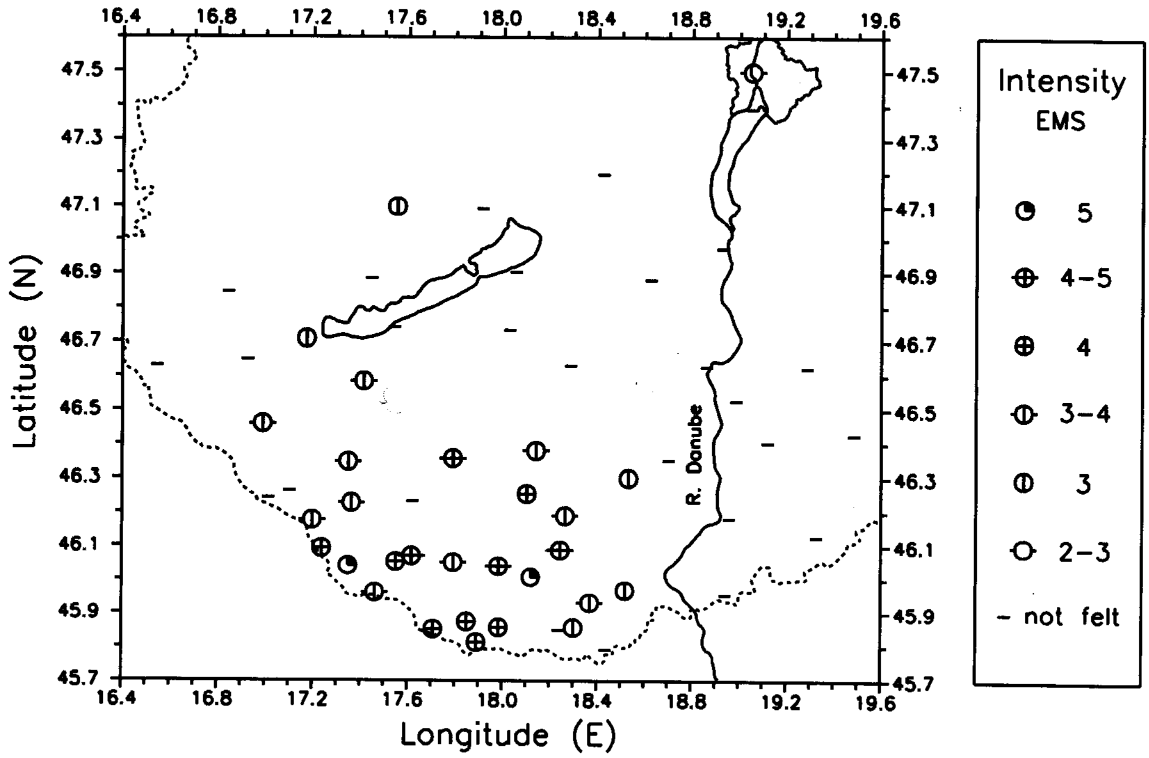


Figure 4.7. Intensity distribution of the Požega (Croatia) Earthquake 25th August 1995, 9:27:19 UTC

25 August 1995 - Požega area (Croatia)

12 September 1995 - Várpalota

HYPOCENTRE PARAMETERS

Date:	1995/09/12
Origin Time:	22:14:05.3 UTC
Latitude and Longitude:	47.224N 18.146E (S.D. 1.6km)
Depth:	7.5 km (S.D. 1.5km)
Magnitude:	3.5 ML
Maximum Intensity:	5-6

DISCUSSION

This event at a very shallow depth caused slight damage (smaller cracks in walls, fall of small pieces of plaster and parts of chimneys) at the epicentre area. However, the attenuation was very strong, the earthquake was felt over an area of less than 300 km^2. The intensity distribution is shown in Table 4.4. and Figure 4.10.

At a strong motion recorder site at Bodajk, some 13 km far from the epicentre, the peak acceleration on hard rock was 3-4 mg on the horizontal components with 4-5 Hz specral peaks (see Fig. 4.11). The macroseismic survey resulted intensity 3 at that locality.

The focal mechanism solution for the event is shown in Figure 4.9.

The town of Várpalota is situated near to the most characteristic earthquake source zone within the Pannonian Basin, running from Komárom through Mór to the NE edge of lake Balaton. The town itself also has some earthquake history: two quakes occurred in 1927 (March and July), with intensity 6-7, both of them were followed by more than 40 aftershocks.

12 September 1995 - Várpalota

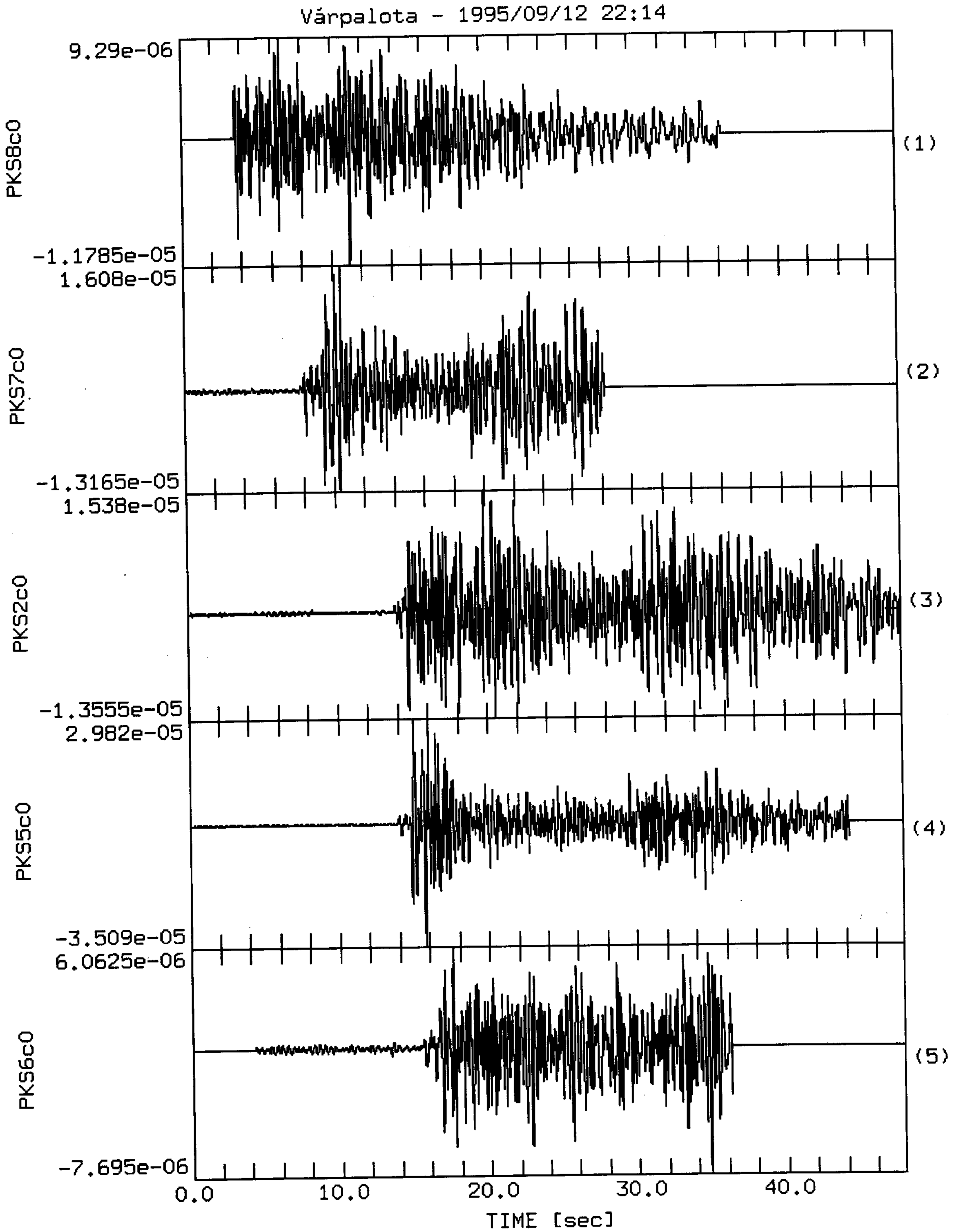
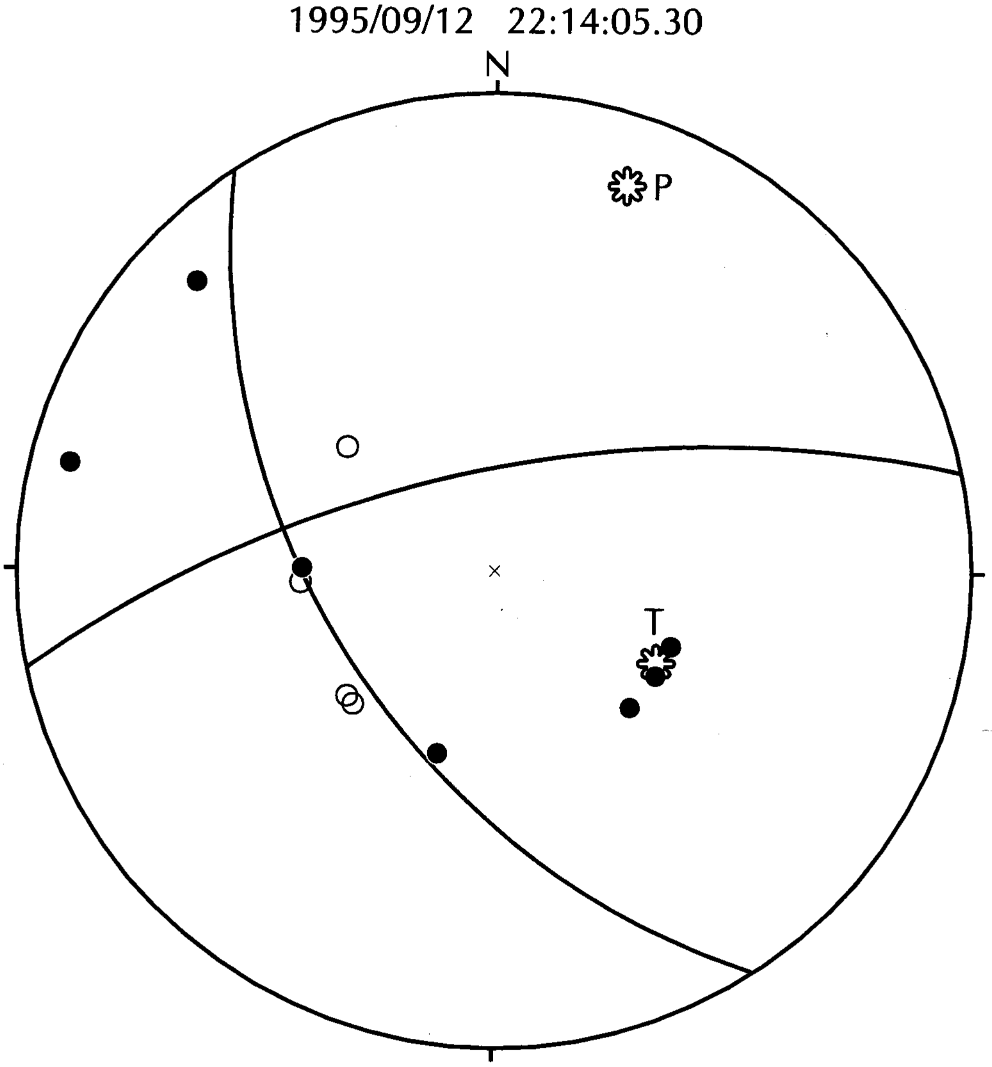


Figure 4.8. Seismograms of the Várpalota Earthquake 12th September 1995, 22:14:05 UTC (vertical component)

12 September 1995 - Várpalota



● - compression
○ - dilatation

	Azim.	Inc.
B:	280.8	48.6
P:	19.0	80.8
T:	119.2	42.8

Figure 4.9. Stereographic projection of the lower focal hemisphere for the Várpalota Earthquake 12th September 1995, 22:14:05 UTC.

12 September 1995 - Várpalota

Table 4.4. *Intensity distribution of the Várpalota Earthquake 12th September 1995, 22:14:05 UTC*

	Location	Coordinates	I	R	N
1	Bakonycsernye	47.323 N 18.101 E	.0	0.%	1
2	Bakonynána	47.284 N 17.975 E	.0	0.%	1
3	Bakonykúti	47.246 N 18.202 E	3.0	36.%	1
4	Berhida	47.113 N 18.134 E	3.0	36.%	1
5	Bodajk	47.322 N 18.241 E	3.0	33.%	1
6	Csór	47.203 N 18.262 E	.0	0.%	1
7	Iszkaszentgyörgy	47.242 N 18.304 E	3.0	32.%	2
8	Isztimér	47.280 N 18.199 E	3.5	41.%	2
9	Jásd	47.284 N 18.030 E	3.5	43.%	2
10	Kincsesbánya	47.258 N 18.271 E	.0	0.%	2
11	Küngös	47.066 N 18.177 E	.0	0.%	2
12	Olaszfalu	47.241 N 17.917 E	.0	0.%	1
13	Ősi	47.141 N 18.188 E	4.0	57.%	2
14	Öskü	47.162 N 18.072 E	3.5	41.%	1
15	Papkeszi	47.084 N 18.083 E	.0	0.%	1
16	Sárkeszi	47.157 N 18.284 E	.0	0.%	2
17	Sárszentmihály	47.155 N 18.339 E	.0	0.%	1
18	Tés	47.260 N 18.034 E	.0	0.%	1
19	Várpalota	47.199 N 18.145 E	5.5	37.%	4
20	Vilonya	47.112 N 18.067 E	3.5	46.%	1
21	Zirc	47.263 N 17.875 E	.0	0.%	2

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

12 September 1995 - Várpalota

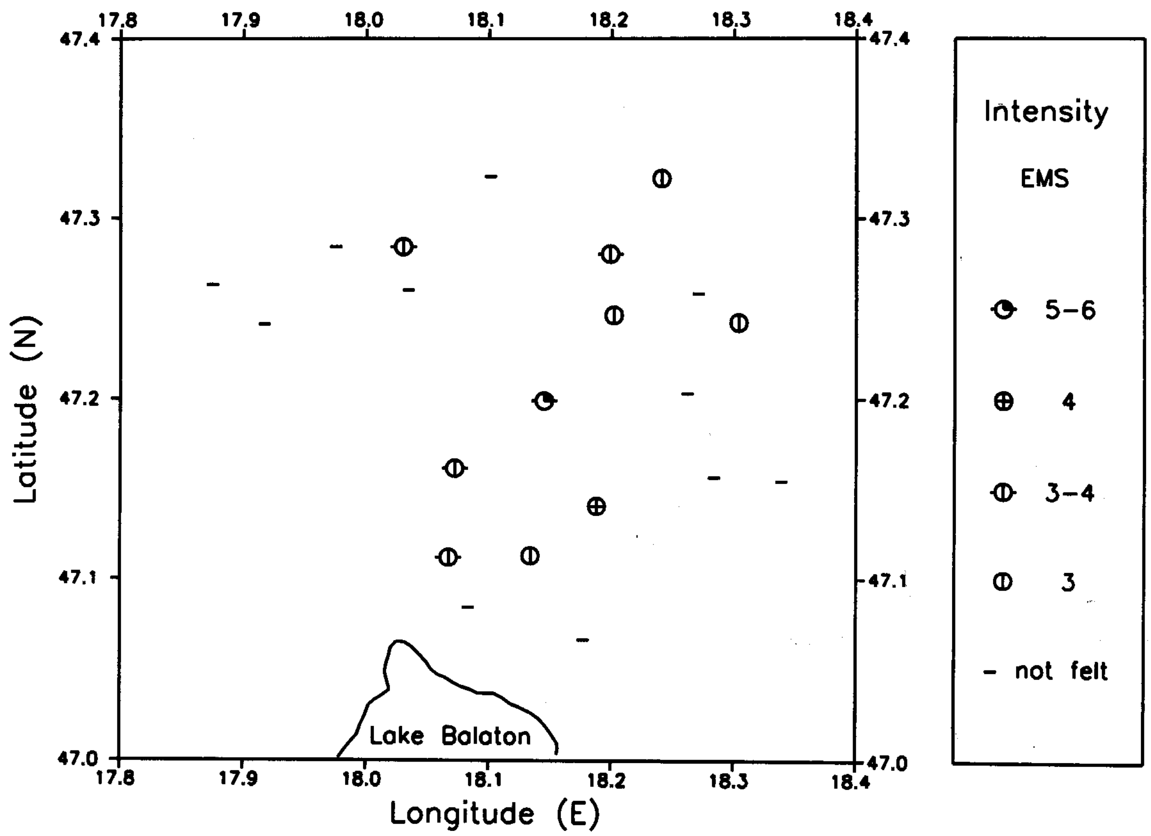


Figure 4.10. Intensity distribution of the Várpalota Earthquake 12th September 1995, 22:14:05 UTC

12 September 1995 - Várpalota

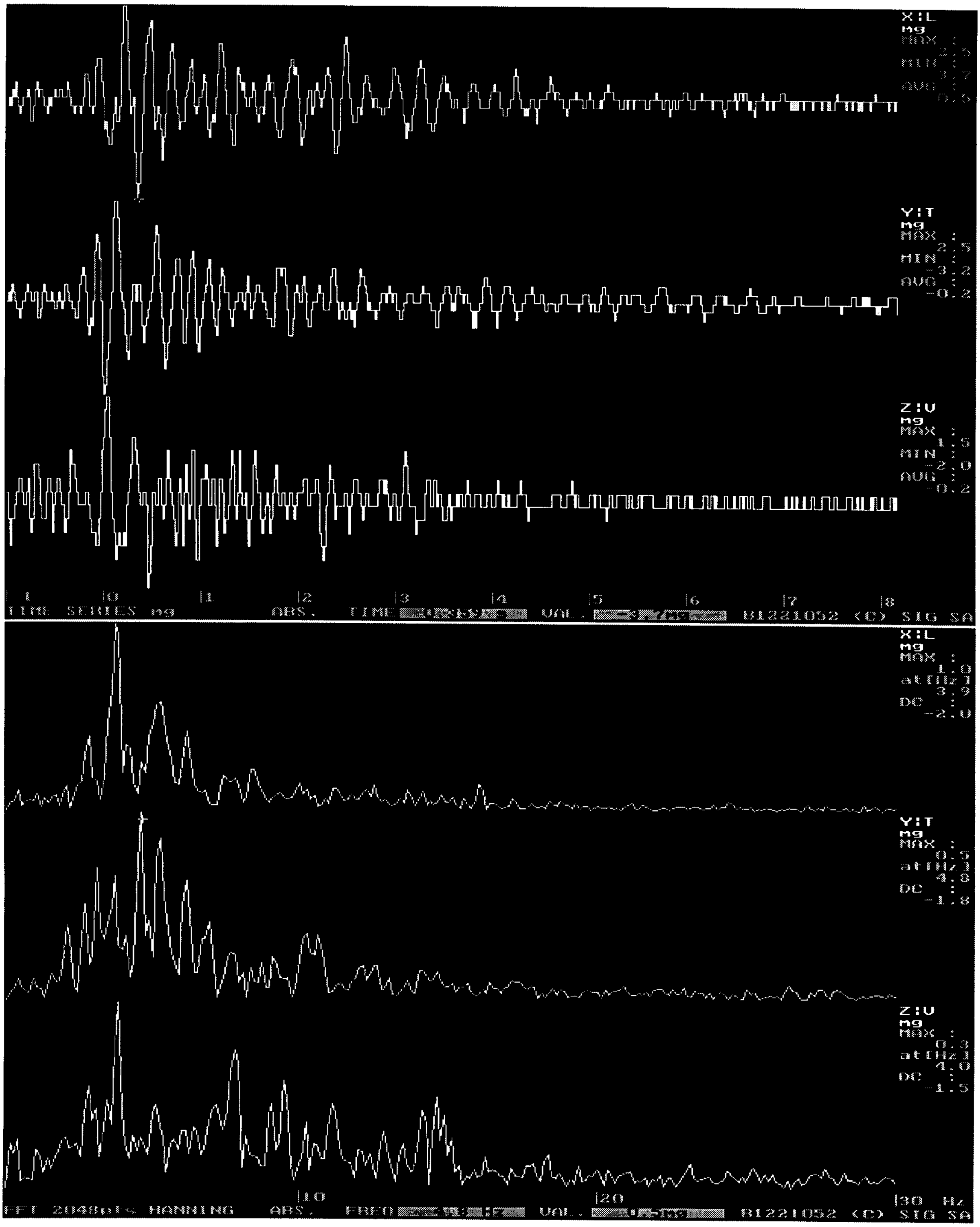


Figure 4.11. Strong motion accelerogram and its spectra of the Várpalota Earthquake 12th September 1995, 22:14:05 UTC (ML=3.5) recorded at Bodajk at a distance of 13 km from the epicentre.

18 September 1995 - Börzsöny mt.

HYPOCENTRE PARAMETERS

Date:	1995/09/18
Origin Time:	08:26:10.8 UTC
Latitude and Longitude:	47.894N 18.879E (S.D. 1.1km)
Depth:	11.8 km (S.D. 1.0km)
Magnitude:	3.7 ML
Maximum Intensity:	5-6

DISCUSSION

The earthquake of 18th September 1995 in the Börzsöny mountain was felt over an area of about 7500 km^2 from Budapest to the North along the Danube Bend. Slight damage, mainly smaller cracks in walls and fallen parts of chimneys, were reported from the epicentral area. The maximum intensity was estimated as high as 5-6 . The intensity distribution in Hungary is shown in Table 4.5. and Figure 4.14. It was also felt in southern Slovakia.

The focal mechanism solution for the event is shown in Figure 4.13.

18 September 1995 - Börzsöny mt.

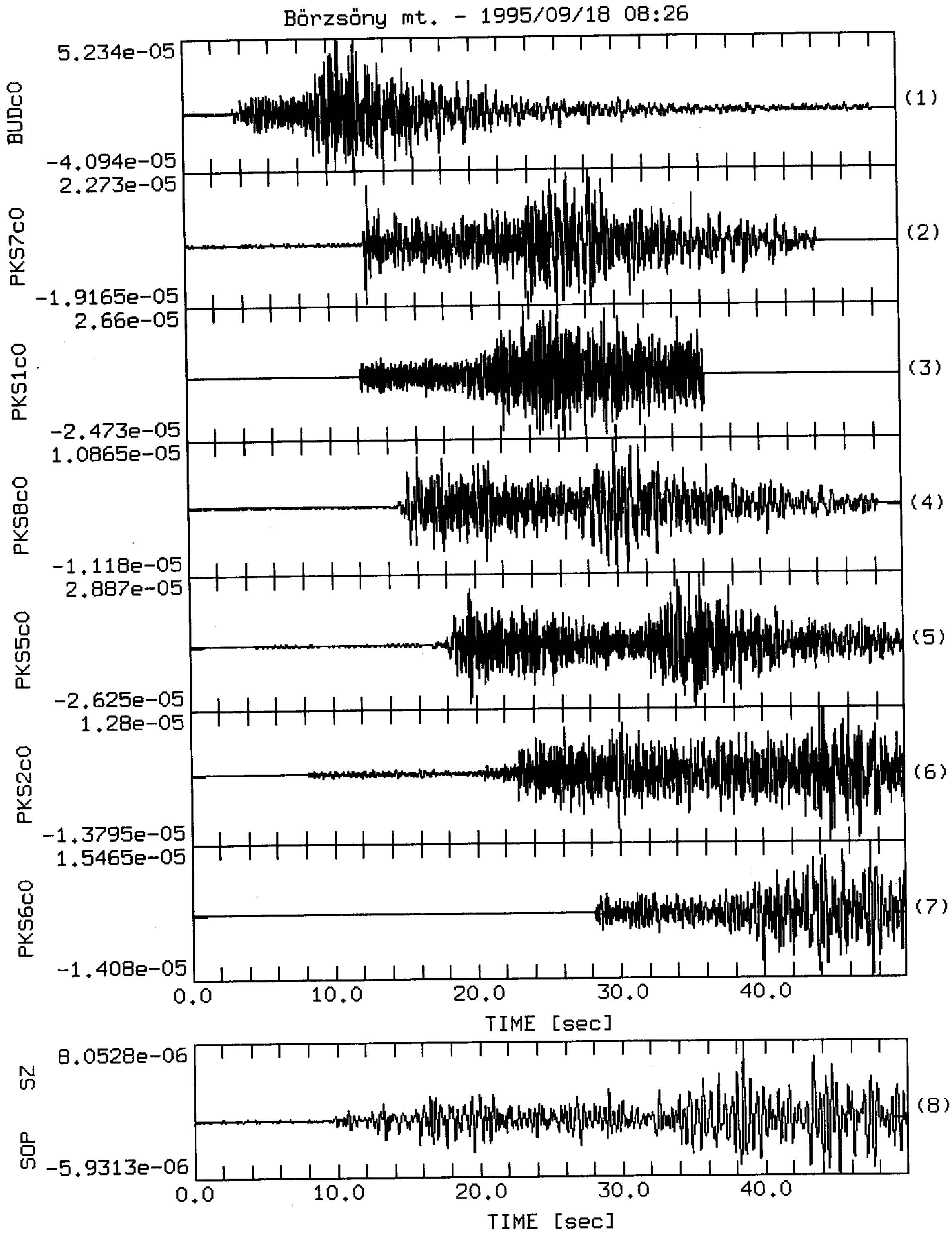


Figure 4.12. Seismograms of the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC (vertical component)

18 September 1995 - Börzsöny mt.

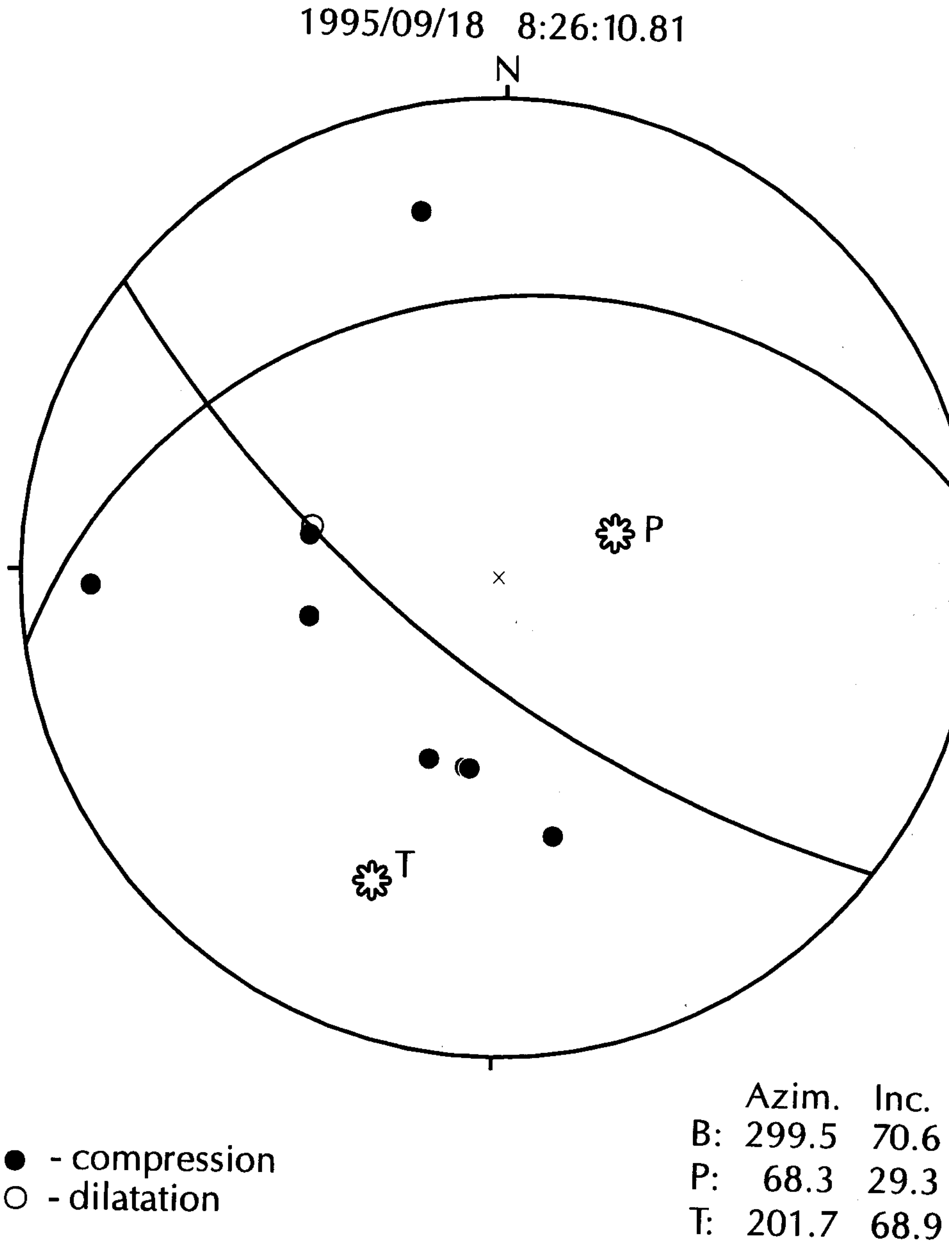


Figure 4.13. Stereographic projection of the lower focal hemisphere for the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC.

18 September 1995 - Börzsöny mt.

Table 4.5. *Intensity distribution of the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC*

	Location	Coordinates	I	R	N
1	Acsa	47.798 N 19.385 E	.0	0.%	2
2	Bajna	47.655 N 18.603 E	.0	0.%	1
3	Bajót	47.728 N 18.563 E	3.5	43.%	1
4	Bernecebaráti	48.038 N 18.918 E	4.0	38.%	2
5	Bicske	47.493 N 18.634 E	.0	0.%	2
6	Budakalász	47.622 N 19.051 E	.0	0.%	2
7	Budapest II	47.540 N 19.000 E	3.0	50.%	3
8	Budapest XIV	47.520 N 19.120 E	3.5	36.%	1
9	Csobánka	47.645 N 18.972 E	.0	0.%	2
10	Csolnok	47.695 N 18.722 E	4.0	33.%	3
11	Dág	47.667 N 18.726 E	2.5	43.%	2
12	Diósd	47.411 N 18.956 E	.0	0.%	1
13	Diósjenő	47.943 N 19.049 E	3.5	44.%	2
14	Dorog	47.725 N 18.741 E	4.0	28.%	6
15	Dömös	47.764 N 18.916 E	3.5	37.%	1
16	Dunabogdány	47.792 N 19.034 E	3.0	31.%	1
17	Epöl	47.650 N 18.649 E	5.0	48.%	2
18	Esztergom	47.790 N 18.752 E	5.0	44.%	29
19	Érsekvadkert	48.000 N 19.197 E	.0	0.%	1
20	Fót	47.615 N 19.193 E	3.5	37.%	2
21	Galgamácsa	47.697 N 19.392 E	.0	0.%	1
22	Göd	47.690 N 19.138 E	.0	0.%	2
23	Hont	48.050 N 18.996 E	3.5	43.%	1
24	Ipolytölgyes	47.922 N 18.780 E	4.0	46.%	2
25	Isaszeg	47.533 N 19.394 E	.0	0.%	3
26	Kesztölc	47.713 N 18.797 E	3.5	35.%	2
27	Kóspallag	47.876 N 18.938 E	5.0	28.%	1
28	Lábatlan	47.747 N 18.507 E	4.5	38.%	2
29	Leányfalu	47.721 N 19.091 E	4.0	33.%	3
30	Leányvár	47.686 N 18.777 E	3.0	43.%	2

Table 4.5. (cont.) *Intensity distribution of the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC*

	Location	Coordinates	I	R	N
31	Letkés	47.887 N 18.779 E	5.5	32.%	5
32	Márianosztra	47.867 N 18.878 E	5.5	33.%	2
33	Mogyoród	47.604 N 19.243 E	.0	0.%	1
34	Nagybörzsöny	47.937 N 18.834 E	5.5	37.%	2
35	Nagykovácsi	47.578 N 18.890 E	3.5	39.%	3
36	Nagymaros	47.795 N 18.958 E	5.0	44.%	9
37	Nagyoroszi	48.006 N 19.086 E	.0	0.%	1
38	Nagysáp	47.687 N 18.606 E	3.5	31.%	5
39	Nézsa	47.845 N 19.296 E	.0	0.%	2
40	Nógrád	47.909 N 19.050 E	3.5	41.%	1
41	Nőtincs	47.885 N 19.144 E	4.0	41.%	2
42	Nyergesújfalu	47.755 N 18.557 E	4.5	33.%	4
43	Őrbottyán	47.686 N 19.267 E	.0	0.%	1
44	Páty	47.515 N 18.833 E	.0	0.%	2
45	Piliscsaba	47.638 N 18.840 E	3.5	46.%	2
46	Piliscsév	47.674 N 18.824 E	3.5	42.%	2
47	Pilismarót	47.787 N 18.882 E	4.5	36.%	5
48	Pilisszántó	47.673 N 18.892 E	3.5	44.%	2
49	Pilisszentkereszt	47.694 N 18.904 E	5.5	34.%	2
50	Pilisszentlászló	47.727 N 18.992 E	3.5	36.%	2
51	Rád	46.779 N 16.995 E	3.0	25.%	2
52	Rétság	47.929 N 19.138 E	3.5	42.%	2
53	Romhány	47.926 N 19.258 E	.0	0.%	1
54	Sárisáp	47.679 N 18.690 E	3.5	38.%	2
55	Süttő	47.759 N 18.450 E	4.5	36.%	4
56	Szada	47.637 N 19.312 E	.0	0.%	2
57	Szendehely	47.859 N 19.111 E	3.0	33.%	1
58	Szob	47.819 N 18.869 E	5.5	35.%	2
59	Szokolya	47.869 N 19.007 E	3.5	39.%	2
60	Sződliget	47.730 N 19.145 E	.0	0.%	1

18 September 1995 - Börzsöny mt.

Table 4.5. (cont.) *Intensity distribution of the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC*

	Location	Coordinates	I	R	N
61	Tahitótfalu	47.758 N 19.090 E	4.5	39.%	1
62	Tarján	47.614 N 18.511 E	3.0	43.%	1
63	Tát	47.741 N 18.654 E	4.5	33.%	1
64	Tokod	47.720 N 18.660 E	5.0	21.%	1
65	Vác	47.783 N 19.135 E	5.0	53.%	1
66	Vámosmikola	47.976 N 18.793 E	3.5	35.%	2
67	Verőce	47.826 N 19.038 E	5.5	32.%	3
68	Visegrád	47.786 N 18.982 E	3.5	40.%	4
69	Zebegény	47.804 N 18.916 E	4.0	32.%	1
70	Zsámbék	47.549 N 18.729 E	.0	0.%	2

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

18 September 1995 - Börzsöny mt.

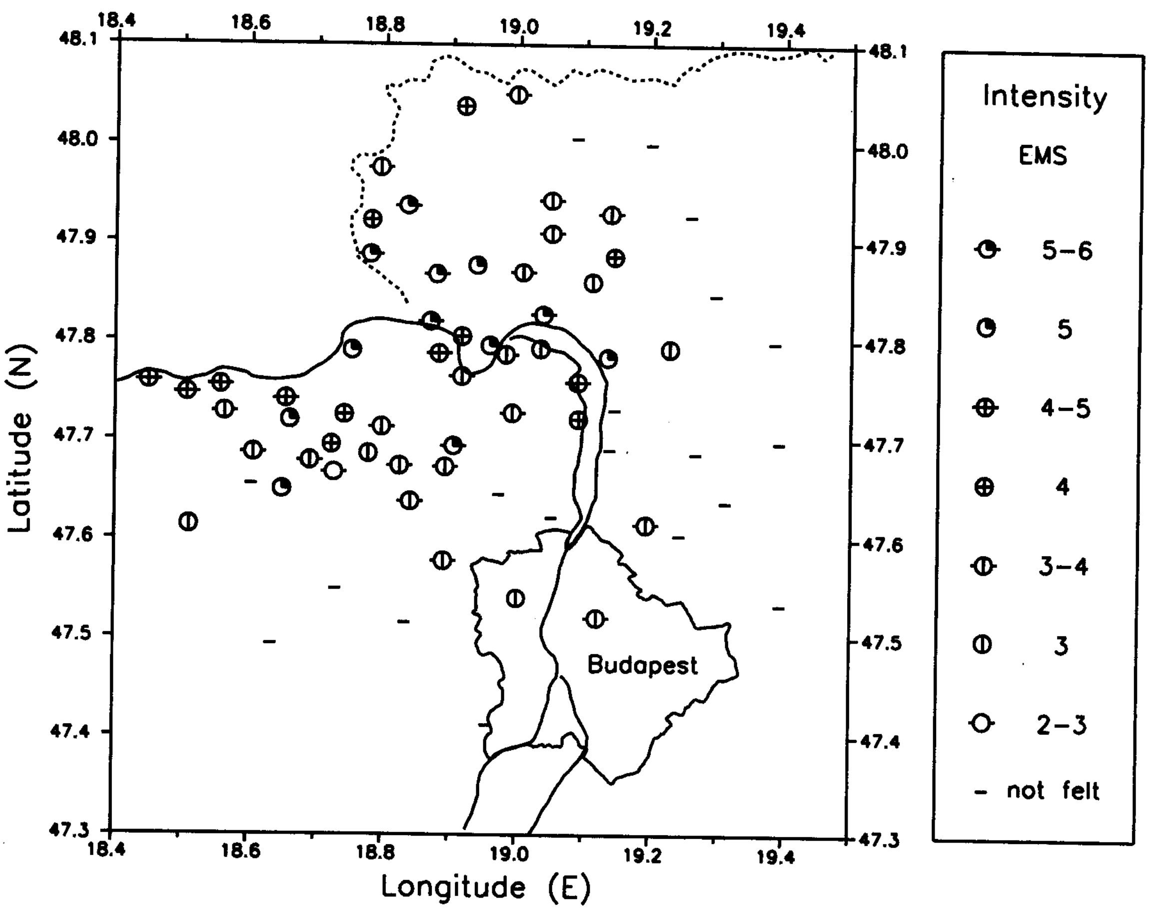


Figure 4.14. Intensity distribution of the Börzsöny mt. Earthquake 18th September 1995, 8:26:11 UTC

18 September 1995 - Börzsöny mt.

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APPENDIX

SIGNIFICANT EARTHQUAKES OF THE WORLD

1995

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

Significant Earthquakes of the World, 1995

FINAL

SIGNIFICANT EARTHQUAKES OF THE WORLD, 1995

Earthquakes of magnitude 6.5 or greater or ones that caused fatalities, injuries or substantial damage.
BRK--Berkeley. PAS--Pasadena.

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 UTC TIME        LAT      LON      DEP    GS MAGS   SD STA REGION AND COMMENTS
 HR MN SEC                                MB  Msz      USED

JAN 1995
01 06:59:55.9    40.701  143.549  15 G 5.8 6.2 1.1 377 OFF EAST COAST OF
                 HONSHU, JAPAN. Mw 6.5 (GS), 6.4 (HRV). Ms 5.9 (BRK).
                 Mo=6.2*10**18 Nm (GS). Mo=5.3*10**18 Nm (HRV). Mo=3.4*10**18 Nm
                 (PPT). Felt (II JMA) in the Hachinohe area.
06 22:37:34.3    40.246  142.175  27 G 6.7 6.9 0.9 611 NEAR EAST COAST OF
                 HONSHU, JAPAN. Mw 6.9 (GS), 7.0 (HRV). Ms 6.6 (BRK).
                 Mo=2.7*10**19 Nm (GS). Mo=3.3*10**19 Nm (HRV). Mo=5.0*10**19 Nm
                 (PPT). Mo=1.0*10**20 Nm (OBN). At least 29 people injured in
                 Aomori and Iwate Prefectures and about 5,000 homes lost water
                 and sewer services in the region. Felt (V JMA) at Hachinohe and
                 Morioka; (IV JMA) at Aomori, Miyako, Mutsu and Ofunato; (III
                 JMA) at Akita and Sendai. Felt (V) at Misawa and as far south
                 as Tokyo. Also felt (III JMA) at Kushiro, Obihiro, Otaru and
                 Tomakomai, Hokkaido.
16 20:46:52.1    34.583  135.018  22 G 6.3 6.8 1.0 503 NEAR S. COAST OF WESTERN
                 HONSHU. Mw 6.8 (GS), 6.9 (HRV). Ms 6.5 (BRK). Mo=1.8*10**19 Nm
                 (GS). Mo=2.4*10**19 Nm (HRV). Mo=6.3*10**19 Nm (PPT). Five
                 thousand five hundred two people confirmed killed, 36,896
                 injured and extensive damage (VII JMA) in the Kobe area and on
                 Awaji-shima. Over 90 percent of the casualties occurred along
                 the southern coast of Honshu between Kobe and Nishinomiya. At
                 least 28 people were killed by a landslide at Nishinomiya.
                 About 310,000 people were evacuated to temporary shelters. Over
                 200,000 buildings were damaged or destroyed. Numerous fires,
                 gas and water main breaks and power outages occurred in the
                 epicentral area. Felt (VII JMA) along a coastal strip extending
                 from Suma Ward, Kobe to Nishinomiya and in the Ichinomiya area
                 on Awaji-shima; (V JMA) at Hikone, Kyoto and Toyooka; (IV JMA)
                 at Nara, Okayama, Osaka and Wakayama; (V) at Iwakuni. Also felt
                 (IV JMA) at Takamatsu, Shikoku. Right-lateral surface faulting
                 was observed for 9 kilometers with horizontal displacement of
                 1.2 to 1.5 meters in the northern part of Awaji-shima.
                 Liquefaction also occurred in the epicentral area.
19 15:05:03.4     5.050  -72.916  17 G 6.3 6.6 0.9 607 COLOMBIA. Mw 6.5 (GS),
                 6.5 (HRV). Ms 6.5 (BRK). Mo=6.9*10**18 Nm (GS). Mo=7.1*10**18
                 Nm (HRV). Mo=8.8*10**18 Nm (PPT). Five people killed, several
                 injured and at least 20 major buildings damaged in the Bogota
                 area. One person also killed at Manizales and another at
                 Miraflores. More than 500 houses damaged or destroyed in Boyaca
                 Department and 12 others destroyed in Casanare Department.
                 Landslides blocked several rivers and streams in Colombia. Felt
                 in much of Colombia and western Venezuela and as far as
                 Caracas, Venezuela.
21 08:47:29.6    43.377  146.720  59 G 6.5 5.9 0.8 621 KURIL ISLANDS. Mw 6.2
                 (GS), 6.3 (HRV). mb 6.6 (BRK). Mo=2.6*10**18 Nm (GS).
                 Mo=2.8*10**18 Nm (HRV). Mo=3.4*10**18 Nm (PPT), 2.0*10**19 Nm
                 (OBN). Felt (VI) on Shikotan and at Yuzhno-Kurilsk, Kunashir.
                 Felt (IV JMA) at Kushiro and (III JMA) at Nemuro, Hokkaido.
24 04:14:26.3    27.560   55.630  33 N 4.9     1.0 100 SOUTHERN IRAN. Mw 5.0
                 (HRV). MD 4.6 (RYD). Mo=3.1*10**16 Nm (HRV). Eleven people
                 injured and some damage in the Bandar-e Abbas area.
27 20:16:52.1    -4.434  134.476  22 G 6.2 6.8 1.2 196 IRIAN JAYA REGION,
                 INDONESIA. Mw 6.7 (GS), 6.8 (HRV). Ms 6.7 (BRK). Mo=1.3*10**19
                 Nm (GS). Mo=1.8*10**19 Nm (HRV). Mo=5.3*10**19 Nm (PPT).
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FEB 1995
03 15:26:10.6 41.529 -109.640 1 G 5.3 4.6 1.0 322 WYOMING. Probable implosion in a trona mine west of Green River. One miner killed and ten injured. Slight damage at Green River and Little America. Felt (V) at Rock Springs; (III) at Eden and Reliance. Also felt at Ogden and Salt Lake City, Utah. Up to one meter of surface subsidence occurred in about a 1 by 2 km area above the mine.
05 22:51:05.1 -37.759 178.752 21 G 6.5 7.5 1.0 566 OFF E. COAST OF N. ISLAND, N.Z. Mw 7.0 (GS), 7.1 (HRV). Ms 7.5 (BRK). Mo=3.1*10**19 Nm (GS). Mo=5.8*10**19 Nm (HRV). Mo=4.0*10**19 Nm (PPT). Felt over much of the North Island and as far south as Christchurch on the South Island. Also felt on the Chatham Islands.
08 18:40:25.3 4.104 -76.622 74 G 6.3 0.9 568 COLOMBIA. Mw 6.4 (GS), 6.4 (HRV). MD 6.0 (UPA). Mo=4.2*10**18 Nm (GS). Mo=4.1*10**18 Nm (HRV). Mo=3.5*10**18 Nm (PPT). Forty-two people killed, nearly 400 injured and over 2,000 buildings damaged or destroyed in the Cali-Pereira area. Landslides blocked two roads in the epicentral area. Damage occurred at Armenia, Calarca, Cali, La Union, Manizales, Pereira, Trujillo and in many other areas of western Colombia. Felt throughout Colombia.
10 01:45:03.9 -37.855 178.602 28 G 5.8 6.4 1.2 223 OFF E. COAST OF N. ISLAND, N.Z. Mw 6.3 (GS), 6.5 (HRV). ML 6.3 (WEL). Mo=3.7*10**18 Nm (GS). Mo=6.1*10**18 Nm (HRV). Mo=1.1*10**19 Nm (PPT). Felt on much of the North Island including Auckland, Bay of Plenty, East Cape and Wellington.
13 15:04:24.0 -1.318 127.438 14 G 6.3 6.7 1.2 348 HALMAHERA, INDONESIA. Mw 6.7 (GS), 6.7 (HRV). Ms 6.8 (BRK). Mo=1.1*10**19 Nm (GS). Mo=1.2*10**19 Nm (HRV). Mo=3.3*10**19 Nm (PPT). Felt (V) on Obi, (IV) at Labuha and (III) at Ternate.
19 04:03:16.1 40.556 -125.539 10 G 6.0 6.8 1.1 527 OFF COAST OF NORTHERN CALIFORNIA. Mw 6.4 (GS), 6.0 (HRV). MD 6.6 (GM). Mo=7.8*10**18 Nm (BRK). Mo=5.1*10**18 Nm (GS). Mo=1.0*10**18 Nm (HRV). Mo=7.0*10**18 Nm (PPT). Felt (V) at Arcata, Crescent City, Honeydew, Kneeland, Redway and Samoa; (IV) at Alderpoint, Blue Lake, Carlotta, Elk, Fort Bragg, Fortuna, Garberville, Loleta, Miranda, Myers Flat, Petrolia, Piercy, Redcrest, Rio Dell, Westport, Whitethorn and Zenia. Felt in Butte, Del Norte, Humboldt, Mendocino, Shasta and Siskiyou Counties of northern California and as far south as the San Francisco Bay area. Also felt at Brookings, Oregon.
23 05:19:01.9 24.137 121.614 41 D 5.9 6.2 1.0 438 TAIWAN. Mw 6.2 (HRV). Mo=2.5*10**18 Nm (HRV). Two people killed and 14 injured on a bus struck by a landslide in the epicentral region. Felt (IV JMA) at Hua-lien, Hsin-chu and Su-ao; (III JMA) at I-lan, Tai-chung and Tai-pei. Felt in Fujian, Jiangxi and Zhejiang Provinces, China.
23 21:03:01.3 35.046 32.279 10 G 5.8 5.7 1.0 492 CYPRUS REGION. Mw 5.9 (GS), 5.9 (HRV). Ms 5.8 (BRK). Mo=7.0*10**17 Nm (GS). Mo=8.1*10**17 Nm (HRV). Two people killed and five injured in the Paphos area. Fifty houses destroyed, 70 seriously damaged and 500 slightly damaged in the Paphos and Nicosia areas. Twenty masonry houses were destroyed at Arodhes. Felt (VII) at Arodhes, Peristerona and Polis; (VI) at Kathikas, Peyia and Stroumbi; (V) at Kykkou Monastery; (IV) at Larnaca, Limassol and Nicosia; (III) at Paralimni. Felt throughout Cyprus. Also felt in northern Israel and Lebanon.

MAR 1995
04 23:23:40.6 1.282 -77.307 50 .4 .2 490 COLOMBIA. At least eight people killed, 10 injured and eight houses damaged in the Pasto area.
19 23:53:14.9 -4.183 135.109 330 .2 .1 .4 340 IRIAN JAYA REGION, INDONESIA. Mw 6.8 (GS), 6.9 (HRV). Ms 7.1 (BRK). Mo=2.1*10**19 Nm (GS). Mo=2.2*10**19 Nm (HRV). Mo=7.8*10**19 Nm (PPT). Some

minor damage to buildings in the Ayam, Fakfak and Nabire areas. Felt in much of Irian Jaya.

APR 1995

01 03:49:33.5 37.925 139.186 11 G 5.8 4.9 .0 290 EASTERN HONSHU, JAPAN. Mw 5.3 (GS), 5.4 (HRV). Mo=1.1*10**17 Nm (GS). Mo=1.5*10**17 Nm (HRV). At least 39 people were injured and 504 buildings were damaged or destroyed in Niigata Prefecture, mostly in the Niigata area. Felt (IV JMA) at Niigata and on Sado; (III JMA) at Sakata and Shirakawa. Also felt at Tokyo and Yokohama.

07 22:06:56.8 -15.199 -173.529 21 G 6.8 8.0 1.1 670 TONGA ISLANDS. Mw 7.4 (GS), 7.4 (HRV). Ms 8.1 (BRK). MD 7.1 (SVA). Mo=1.2*10**20 Nm (GS). Mo=1.3*10**20 Nm (HRV). Mo=1.1*10**20 Nm (PPT). Felt at Apia, Western Samoa. Local tsunami generated with recorded maximum wave heights (peak-to-trough) of about 30 cm at Pago Pago, American Samoa and about 5 cm on Niue Island.

14 00:32:56.1 30.285 -103.347 18 G 5.6 5.7 1.0 397 WESTERN TEXAS. Mw 5.7 (GS), 5.7 (HRV). Mo=3.9*10**17 Nm (GS). Mo=3.8*10**17 Nm (HRV). Two people were slightly injured in Brewster County. Slight damage (VI) at Alpine and Fort Davis. Also slight damage in the Marathon and Ozona areas. Felt (V) at Balmorhea, Barstow, Coyanosa, Fort Stockton, Imperial, Kermit, Marfa, Pecos, Presidio, Sanderson, Sheffield, Toyah, Wickett and Wink; (IV) at Big Spring, Cameron, Crane, Midland, Odessa, Pyote and Valentine. Also felt (V) at Jal and Malaga; (IV) at Artesia, Dexter and White City, New Mexico. Felt in much of western and central Texas as far east as San Antonio and the Dallas-Fort Worth area. Felt west as far as Sierra Blanca, Texas and north to Roswell, New Mexico.

17 23:28:06.8 45.928 151.283 23 G 6.1 6.4 1.0 651 KURIL ISLANDS. Mw 6.7 (GS), 6.8 (HRV). Ms 6.2 (BRK). Mo=1.1*10**19 Nm (GS). Mo=1.5*10**19 Nm (HRV). Mo=2.6*10**19 Nm (OBN), 1.4*10**19 Nm (PPT). Felt (VI) on Urup; (V) at Kurilsk, Iturup; (IV) on Simushir and Shikotan; (III) at Yuzhno-Kurilsk, Kunashir.

20 08:45:11.6 6.279 126.777 94 G 6.2 1.1 510 MINDANAO, PHILIPPINE ISLANDS. Mw 6.6 (GS), 6.5 (HRV). Mo=9.0*10**18 Nm (GS). Mo=5.9*10**18 Nm (HRV). Mo=8.1*10**18 Nm (PPT).

21 00:09:54.3 12.011 125.656 20 G 6.2 6.9 1.0 439 SAMAR, PHILIPPINE ISLANDS. Mw 6.7 (GS), 6.9 (HRV). Ms 6.9 (BRK). Mo=1.4*10**19 Nm (GS). Mo=2.3*10**19 Nm (HRV). Mo=2.9*10**19 Nm (PPT). Felt (IV RF) at Surigao, Mindanao and (III RF) at Catarman, Samar.

21 00:30:10.8 11.925 125.564 17 G 6.3 7.2 1.0 443 SAMAR, PHILIPPINE ISLANDS. Mw 6.8 (HRV). Mo=2.0*10**19 Nm (HRV).

21 00:34:46.0 12.059 125.580 21 G 6.3 7.3 1.2 201 SAMAR, PHILIPPINE ISLANDS. Mw 7.1 (GS), 7.2 (HRV). Mo=5.0*10**19 Nm (GS). Mo=6.6*10**19 Nm (HRV). Mo=1.2*10**20 Nm (PPT). Some damage occurred at Borongan and Sulat. Felt (IV RF) at Butuan, Mindanao; (III RF) on Masbate; (II RF) on Cebu and at Cagayan de Oro, Mindanao. Also felt at Davao, Mindanao. Local tsunami generated with maximum wave heights (peak-to- trough) of 10 cm recorded at Legaspi, Luzon.

21 05:17:01.3 12.047 125.920 27 G 5.6 6.9 1.1 234 SAMAR, PHILIPPINE ISLANDS. Mw 6.6 (GS), 6.8 (HRV). Ms 6.8 (BRK). Mo=7.9*10**18 Nm (GS). Mo=2.0*10**19 Nm (HRV). Mo=3.3*10**19 Nm (PPT). Felt at Davao, Mindanao.

23 02:55:55.1 51.334 179.714 17 G 6.2 6.5 1.0 573 RAT ISLANDS, ALEUTIAN ISLANDS. Mw 6.4 (GS), 6.5 (HRV). ML 6.7 (PMR). Ms 6.2 (BRK). Mo=4.4*10**18 Nm (GS). Mo=6.2*10**18 Nm (HRV). Mo=1.0*10**19 Nm (PPT). Felt (IV) on Adak.

23 05:08:01.9 12.390 125.396 24 G 6.1 6.6 1.0 463 SAMAR, PHILIPPINE ISLANDS. Mw 6.6 (GS), 6.8 (HRV). Ms 6.6 (BRK). Mo=1.0*10**19 Nm (GS). Mo=1.5*10**19 Nm (HRV). Mo=3.0*10**19 Nm (PPT).

28 16:30:00.7 44.072 148.004 29 G 6.5 6.8 0.9 571 KURIL ISLANDS. Mw 6.9 (GS), 6.9 (HRV). Ms 6.6 (BRK). Mo=2.9*10**19 Nm (GS). Mo=2.8*10**19 Nm (HRV). Mo=3.7*10**19 Nm (OBN), 3.9*10**19 Nm (PPT). Felt (VII) on Kunashir and Iturup, (V) on Shikotan and

(IV) at Kurilsk, Iturup.

MAY 1995
02 06:06:05.6 -3.792 -76.917 97 G 6.5 1.0 604 NORTHERN PERU. Mw 6.7 (GS), 6.7 (HRV). Mo=1.3*10**19 Nm (GS). Mo=1.3*10**19 Nm (HRV). Mo=1.2*10**19 Nm (PPT). Felt at Andoas, Moyobamba, Tarapoto and along the Peru-Ecuador border.
05 03:53:45.0 12.626 125.297 16 G 6.2 7.0 0.9 338 SAMAR, PHILIPPINE ISLANDS. Mw 7.0 (GS), 7.1 (HRV). Ms 7.1 (BRK). Mo=3.8*10**19 Nm (GS). Mo=4.5*10**19 Nm (HRV). Mo=4.5*10**19 Nm (PPT). Felt on Catanduanes, Leyte and Masbate. Also felt in southern Luzon.
13 08:47:12.7 40.149 21.695 14 G 6.2 6.6 1.2 580 GREECE. Mw 6.4 (GS), 6.6 (HRV). Ms 6.8 (BRK). ML 6.2 (TTG), 6.1 (ATH). Mo=4.7*10**18 Nm (GS). Mo=7.6*10**18 Nm (HRV). Mo=2.0*10**19 Nm (PPT). Twenty-five people injured and substantial damage in the Grevena-Kozani area. Maximum intensity VIII. The earthquake and aftershocks destroyed 5,000 homes and damaged 7,000 others with a preliminary estimate of 450 million U.S. dollars in damage. Felt in central and northern Greece, including Thessaloniki. Felt (IV-VI) in the former Yugoslav Republic of Macedonia. Felt (III) at Herceg Novi, Podgorica and Ulcinj, Yugoslavia.
14 11:33:18.8 -8.378 125.127 11 G 6.2 6.9 1.4 299 TIMOR REGION, INDONESIA. Mw 6.5 (GS), 6.9 (HRV). Mo=6.3*10**18 Nm (GS). Mo=2.4*10**19 Nm (HRV). Mo=8.6*10**19 Nm (PPT). Eleven people missing on Timor. Several houses destroyed by a local tsunami in the Dili area. Considerable damage also occurred in the Maliana and Maubara areas. Landslides occurred in the epicentral area.
15 04:05:57.8 41.603 88.820 0 G 6.1 5.0 1.0 514 SOUTHERN XINJIANG, CHINA. Underground nuclear explosion.
16 20:12:44.2 -23.008 169.900 20 G 6.9 7.7 1.3 592 LOYALTY ISLANDS REGION. Mw 7.3 (GS), 7.7 (HRV). Ms 7.8 (BRK). Mo=9.7*10**19 Nm (GS). Mo=3.9*10**20 Nm (HRV). Mo=2.5*10**20 Nm (PPT). Felt (III) on the Loyalty Islands and at Noumea, New Caledonia. Tsunami generated with maximum wave heights (peak- to-trough) at the following locations: 40 cm at Port-Vila, Vanuatu; 10 cm at Pago Pago, American Samoa; 6 cm at Lautoka and 5 cm at Suva, Fiji; 3 cm at Apia, Western Samoa; 3 cm at Nukualofa, Tonga; 3 cm at Rarotonga, Cook Islands. The tsunami was also recorded along the coast of New South Wales, Australia.
17 11:23:49.5 -23.030 170.108 20 G 5.9 6.5 1.4 347 LOYALTY ISLANDS REGION. Mw 6.2 (GS), 6.5 (HRV). Ms 6.5 (BRK). Mo=2.2*10**18 Nm (GS). Mo=5.4*10**18 Nm (HRV). Mo=7.2*10**18 Nm (PPT).
18 00:06:27.4 -0.893 -21.996 12 G 6.2 6.2 1.0 536 CENTRAL MID-ATLANTIC RIDGE. Mw 6.7 (GS), 6.8 (HRV). Ms 6.1 (BRK). Mo=1.3*10**19 Nm (GS). Mo=1.8*10**19 Nm (HRV). Mo=2.0*10**19 Nm (PPT).
19 21:30:06.4 -1.021 120.505 26 D 5.5 5.3 1.2 188 SULAWESI, INDONESIA. Mw 5.9 (HRV). Ms 5.2 (BRK). Mo= 7.7*10**17 Nm (HRV). Twenty-six people injured and 115 houses damaged in the Parigi area. Felt strongly at Palu and Poso.
21 06:13:11.8 -8.265 122.977 28 D 5.2 4.6 1.2 89 FLORES REGION, INDONESIA. Mw 5.2 (HRV). Mo=7.7*10**16 Nm (HRV). One person killed, 5 injured and several buildings destroyed on Adonara.
23 10:01:28.4 43.665 141.736 17 D 5.5 5.3 0.9 453 HOKKAIDO, JAPAN REGION. Mw 5.6 (HRV). Mo=3.1*10**17 Nm (HRV). Four people slightly injured on Hokkaido. Felt (IV JMA) at Hokuryu and (III JMA) at Rumoi.
23 22:10:11.8 -55.945 -3.361 10 G 5.4 6.5 1.3 80 SOUTHERN MID-ATLANTIC RIDGE. Mw 6.6 (GS), 6.8 (HRV). Mo=8.5*10**18 Nm (GS). Mo=1.5*10**19 Nm (HRV). Mo=3.3*10**19 Nm (PPT).
26 03:11:17.1 12.115 57.939 62 * 5.4 1.0 224 ARABIAN SEA. MW 6.5 (HRV). Mo=6.1*10**18 Nm (HRV).
27 13:03:52.6 52.629 142.827 11 G 6.7 7.5 0.9 599 SAKHALIN ISLAND. Mw 7.1 (GS), 7.1 (HRV). Ms 7.3 (BRK). Mo=4.3*10**19 Nm (GS). Mo=4.3*10**19 Nm (HRV). Mo=5.6*10**19 Nm (PPT). Mo=1.8*10**19 Nm (OBN). As many as 1,989 people killed, about 750 injured and severe damage (IX) in the Neftegorsk area. Some damage (VII)

occurred at Okha. Felt (VI) at Moskalvo; (V) at Nikolayevsk-na-Amure and Nyvrovo; (IV) at Aleksandrovsk-Sakhalinskiy and Nysh.

JUN 1995

14 11:11:49.5 12.204 -88.349 39 5.6 6.0 1.1 296 OFF COAST OF CENTRAL AMERICA. Mw 6.6 (HRV). Mo=8.5*10**18 Nm (HRV). Mo=2.5*10**19 Nm (PPT).

15 00:15:48.6 38.401 22.269 14 G 6.0 6.5 1.2 409 GREECE. Mw 6.3 (GS), 6.5 (HRV). ML 5.7 (THE). Mo=3.5*10**18 Nm (GS). Mo=5.7*10**18 Nm (HRV). Twenty-six people killed and sixty injured in the Aiyion area. Extensive damage occured at Aiyion and Eratini. Damage also occurred at Corinth, Patras and Pirgos. Preliminary estimate of damage was placed at 660 million US dollars. Felt at Athens, Ioannina, Kalamata, Kardhitsa and Kozani. Also felt on Kefallina.

21 15:28:51.4 -61.621 154.714 10 G 5.6 6.7 1.3 163 BALLENY ISLANDS REGION. Mw 6.8 (GS), 6.8 (HRV). Mo=1.6*10**19 Nm (GS). Mo=2.0*10**19 Nm (HRV). Mo=1.3*10**19 Nm (PPT).

24 06:58:06.5 -3.979 153.945 386 D 6.2 1.0 334 NEW IRELAND REGION, P.N.G. Mw 6.8 (GS). Mo=1.8*10**19 Nm (GS). Mo=4.0*10**19 Nm (PPT).

25 06:59:04.9 24.598 121.725 41 D 5.8 5.5 1.0 222 TAIWAN. Mw 6.0 (GS), 6.0 (HRV). Mo=1.1*10**18 Nm (GS). Mo=1.1*10**18 Nm (HRV). One person was killed, three injured and six houses damaged by landslides in the epicentral area. Felt throughout Taiwan. Also felt (II JMA) on Kin-men and Peng-hu.

29 12:24:03.7 -19.478 169.162 144 D 6.2 1.0 90 VANUATU ISLANDS. Mw 6.7 (GS), 6.6 (HRV). Mo=1.3*10**19 Nm (GS). Mo=8.6*10**18 Nm (HRV). Mo=1.8*10**19 Nm (PPT). Felt on the Loyalty Islands.

JUL 1995

03 19:50:50.1 -29.198 -177.612 33 N 6.5 7.2 1.1 157 KERMADEC ISLANDS, NEW ZEALAND. Mw 7.2 (GS), 7.2 (HRV). Ms 7.2 (BRK). Mo=6.7*10**19 Nm (GS). Mo=6.1*10**19 Nm (HRV). Mo=5.6*10**19 Nm (PPT). Felt (VI) on Raoul Island.

11 21:46:39.7 21.933 99.162 13 D 6.1 7.2 1.3 302 MYANMAR-CHINA BORDER REGION. Mw 6.8 (GS), 6.8 (HRV). Ms 6.9 (BRK). Mo=2.0*10**19 Nm (GS). Mo=2.0*10**19 Nm (HRV). Mo=4.9*10**19 Nm (PPT). Six people killed, 99 injured, more than 100,000 houses destroyed and 42,000 damaged in the Lancang-Menglian-Ximeng area, China. Some buildings were also damaged in Chiang Mai and Chiang Rai Provinces, Thailand.

12 15:46:59.8 -23.237 170.824 33 N 5.9 6.4 1.1 133 LOYALTY ISLANDS REGION. Mw 6.4 (GS), 6.5 (HRV). Mo=5.3*10**18 Nm (GS). Mo=5.5*10**18 Nm (HRV). Mo=3.2*10**18 Nm (PPT).

21 22:44:07.6 36.443 103.105 33 N 5.7 5.4 1.0 311 GANSU, CHINA. Mw 5.6 (GS), 5.6 (HRV). Mo=2.4*10**17 Nm (GS). Mo=3.3*10**17 Nm (HRV). Fourteen people killed, at least 60 injured, 5,000 left homeless, 4,500 houses destroyed and 5,000 houses damaged in the Yongdeng area. Felt at Baiyin, Dingxi, Jingtai, Lanzhou, Tianzhu and Wuwei. Also felt at Xining, Qinghai.

28 14:29:12.2 -21.097 -175.485 102 D 6.1 0.8 407 TONGA ISLANDS. Mw 6.5 (GS), 6.4 (HRV). Mo=5.8*10**18 Nm (GS). Mo=4.5*10**18 Nm (HRV). Mo=1.1*10**19 Nm (PPT).

30 05:11:23.5 -23.364 -70.312 47 G 6.6 7.3 1.0 359 NEAR COAST OF NORTHERN CHILE. Mw 7.5 (GS), 8.1 (HRV). Ms 7.2 (BRK). Mo=2.2*10**20 Nm (GS). Mo=1.7*10**21 Nm (HRV). Mo=2.3*10**21 Nm (PPT). Three people were killed, 58 injured, 630 left homeless and 115 houses destroyed (VII) in the Antofagasta area. Landslides blocked several roads in the Antofagasta area. One person was injured at Mejillones. Several houses were damaged at Calama, Mejillones, San Pedro de Atacama, Taltal and Tocopilla. Felt (VI) at Baquedano, Chuquicamata, Copiapo, Diego de Almagro, Inca de Oro, Iquique, Mejillones, Peine, Sierra Gorda, Taltal, Tierra Amarilla and Tocopilla; (V) at Chanaral, El Salvador,

Significant Earthquakes of the World, 1995

Huasco and Vallenar; (IV) at Arica, Caldera and La Serena. Felt in Buenos Aires, Cordoba, Jujuy, La Rioja, Mendoza, Salta and San Juan Provinces and as far away as Buenos Aires, Argentina. Also felt in southern Peru and (III) at La Paz, Bolivia. Tsunami generated with maximum wave heights (peak- to-trough, in cm) recorded at the following selected tide stations: 55 at Valparaiso, Chile; 10 on Easter Island; 75 at Hilo, 70 at Kahului, 15 at Honolulu and 12 at Nawiliwili, Hawaii; 27 at Crescent City, 25 at Santa Monica, 11 at San Diego and 10 at Los Angeles, California; 30 at Adak, 21 at Sand Point, 20 on Shemya, 10 at Kodiak and 9 at Seward, Alaska; 25 at Pago Pago, American Samoa; 9 at Papeete, Tahiti; 29 at Miyako and 26 at Hachinohe, Japan.

AUG 1995

16 10:27:26.4 -5.809 154.212 16 D 6.4 7.8 1.1 189 SOLOMON ISLANDS. Mw 7.4 (GS), 7.8 (HRV). Ms 7.8 (BRK). Mo=1.5*10**20 Nm (GS). Mo=5.5*10**20 Nm (HRV). Mo=3.1*10**20 Nm (PPT). Minor damage occurred in the epicentral area. Landslides blocked road between Rabaul and Kokopo, New Britain.

16 16:24:26.7 -5.418 153.765 21 G 5.6 6.8 1.1 276 NEW IRELAND REGION, P.N.G. Mw 6.6 (GS). Ms 6.8 (BRK). Mo=9.8*10**18 Nm (GS).

16 23:10:28.9 -5.782 154.256 74 D 6.1 7.2 0.9 185 SOLOMON ISLANDS. Mw 6.9 (GS), 7.2 (HRV). Ms 7.2 (BRK). Mo=2.7*10**19 Nm (GS). Mo=7.3*10**19 Nm (HRV). Mo=5.0*10**19 Nm (PPT).

17 00:15:53.2 -5.951 154.194 33 N 6.0 6.5 1.1 137 SOLOMON ISLANDS. Mw 6.4 (HRV). Mo=4.4*10**18 Nm (HRV).

17 10:01:27.6 -5.176 153.404 33 N 5.5 6.4 1.2 101 NEW IRELAND REGION, P.N.G. Mw 6.4 (GS), 6.4 (HRV). Ms 6.5 (BRK). Mo=3.8*10**18 Nm (GS). Mo=3.8*10**18 Nm (HRV).

19 21:43:32.4 5.096 -75.690 125 D 6.1 0.8 356 COLOMBIA. Mw 6.6 (GS), 6.5 (HRV). Mo=7.5*10**18 Nm (GS). Mo=6.9*10**18 Nm (HRV). Some damage and power outages occurred in the epicentral area. Felt in much of Colombia.

23 07:06:02.6 18.857 145.186 596 D 6.3 0.8 424 MARIANA ISLANDS. Mw 7.0 (GS), 7.0 (HRV). mb 6.3 (BRK). Mo=3.8*10**19 Nm (GS). Mo=4.2*10**19 Nm (HRV). Mo=3.2*10**19 Nm (PPT). Felt on Saipan.

28 10:46:12.9 26.158 -110.349 10 G 5.6 6.5 1.7 205 GULF OF CALIFORNIA.

31 17:10:37.4 -15.826 166.409 33 N 5.9 6.4 0.9 339 VANUATU ISLANDS. Mw 6.3 (GS), 6.4 (HRV). Ms 6.6 (BRK). Mo=3.5*10**18 Nm (GS). Mo=5.1*10**18 Nm (HRV). Mo=8.0*10**18 Nm (PPT).

SEP 1995

14 14:04:31.5 16.808 -98.648 21 G 6.4 7.2 1.1 238 NEAR COAST OF GUERRERO, MEXICO. Mw 7.5 (GS), 7.5 (HRV). Mo=1.8*10**20 Nm (GS). Mo=1.8*10**20 Nm (HRV). Mo=1.3*10**20 Nm (PPT). Three people killed, nearly 100 injured, 500 homeless and extensive damage in Guerrero. Several people injured, 400 homeless and considerable damage in Oaxaca. Some minor damage occurred in Puebla and at Mexico City. Felt strongly along the Pacific coast of Mexico from Michoacan to Chiapas.

17 17:09:19.9 -17.452 66.553 10 G 5.4 6.5 1.0 116 MAURITIUS-REUNION REGION. Mw 6.3 (GS), 6.5 (HRV). Mo=2.8*10**18 Nm (GS). Mo=6.2*10**18 Nm (HRV). Mo=1.0*10**19 Nm (PPT).

OCT 1995

01 15:57:16.0 38.099 30.175 33 N 5.7 6.1 1.0 340 TURKEY. Mw 6.0 (GS), 6.3 (HRV). Mo=1.3*10**18 Nm (GS). Mo=3.5*10**18 Nm (HRV). Mo=5.4*10**18 Nm (PPT). One hundred one people killed, 348 injured, 50,000 homeless and 4,500 houses and buildings damaged or destroyed in the Dinar area. About 600 buildings were destroyed at Evciler. Felt in much of western Turkey as far west as Izmir and as far north as Bursa and Yalova.

03 01:51:24.1 -2.774 -77.884 27 G 6.5 7.0 0.9 487 PERU-ECUADOR BORDER REGION. Mw 6.8 (GS), 7.0 (HRV). Ms 6.9 (BRK). Mo=1.8*10**19 Nm (GS). Mo=3.3*10**19 Nm (HRV). Mo=1.9*10**19 Nm (PPT). Two

people killed, injured and at least 83 homes damaged or destroyed in Ecuador. Some damage at Archidona, Canelos, Limon, Macas, Mendez, Patuca, Puyo, Santiago, Sucua and Tena, Ecuador. Slight damage (V) at Quito, Ecuador. Felt (V) at Ayabaca; (IV) at Chachapoyas and Moyobamba; (III) at Chulucanas, Jaen and Tumbes; (II) at Tarapoto, Peru. Felt in many parts of Ecuador, Peru and in Colombia as far north as Bogota. Two events about 2.6 seconds apart.

06 18:09:45.9 -2.089 101.414 33 N 5.8 6.9 1.2 267 SOUTHERN SUMATERA, INDONESIA. Mw 6.8 (GS), 6.8 (HRV). Mo=1.8*10**19 Nm (GS). Mo=1.5*10**19 Nm (HRV). Eighty-four people killed, 2,178 injured, nearly 65,000 homeless and over 18,900 homes and buildings damaged or destroyed in Jambi Province. Landslides occurred in the epicentral area. Felt in many parts of central Sumatera and as far as southern Malaysia and Singapore.

09 15:35:54.6 19.245 -104.188 33 N 6.5 7.3 1.2 236 NEAR COAST OF JALISCO, MEXICO. Mw 7.6 (GS), 7.9 (HRV). Mo=3.1*10**20 Nm (GS). Mo=7.7*10**20 Nm (HRV). Mo=9.6*10**20 Nm (PPT). At least 38 people killed, 200 injured, nearly 1,000 homeless and substantial damage in the Cihuatlan-Manzanillo area. Ten other people were killed in the state of Jalisco and one person was injured at Puerto Vallarta. Damage occurred in the states of Colima, Guerrero, Jalisco and Michoacan. Felt strongly at Mexico City. Felt as far as Dallas and Houston, Texas and Oklahoma City, Oklahoma. Tsunami generated with maximum wave heights (peak-to-trough) recorded at the following tide stations: 200 cm at Manzanillo, 50 cm at Cabo San Lucas, 20 cm on Isla Socorro and 12 cm at Kahului, Hawaii. Complex event with major subevent occurring about 35 seconds after onset observed on broadband displacement seismograms.

12 16:52:54.2 18.833 -104.012 25 D 5.5 5.5 1.0 246 NEAR COAST OF JALISCO, MEXICO. Mw 6.0 (GS), 6.0 (HRV). Ms 5.2 (BRK). Mo=9.9*10**17 Nm (GS). Mo=1.1*10**18 Nm (HRV). Mo=9.9*10**17 Nm (PPT). Five people injured and some additional damage occurred at Manzanillo. Felt at Mexico City.

18 10:37:26.3 27.920 130.337 27 G 6.5 6.8 1.2 373 RYUKYU ISLANDS. Mw 6.9 (GS), 7.1 (HRV). Ms 6.7 (BRK). Mo=2.7*10**19 Nm (GS). Mo=4.9*10**19 Nm (HRV). Mo=9.0*10**19 Nm (PPT). One person was slightly injured on Amami O-shima. Felt (V JMA) on Kikai-shima and (IV JMA) at Naze, Amami O-shima. Local tsunami generated with wave heights up to 1.8 meters along some coastal areas.

19 02:41:37.9 28.075 130.309 31 G 6.3 6.8 1.3 322 RYUKYU ISLANDS. Mw 6.6 (GS). Ms 6.6 (BRK). Mo=1.0*10**19 Nm (GS). Felt (V JMA) on Amami O-shima. Landslides occurred on Kikai-shima. Local tsunami generated with wave heights up to 1.5 meters along some coastal areas.

21 02:38:57.5 16.890 -93.451 161 G 6.2 1.0 463 CHIAPAS, MEXICO. Mw 7.3 (GS), 7.3 (HRV). Mo=9.1*10**19 Nm (GS). Mo=9.2*10**19 Nm (HRV). Mo=1.5*10**20 Nm (PPT). Several houses damaged at San Andres Larrainzar. Felt strongly in many parts of southern Mexico and at Mexico City. Also felt in many parts of Guatemala. Felt (II) at Metapan, El Salvador.

23 22:46:54.1 25.923 102.227 33 N 5.8 6.4 1.0 196 YUNNAN, CHINA. Mw 6.1 (GS), 6.2 (HRV). Mo=1.5*10**18 Nm (GS). Mo=2.3*10**18 Nm (HRV). At least 36 people killed, 200 injured and more than 100 houses collapsed in the Wuding area. Felt in Sichuan Province and in northern Vietnam.

NOV 1995

01 00:35:32.3 -28.958 -71.503 20 G 6.3 6.4 1.0 351 NEAR COAST OF CENTRAL CHILE. Mw 6.6 (GS), 6.7 (HRV). Ms 6.3 (BRK). Mo=8.6*10**18 Nm (GS). Mo=1.2*10**19 Nm (HRV). Mo=2.1*10**19 Nm (PPT). Felt (VI) at La Serena and (II) at Santiago. Also felt (IV) in Mendoza Province, Argentina.

08 07:14:18.5 1.853 95.062 33 N 6.1 6.9 0.9 314 OFF W COAST OF NORTHERN SUMATERA. Mw 6.9 (GS), 6.9 (HRV). Ms 6.7 (BRK). Mo=2.2*10**19

Nm (GS). Mo=2.6*10**19 Nm (HRV). Mo=2.0*10**19 Nm (PPT). Felt (III) at Gunungsitoli, Nias. Felt (III) at Medan; (II) at Bengkulu and Padangpanjang, Sumatera. Felt at Banda Aceh, Meulaboh, Sigli and Tapaktuan, Sumatera. Also felt in southern Thailand.

22 04:15:11.7 28.818 34.861 10 G 6.2 7.3 1.2 364 EGYPT. Mw 7.0 (GS), 7.2 (HRV). Mo=3.1*10**19 Nm (GS). Mo=7.7*10**19 Nm (HRV). ML 6.2 (JER). At least eight people killed and 30 injured in the epicentral region, including two killed and 11 injured at Nuwaybi. Damage occurred in many parts of northeastern Egypt as far away as Cairo. One person was killed and two slightly injured at Al Bad, Saudi Arabia. Some damage occurred at Al Bad, Al Ula and Haql, Saudi Arabia. One person died of a heart attack, several people were injured and substantial damage with power outages and liquefaction occurred at Elat, Israel. Some damage also occurred at Jerusalem, Israel and Aqaba, Jordan. Felt from Sudan to Lebanon. High waves were reported along the coast at Aqaba, Jordan.

24 17:24:12.5 44.542 149.091 33 N 6.1 6.3 0.9 432 KURIL ISLANDS. Mw 6.4 (GS), 6.6 (HRV). Ms 6.1 (BRK). Mo=5.3*10**18 Nm (GS). Mo=8.2*10**18 Nm (HRV).

DEC 1995

01 05:20:27.7 10.054 -104.053 10 G 5.6 6.2 1.0 92 OFF COAST OF MEXICO. Mw 6.5 (GS), 6.6 (HRV). Mo=7.3*10**18 Nm (GS). Mo=7.9*10**18 Nm (HRV). Mo=1.1*10**19 Nm (PPT).

02 17:13:20.7 44.672 149.221 33 N 5.9 6.5 0.9 124 KURIL ISLANDS

03 18:01:08.5 44.568 149.375 33 N 6.6 8.0 1.1 402 KURIL ISLANDS

03 18:01:08.7 44.660 149.380 33 N 6.8 8.0 1.0 176 KURIL ISLANDS. Mw 7.8 (GS), 7.9 (HRV). Mo=6.5*10**20 Nm (GS). Mo=8.0*10**20 Nm (HRV). Felt (V) on Iturup, (IV) on Matua and (III) on Kunashir. Felt (II JMA) at Akkeshi, Kushiro and Urakawa, Hokkaido. Also felt (II JMA) at Aomori and Mutsu, Honshu. Local tsunami generated with maximum wave heights (peak-to-trough) recorded at the following tide stations: 17 cm at Nemuro and 10 cm at Kushiro, Hokkaido; 13 cm at Hachinohe and 6 cm at Ayukawa, Honshu.

03 18:14:27.8 44.845 150.687 33 N 6.4 6.6 1.1 291 EAST OF KURIL ISLANDS

03 21:38:38.0 44.697 150.299 33 N 5.7 6.5 1.1 259 EAST OF KURIL ISLANDS

10 22:23:14.7 44.331 149.784 33 N 5.6 6.4 1.0 180 KURIL ISLANDS. Mw 6.5 (GS), 6.3 (HRV). Mo=6.1*10**18 Nm (GS). Mo=3.6*10**18 Nm (HRV). Felt (III) on Iturup.

19 20:56:06.1 15.274 -90.060 10 G 5.0 4.8 1.4 52 GUATEMALA. One person killed and one person injured by rockslides at Tactic. Some houses damaged at San Miguel Tucuru and Tamahu. Landslides occurred in the epicentral area. Felt (IV) at Coban and (III) at Guatemala City.

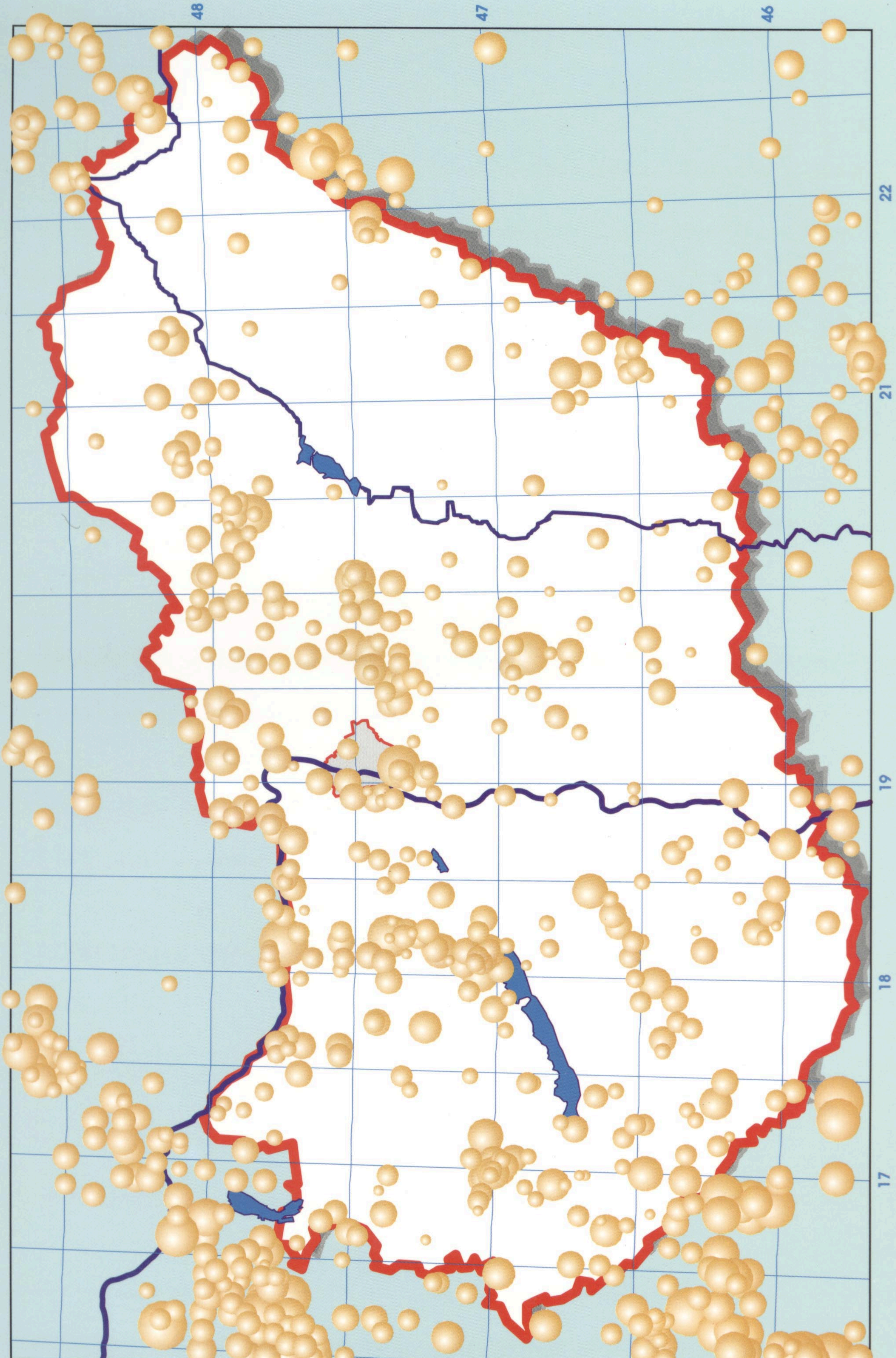
19 23:28:12.8 -3.694 140.268 71 D 6.2 1.1 56 IRIAN JAYA, INDONESIA. Mw 6.5 (GS). Mo=6.0*10**18 Nm (GS). Mo=6.0*10**18 Nm (PPT). Felt (IV) at Jayapura and Wamena; (III) at Tanahmerah; (II) at Nabire.

25 04:43:24.9 -6.943 129.179 150 D 6.2 1.4 277 BANDA SEA. Mw 7.1 (GS), 7.1 (HRV). Mo=4.5*10**19 Nm (GS). Mo=4.7*10**19 Nm (HRV). Mo=8.2*10**19 Nm (PPT). Felt (VI) at Saumlaki; (IV) at Ambon and Tual.

Hypocenters for June through December to be recomputed.

Compiled by Waverly J. Person

Historical Seismicity in Hungary (456 – 1994)



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