

RELATIONSHIPS BETWEEN INSTRUMENTAL GROUND MOTION PARAMETERS, AND MODIFIED MERCALLI INTENSITY IN GUERRERO, MEXICO

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ABSTRACT :

This paper presents regression relationships between Modified Mercalli Intensity (MMI) and peak ground acceleration (PGA), and between MMI and peak ground velocity (PGV), for ten Mexican Pacific earthquakes. Correlations were developed for the MMI range of III \leq IMM \leq IX. When these relationships are compared with others correlations of California reported by others investigators, we found significant differences. Thus, PGA relationship are higher than those obtained in this study. But PGV relations are similars in higher intensities. In order to estimate expected response spectra for the July 18, 1957, Guerrero Earthquake, period dependence was associated, using results of regressions of observed response spectra with MMI, from accelerations from ten earthquakes.

KEYWORDS: Modified Mercalli Intensity, Ground motion parameters, Regression relationships.

1. INTRODUCTION

The seismic intensity traditionally has been used as a parameter for quantify the pattern of shock and the extension of the damage caused by earthquakes. Although it has been used before the coming of the present modern seismic instrumentation, continues providing useful means of description of the shock level, in a simplified way. Since a long time, attempts have been in order to establish relations among the Mercalli Modified Intensity (MMI), the Peak Ground Acceleration (PGA), and the Peak Ground Velocity (PGV), when relating the records of the strong ground motion to the intensities observed during strong earthquakes (see for example Wood and Neumann, 1931; and Richter, 1958). Later, from the studies of Trifunac and Brady (1975) on this subject, until today, a considerably great amount of data exists on strong ground motion, particularly from earthquakes with important intensity. When PGA is related with the MMI a useful criterion is to correlate only those values of the stations located at no more of 3 kilometers of the observed intensity.

The first comparisons between the peak of the ground movements and intensities were based mainly on the regressions of intensity with PGA, and in few cases, with the velocity, and with the maximum displacement. The goal of this study is to develop relations that can be used to estimates accelerations and velocities of past earthquakes, which seismic intensities are known, as well as inferring approximated values of PGA and PGV during future earthquakes.

2. RELATIONS BETWEEN SEISMIC INTENSITY AND STRONG GROUND MOTIONS PARAMETERS

In Table 2.1 is presented a summary of several relations of the Intensities with PGA, with PGV, or with PGD. These relations were developed for different seismic regions of the world (see Trifunac and Brady (1975). Thus, in the decade of the 40s and 50s, Gutenberg and Richter in 1942, Kawasumi in 1951 (see Trifunac and Brady, 1975), Neumann in 1954 (see Trifunac and Brady, 1975), and Hershberger in 1956, they were first in developing functional of the form: log a = A+B*I, where a is the PGA, A and B are adjustment coefficients, and I is the seismic intensity. Each one of those expressions is applicable only to the region from which the data

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belong. Trifunac and Brady (1975), considered horizontal and vertical components separately, as can be observed in the functional of Table 2.1. Also, they grouped the records in such way that the effect of geology in each level of intensity could be identified. When their results are compared, they find that the values for acceleration, velocity and displacement are greater than those obtained in previous works.

Author	Relation	Interval	Region
Gutenberg-Richter (1942)	$\log a = -0.5 + 0.33$ I	MM	
Kawasumi, (1951)*	$\log \bar{a} = -0.35 + 0.5\mathbf{I}$	JMA	Japan
Neumann, (1954) *	$\log a = -0.041 + 0.308$ I	Between 15 and 25 millas	
Hershberger, (1956)	$\log a = -0.9 + 0.43$ I		
*Trifunac-Brady, (1975)	$\log a_{\rm v} = -0.18 + 0.30 I_{\rm MM}, \log a_{\rm H} = 0.014 + 0.30 I_{\rm MM}$ $\log v_{\rm v} = -1.10 + 0.28 I_{\rm MM}, \log v_{\rm H} = -0.63 + 0.25 I_{\rm MM}$	$IV < I_{MM} < X$ $IV \le I_{MM} \le X$	West USA
	$\log d_v = -1.13 + 0.24 I_{MM}$, $\log d_H = -0.53 + 0.19 I_{MM}$	$V \leq I_{MM} \leq X$	
Barrientos, (1980)	I=1.3844M-3.7355log ₁₀ (r)-0.0006r+3.8461 I-Intensity, r: Hip. Dist. (km), M: Magnitude Ms		Chile
Wald, et al., (1999)	$I_{mm} = 3.66 \log(PGA) - 1.66; (\sigma = 1.08)$ $I_{mm} = 3.47 \log(PGV) + 2.35; (\sigma = 0.98)$	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	California
Boatwright, et al., (2006)	$I_{instr} = 3.66 logPGA + 1.99 PGA (%g)$ $I_{instr} = 3.47 logPGV + 2.35 PGV (cm/seg)$	$I_{instr} \leq 5$ $I_{instr} \geq 6 \qquad MM$	San Fco California
D. Benouar, (2007)	$\begin{array}{l} Msc=A_1+A_2(I_i)+A_3(R_i)+A_4logR_i+\sigma P\\ I=B_1+B_2(Ms)+B_3(R)+B_4logR+\sigma P \end{array}$		Algeria
Atkinson and Kaka (2007)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	MMI <0.48 MMI <u>></u> 0.48	California

Table 2.1 Data for relations from several studies.

More recently, Wald et al. (1999) obtained relations, that define the intensity from the acceleration or from the velocity, as I_{mm} = A log (PGA) +B, and I_{mm} = C log (PGV) +D, respectively. These relations are applicable for a range of MMI between V-VIII and V-IX, respectively. Their results determine values considerably greater than those obtained by Trifunac and Brady (1975). On the other hand, Boatwright et al. (2006), developed expressions for California, as much for the acceleration as for the velocity. They extended their study when considered relations between MMI and pseudo-acceleration spectra, with the purpose of considering maps based on spectral ordinates for the San Francisco earthquake of 1906. Atkinson and Kaka (2007) propose an equation that relates MMI with instrumental parameters. This relation is based on data of moderate earthquakes of the central region of the United States. These data correspond to acceleration records and seismograms. The data were calibrated and extrapolated from observations of California earthquakes in order to determine maps of strong movement.

Additionally, several expressions have been developed to correlate Intensity I, with magnitude. Some cases are presented in Table 2.1, like Benouar (2007) that related the intensity, the magnitude and the distance. On the other hand, Barrientos (1980), related the intensity to the magnitude and the hypocentral distance for Chilean subduction earthquakes. Whereas Lopez Casados et al. (2000), presented relations for the Iberian Peninsula according to the MSK European scale

3. SISMICITY IN GUERRERO MEXICO

In the Guerrero State occurs about 25% of the total seismicity of the Mexican territory. This is due to the subduction of the Cocos Plate under the North American Plate. The contact between these tectonic plates happens in the Mexican Pacific coasts, since the State of Jalisco, to the state of Chiapas. The Guerrero Gap considers a site with high seismicity, and a high probability of occurrence of a destructive event, like the earthquake of July, 28 of 1957. The earthquake of 1957 with magnitude M=7.8, caused severe damages both in the City of Mexico, and the city of Chilpancingo, Capital of Guerrero State. A value of IX in MMI scale was assigned close to the epicenter. In the corresponding intensities map for this event, stand out two pronounced zones, one in Chilpancingo and other in the City of Mexico.



An intensity of VIII was assigned to the city of Chilpancingo for the 1957 earthquake (Duke et al., 1959). It was considered that approximately a third of the buildings between one and three storey, had some type of damages, since cracks to the complete collapse of the structure. It was not observed any variation in the pattern of the damage among the several types of construction: masonry, adobe, and structures of reinforced concrete. During the earthquake, the buildings in construction, suffered a serious damage. Systematic variation in the damage between buildings located on slopes with respect to other buildings located on the bottom of the valley was not observed, except some damage in the direction West of the slope of the valley. The city of Chilpancingo is located in the central part of a valley which rest on not consolidated alluvium deposits of more than 100 meters. If variation of the geologic conditions near the surface is considered, it is possible to be explained partially, the great intensity observed in the city of Chilpancingo.

4. RELATIONS BETWEEN PGA, PGV AND SEISMIC INTENSITY IN GUERRERO MEXICO

In this study we used information of iso-intensities maps from ten earthquakes of great magnitude, which affected to the Guerrero state, and specially to the city of Chilpancingo. In addition, maps with the lines of equal horizontal PGA (iso-accelerations) were constructed, corresponding to all the studied earthquakes. These ten earthquakes with magnitudes between 6.8 and 8.1, (see Table 4.1), all they have caused a considerable intensity in the city of Chilpancingo. In Figure 1 are presented simultaneously both maps (MMI and PGA) for all the earthquakes. The used records correspond to stations located on firm soil.



Figure 1. MMI intensities and contours of accelerations for the studied earthquakes.





Figure 1 (cont). MMI intensities and contours of accelerations for the studied earthquakes.

	Table	4.1 Data 101	eartinquakes	used in this st	.udy		
Seismic source	Date (GMT)	Time, GMT	Latitude N	Longitude W	Depth (km)	Mag.	MMI
Central Guerrero	1979/03/14	11:07:15	17.75	-101.26	25	7.4	VIII
Depth	1980/10/24	14:53:36	18.17	-98.22	65	7.1	IX
Ometepec	1982/06/07	06:52:33	16.42	-98.25	6	6.9	VIII
Ometepec	1982/06/07	10:59:40	16.52	-98.34	19	7.0	VIII
Michoacan	1985/09/19	13:17:49	18.42	-102.47	15	8.1	IX
Michoacan	1985/09/21	01:37:14	17.828	-101.681	17	7.6	IX
Acapulco-S.M.	1989/04/25	14:29:03	16.80	-99.28	23	6.8	VII
Ometepec	1995/09/14	14:04:33	16.75	-98.67	21	7.3	VIII
Depth	1999/06/15	20:42:00	18.13	-97.53	60	7.0	VIII
Oaxaca	1999/09/30	16:31:13	16.06	-97.00	39	7.4	VIII

Table 4.1 Data for earthquakes used in this study



Table	4.2 Dates	s used m	uns si	uuy ioi	estimate	ine relatio	JIS De	tween w	nvn and i	UA 01 F	Gν
station	PGA_{H} (cm/sec ²)	PGV _H (cm/sec)	MMI	station	PGA_{H} (cm/sec ²)	PGV _H (cm/sec)	MMI	Station	PGA_{H} (cm/sec ²)	PGV _H (cm/sec)	MMI
Earthquak	(em/see) (e: March 14	. 1979		INMD	34.17	2.24	VI	CHIL	21.95	1.41	V
ACAP	35.87	2.00	V	PAPN	249.41	9.13	VIII	COMD	17.13	2.37	ĪV
APAT	61.33	2.80	VI	PARS	577.48*	20.05*	VII	COPL	10.20	1.75	IV
CALT	119.68	3.46	VII	SUCH	81.93	11.20	VII	COYC	9.07	2.26	III
CU01	19.65	1.95	V	SXPU	24.82	2.21	V	COYO	9.83	0.87	III
INCM	118.54	6.20	VIII	TEAC	32.32	6.98	V	CSER	195.40	17.65	VIII
SICS	157.10	8.29	VIII	TXCL	35.14	5.83	VI	CUER	45.01	3.03	VI
SXCU	16.21	1.37	V	UNIO	87.93	13.36	VII	HUIG	13.02	-	III
SXPU	15.22	2.03	v	VILE	46.23	14.08	VI	IGUA	19.53	1.28	V
TXSO	52.49	5.14	VI	VNTA	15.80	2.96	V	INMI	7.87	0.52	т Ш
Earthquak	ce: October 2	4 1980	• •	XALT	16.39	4.06	v	INMI	7.87	0.52	m
ACAS	18 37	0.65	IV	ZACA	79.15	9.82	VII	LVIG	4 65	0.44	Ш
MINA	9.95	0.51	III	Earthqua	ke: April 25	1989		MADR	6.00	2.99	IV
OAXM	158.68	3.17	VII	ACAP	101.18	6.06	VII	MEZC	28.91	2.23	V
PAIA	31.31	1 23	IV	ATYC	18.08	2.93	V	OCU	8 73	1.16	т Ш
SXCU	27.22	1.25	V	CAMI	28.92	2.55	VI	OXIG	37.82	1.10	VI
SYPLI	78.60	5.45	VI	COMD	8 80	2.05	IV	DENI	2.81	0.22	m
SXIO	34.28	3.45	VI	CONID	103.82	2.00	VII	DET2	3.74	0.22	m
TEMD	<u> </u>	1.48	VI	COVC	81.05	3.06	VII	PNIG	3.74	0.88	m
TYCI	40.71	3.67	VI	CPDP	01.05	8.67	VII	POZU	10.49	1 72	IV IV
Farthquel	+/.0/	3.07	V 1	CSEP	15 52	0.07	VII IV	RICC	17.40	1.72	I V VI
CH11	57 17	4 07	VI	CUO2	13.33	4.11	IV	RITC	5 45	1 27	VI IV
CU01	J/.1/ 11.60	4.9/		FIC2	12.49	4.03	1V V	SMP2	0.43 0.10	1.2/	IV
MADM	11.69	1.0/		FIC2	15.93	3.97	V	SMK2	8.10	1.45	
MADM	12.81	0.79		LLAV	7.10	1.86		SOLI	5.51	0.75	
OAAM	51.49	1.//	VI	MAGY	/.10	1.80		TNUD	41.29	5.55	V
SMAK	51.48	1.52	VI	MSAS	108.78	10.89	VII	INLP	36.46	5.97	V
	34.54	4.89	v	OCLL	33.65	2.81	VI	UNIO	2.53	0.94	
Earthquak	ce: Septembe	r 19, 1985	N/T	DUCTI	208.45*	9.50	VII	VIGA	18.07	2.44	
ACAP	27.70	1.62	VI	PARS	116.90	4.57	VII	VNIA	/.16	1.00	
APAI	81.30	9.43	VII	SMR2	164./3	36.90*	VII	YAIG	66.65	2.79	VI
ALYC	59 X0	X 34	V I I		14 44	4 //1	11/	7117	1 110	11 / 6	
	57.00	0.54	VII	ILAC	13.93	3.70	1 V	ZIIO	1.98	0.50	III
AZIH	155.26	21.61	IX	VNTA	58.94	7.12	VII	Earth	quake: Septe	0.36 ember 30, 19	999 111
AZIH CALE	155.26 152.21	21.61 34.52	IX IX	VNTA VIGA	58.94 314.63*	7.12 24.19*	VII VII	Earth ACAJ	1.98 quake: Septe 9.29	0.56 ember 30, 19 0.65	111 999 IV
AZIH CALE CAMI	155.26 152.21 84.25	21.61 34.52 5.49	IX IX VII	VNTA VIGA XALT	58.94 314.63* 57.99	7.12 24.19* 5.82	VII VII VI	Earth ACAJ ANGI	1.98 quake: Septe 9.29 3.59	0.36 ember 30, 19 0.65 0.30	III 999 IV III
AZIH CALE CAMI CHI1	155.26 152.21 84.25 177.08	21.61 34.52 5.49 17.22	IX IX VII IX	VNTA VIGA XALT Earthqua	13.95 58.94 314.63* 57.99 ke: Septembe	7.12 24.19* 5.82 er 14, 1995	VII VII VI	Earth ACAJ ANGI CAIG	1.98 aquake: Septe 9.29 3.59 5.18	0.36 ember 30, 19 0.65 0.30 0.38	III 099 IV III III
AZIH CALE CAMI CHI1 COYC	155.26 152.21 84.25 177.08 42.00	21.61 34.52 5.49 17.22 7.81	VII IX IX VII IX VI	VNTA VIGA XALT Earthqua ACAJ	13.93 58.94 314.63* 57.99 ke: Septembe 13.80	5.70 7.12 24.19* 5.82 er 14, 1995 1.84	VII VII VI VI	Earth ACAJ ANGI CAIG CARI	1.98 quake: Septe 9.29 3.59 5.18 10.13	0.30 ember 30, 19 0.65 0.30 0.38 0.97	III 099 IV III III IV
AZIH CALE CAMI CHI1 COYC CPDR	155.26 155.26 152.21 84.25 177.08 42.00 25.80	21.61 34.52 5.49 17.22 7.81 3.89	IX IX VII IX VI VI VI VI	VNTA VIGA XALT Earthqua ACAJ ATYC	13.93 58.94 314.63* 57.99 ke: September 13.80 7.32	7.12 24.19* 5.82 er 14, 1995 1.84 0.94	VII VII VI VI	Earth ACAJ ANGI CAIG CARI CENA	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89	III 099 IV III III IV IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10	21.61 34.52 5.49 17.22 7.81 3.89 9.45	VII IX VII IX VII VI VI VI VI	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG	13.93 58.94 314.63* 57.99 ke: September 13.80 7.32 6.04	7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08	VII VII VI VI IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47	III 999 IV III IV IV III
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62	VII IX VII IX VI VI VI VI VI VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI	13.99 58.94 314.63* 57.99 ke: September 13.80 7.32 6.04 9.50	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18	VII VII VI VI IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHII	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26	III 999 IV III IV IV IV IV IV IV IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25	VII IX VII IX VI VI VI VI VII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COM	13:93 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6.04 9.50 29:09	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65	VII VII VI VI VI IV IV VI	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72*	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20*	III 999 IV III IV IV IV IV IV IV IV IV III V III
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI	155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 9.78	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40	VII IX IX VII IX VI VI VI VII VII VIII IV	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL	13:93 58:94 314.63* 57.99 ke: Septembo 13.80 7.32 6.04 9.50 29.09 75.03	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94	IV VII VII VI IV IV IV VI	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 4.21	III 099 IV III IV IV IV III V II VI V
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS	155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30	$\begin{array}{r} 31.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.60\end{array}$	VII IX IX VII IX VII VI VI VII VII VIII VIII VVII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUED	13:93 58:94 314.63* 57.99 ke: Septembo 13:80 7.32 6.04 9.50 29:09 75:03 12:10	7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45	IV VII VII VI IV VII VII	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.19	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.00	III 999 IV III IV VI IV V IV
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT DADY	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66	$\begin{array}{r} 31.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.68\\ 8.60\end{array}$	VII IX IX VII IX VII VI VI VII VIII IV VIII IV VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CLUY	13:93 58:94 314.63* 57.99 ke: Septembo 13:80 7.32 6.04 9.50 29:09 75:03 12:10 12:90	7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36	IV VII VII VI V IV IV IV VII VII VII VII IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ COSEP	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90	III 999 IV III III IV III V III V V V V V V V
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PAPN	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 100.02	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69	VII IX IX VII IX VII VI VII VIII IV VIII IV VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAMI CHIL COPL COYC CUER CUP1 LCU4	13:33 58:94 314:63* 57:99 ke: Septembe 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19	IV VII VII VI V IV IV IV VII VII VII IV IV IV IV IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.12	III 099 IV III III IV III V III V III V III V IV V IV V V V VI VI V VI
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS CUCY	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92	$\begin{array}{r} 31.54\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.22\end{array}$	VII IX VII IX VII IX VII VI VII VII VIII IV VIII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.32	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13	III IV III IV III IV III IV III V III VV VI V VI V VI
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03	$\begin{array}{c} 3.54\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ \hline 4.62\\ 8.25\\ 2.40\\ \hline 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ \hline 7.66\end{array}$	VII IX VII IX VII IX VII VII VII VIII VIII VIII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.55	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77*	III 999 IV III IV IV IV IV IV IV V II VV V VI VI VII VVI
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60	$\begin{array}{c} 3.94\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ \hline 4.62\\ 8.25\\ 2.40\\ \hline 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ \hline 7.09\\ 2.52\end{array}$	VII IX VII IX VII IX VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAYY	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76 13:20	3.70 7.12 24.19* 5.82 pr 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 2.52	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05	0.36 ember 30, 19 0.65 0.30 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86	III 999 IV III IV IV IV IV IV IV V II V VI V VIII IV
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11	$\begin{array}{r} 3.94\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ \hline 4.62\\ 8.25\\ 2.40\\ \hline 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ \hline 7.09\\ 8.52\\ 2.55\\ \hline 2.55\\ \hline 2.55\\ \hline 3.55\\ $	VII IX VII IX VII IX VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VIII VIII VII VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OAXM	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76 13:20 42:63	$\begin{array}{r} 3.70 \\ \hline 7.12 \\ 24.19^* \\ 5.82 \\ \hline 5.82 \\ er 14, 1995 \\ \hline 1.84 \\ 0.94 \\ \hline 1.08 \\ \hline 1.18 \\ 2.65 \\ \hline 11.94 \\ \hline 1.45 \\ 3.36 \\ \hline 4.19 \\ \hline 1.32 \\ \hline 1.30 \\ \hline 1.05 \\ 3.52 \\ \hline 5.0 \\ \hline \end{array}$	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23	III 999 IV III IV IV IV IV IV IV IV V VI V VIII IV IV
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90	$\begin{array}{r} 3.94\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ \hline 4.62\\ 8.25\\ 2.40\\ \hline 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ \hline 7.09\\ 8.52\\ 35.16\\ \hline 42.515\end{array}$	VII IX VII IX VII IX VII VI VII VII VIII VIII VIII VIII VIII VIII VIII VIII VII VII VII VII IX	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCCLL	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76 13:20 42:63 11:70	3.70 7.12 24.19* 5.82 pr 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 2.22	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59	0.36 ember 30, 19 0.65 0.30 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61	III 999 IV III IV IV IV IV IV IV IV IV IV V VI V VIII IV III
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE	155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 10.01	$\begin{array}{r} 3.94\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ 7.09\\ 8.52\\ 35.16\\ 42.51*\\ \end{array}$	VII IX VII IX VII IX VII VI VII VII VII VIII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VII VII VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT DOZU	13.33 58.94 314.63* 57.99 ke: Septembo 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10	$\begin{array}{r} 3.70 \\ \hline 7.12 \\ 24.19^* \\ 5.82 \\ \hline 5.82 \\ er 14, 1995 \\ \hline 1.84 \\ 0.94 \\ \hline 1.08 \\ \hline 1.18 \\ 2.65 \\ \hline 11.94 \\ \hline 1.45 \\ 3.36 \\ \hline 4.19 \\ \hline 1.32 \\ \hline 1.30 \\ \hline 1.05 \\ 3.52 \\ \hline 1.29 \\ \hline 3.23 \\ \hline 1.20 \end{array}$	IV VII VII V IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61 1.52	III 999 IV III IV V VI V VIII IV III IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA	155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 22.62	$\begin{array}{r} 3.94\\ \hline 21.61\\ \hline 34.52\\ \hline 5.49\\ \hline 17.22\\ \hline 7.81\\ \hline 3.89\\ \hline 9.45\\ \hline 4.62\\ \hline 8.25\\ \hline 2.40\\ \hline 4.13\\ \hline 5.68\\ \hline 8.69\\ \hline 10.20\\ \hline 14.32\\ \hline 7.09\\ \hline 8.52\\ \hline 35.16\\ \hline 42.51*\\ \hline 8.77\\ \hline 7.67\end{array}$	VII IX IX VII IX VII VI VI VII VII VII VII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU DBC	13:33 58:94 314:63* 57:99 ke: Septembo 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76 13:20 42:63 11:70 60:10 60:10 41:70	$\begin{array}{r} 3.70 \\ \hline 7.12 \\ 24.19^* \\ \hline 5.82 \\ er 14, 1995 \\ \hline 1.84 \\ 0.94 \\ \hline 1.08 \\ \hline 1.18 \\ 2.65 \\ \hline 11.94 \\ \hline 1.45 \\ 3.36 \\ 4.19 \\ \hline 1.32 \\ \hline 1.30 \\ \hline 1.05 \\ 3.52 \\ \hline 1.29 \\ 3.23 \\ \hline 1.38 \\ \hline 2.65 \\ \hline 11.94 \\ \hline 2.65 \\ \hline 11.94 \\ \hline 2.65 \\ \hline 11.94 \\ \hline 3.36 \\ \hline 3.6 \\ \hline 5.6 \\ \hline 5.6 \\ \hline 5.6 \\ \hline 5.8 \\$	IV VII VII VI IV VI VI VI VI VI VI VI VI VI	Earth ACAJ ANGI CAIG CARI CENA CHII COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61 1.52 0.90	III 999 IV III IV IV IV IV IV III V VI VV VV VV VIII IV IV VIII IV IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63	$\begin{array}{r} 31.61\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ 7.09\\ 8.52\\ 35.16\\ 42.51*\\ 8.77\\ 7.65\end{array}$	VII IX IX VII IX VII VI VI VII VII VIII VVI VIII VVI VIII VIII VIII VIII VII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC	13:33 58:94 314:63* 57:99 ke: Septembol 13:80 7:32 6:04 9:50 29:09 75:03 12:10 12:90 11:80 7:78 5:76 13:20 42:63 11:70 60:10 41:70 13:80	$\begin{array}{c} 3.70 \\ \hline 7.12 \\ 24.19^* \\ \hline 5.82 \\ er 14, 1995 \\ \hline 1.84 \\ 0.94 \\ 1.08 \\ 1.18 \\ 2.65 \\ \hline 11.94 \\ 1.45 \\ 3.36 \\ \hline 4.19 \\ 1.32 \\ 1.30 \\ 1.05 \\ 3.52 \\ \hline 1.29 \\ 3.23 \\ \hline 1.38 \\ 3.95 \\ \hline \end{array}$	IV VII VII VI IV VI VI V	Earth ACAJ ANGI CAIG CARI CENA CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61 1.52 0.90 1.31	III 099 IV III IV IV IV IV IV III VV VI VV VI IV IV III IV VIII IV III IV IV III IV III IV III IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16	$\begin{array}{r} 31.61\\ 21.61\\ 34.52\\ 5.49\\ 17.22\\ \hline 7.81\\ 3.89\\ 9.45\\ 4.62\\ 8.25\\ 2.40\\ 4.13\\ 5.68\\ 8.69\\ 10.20\\ 14.32\\ \hline 7.09\\ 8.52\\ 35.16\\ 42.51*\\ 8.77\\ \hline 7.65\\ \textbf{35.96}\\ \textbf{35.96} \end{array}$	VII IX VII IX VII VI VI VII VIII VIII VIII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VIII VIII VIII VIII VIII VIII	VNTA VVIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC	13:33 58:94 314.63* 57.99 ke: Septembo 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90	$\begin{array}{r} 3.70\\ \hline 7.12\\ \hline 24.19*\\ \hline 5.82\\ \mbox{sr} 14, 1995\\ \hline 1.84\\ \hline 0.94\\ \hline 1.08\\ \hline 1.18\\ \hline 2.65\\ \hline 11.94\\ \hline 1.45\\ \hline 3.36\\ \hline 4.19\\ \hline 1.32\\ \hline 1.30\\ \hline 1.05\\ \hline 3.52\\ \hline 1.29\\ \hline 3.23\\ \hline 1.38\\ \hline 3.95\\ \hline 0.88\\ \mbox{sr} \\ \end{array}$	IV VII VI VI IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23	$\begin{array}{c} 0.36\\ ember 30, 19\\ 0.65\\ 0.30\\ 0.38\\ 0.97\\ 4.89\\ 0.47\\ 1.26\\ 0.20*\\ 4.21\\ 1.22\\ 0.90\\ 6.00\\ 2.13\\ 3.77*\\ 1.86\\ 0.23\\ 0.61\\ 1.52\\ 0.90\\ 1.31\\ 5.85\\ \end{array}$	III 099 IV III IV IV IV IV IV IV IV IV V IV V VI VV VIII IV IV VIII IV IV VIII IV VIII IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthqual	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985	VII IX IX VII VII VI VI VII VIII VIII VIII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VIII VIII VIII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUPI IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC	13:33 58:94 314.63* 57.99 ke: Septembe 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70	3.70 7.12 24.19* 5.82 st 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70	IV VII VII VI IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61 1.52 0.90 1.31 5.85 0.91	III IV III IV IV IV IV IV IV V II VV VI IV VI IV VIII IV VIII IV VIII IV VIII IV VIII III IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquak ACAP	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88	VII IX IX VII VII VI VI VII VIII VIII VIII VIII VIII VIII VIII VIII VII VII VI IX VIII V VI IX	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP	13:33 58:94 314.63* 57.99 ke: Septembe 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.75	$\begin{array}{r} 3.70 \\ \hline 7.12 \\ \hline 24.19^* \\ 5.82 \\ \mbox{or}\ 14, 1995 \\ \hline 1.84 \\ \hline 0.94 \\ \hline 1.08 \\ \hline 1.18 \\ \hline 2.65 \\ \hline 11.94 \\ \hline 1.45 \\ \hline 3.36 \\ \hline 4.19 \\ \hline 1.32 \\ \hline 1.30 \\ \hline 1.05 \\ \hline 3.52 \\ \hline 1.29 \\ \hline 3.23 \\ \hline 1.38 \\ \hline 3.95 \\ \hline 0.88 \\ \hline 1.70 \\ \hline 2.66 \\ \hline \end{array}$	IV VII VII VI IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58	0.36 ember 30, 19 0.65 0.30 0.38 0.97 4.89 0.47 1.26 0.20* 4.21 1.22 0.90 6.00 2.13 3.77* 1.86 0.23 0.61 1.52 0.90 1.31 5.85 0.91 0.69	III IV III IV IV IV IV IV IV V II VV VI IV VI IV VIII IV VIII III IV VIII III IV VIII
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthqual ACAP	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07	IX IX IX VII IX VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VII VII VI IX V V V V V V V V	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA	13:33 58:94 314.63* 57.99 ke: Septembe 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06	$\begin{array}{r} 3.70 \\ \hline 7.12 \\ \hline 24.19^* \\ 5.82 \\ \hline 7.12 \\ \hline 24.19^* \\ \hline 7.12 \\ \hline 9.10 \\ \hline 1.12 \\ \hline 1.84 \\ \hline 0.94 \\ \hline 1.84 \\ \hline 0.94 \\ \hline 1.84 \\ \hline 1.08 \\ \hline 1.18 \\ \hline 2.65 \\ \hline 11.94 \\ \hline 1.45 \\ \hline 3.36 \\ \hline 4.19 \\ \hline 1.32 \\ \hline 1.30 \\ \hline 1.05 \\ \hline 3.52 \\ \hline 1.29 \\ \hline 3.23 \\ \hline 3.23 \\ \hline 1.38 \\ \hline 3.95 \\ \hline 0.88 \\ \hline 1.70 \\ \hline 2.66 \\ \hline 10.05 \\$	IV VII VII VI IV VI IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline 0.mber 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.61\\ \hline 1.52\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.$	III IV III IV IV IV IV IV IV V II VV VI IV VIII IV VIII IV VIII IV III IV VIII IV III IV
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthqual ACAP APAT ATYC	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59 78.68	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73	VII IX IX VII IX VII VII VII VII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VI IX V V V V V V V V V V V VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA Ea	13:33 58:94 314.63* 57.99 ke: Septembe 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 13.80 5.90 11.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju	3.70 7.12 24.19* 5.82 rt 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 n.170 2.66 10.05	IV VII VII VI IV VI VII	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline 0.mber 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.61\\ \hline 1.52\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \end{array}$	III IV III IV III IV IV IV IV IV IV V IV VV VIII IV IV VIII IV III IV VIII IV III IV VIII IV VIII IV VIII IV VIII IV VIII V VIII VIII VIII VIII VIII
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquak ACAP APAT ATYC AZIH	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59 78.68 142.40	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21	VII IX IX VII IX VII VII VII VII VII VIII VIII VIII VIII VII VII VII VII VII VI IX V V IX V V V VII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA Ea ACAJ	13:33 58:94 314.63* 57.99 ke: September 13:80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju 5.69	3.70 7.12 24.19* 5.82 rt 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 ne 15, 1999 0.52	IV VII VII VI IV VI VI VI VI VI VI VI VI VI IV VII IV IV IV IV IV IV IV IV IV III	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline ember 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.61\\ \hline 1.52\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \end{array}$	III IV III IV III IV IV IV IV IV IV IV V VI VV VIII IV III IV VIII IV VIII III IV VIII IV VIII III IV VIII III III III III III III III III III
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquał ACAP APAT ATYC AZIH CARI	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59 78.68 142.40 62.41	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21 1.48	VII IX IX VII IX VII VII VII VII VII VIII VIII VIII VIII VIII VII VII VII VII VII VII VII V V V V VIII VIII VIII VIII VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA AGCA	13:33 58:94 314.63* 57.99 ke: September 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju 5.69 11.14	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 ne 15, 1999 0.52 1.90	IV VII VII VI IV VI VI VI VI IV IV VII IV III IIII	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI SOLI	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18 2.55	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline 0.mber 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.61\\ \hline 1.52\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \hline 0.57\\ \hline \end{array}$	III IV III IV IV IV IV IV IV IV IV IV V VI V VIII IV III IV VIII IV VIII IV VIII IV VIII IV VIII III
AZIH CALE CAMI CHII COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquak ACAP APAT ATYC AZIH CARI CAYA	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59 78.68 142.40 62.41 57.76	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21 1.48 2.37	VII IX IX VII IX VII VII VII VII VIII VIII VIII VIII VIII VIII VII VII VII VII VII VII VII V V V V V VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RIPC RIPC RITC TEAC TNLP VIGA Ea ACAJ AGCA ATYC	13:33 58:94 314.63* 57.99 ke: Septembol 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju 5.69 11.14 7.25	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.95 0.88 1.70 2.66 10.05 ne 15, 1999 0.52 1.90 1.77	IV VII VII VI IV VI VI VI VI VI VI VI IV IV IV III III III	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI SOLI TEAC	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18 2.55 8.77	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline 0.86\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \hline 0.57\\ \hline 2.96\\ \end{array}$	III JV III IV V VI VV VIII IV III IV VIII III III <t< td=""></t<>
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquak ACAP APAT ATYC AZIH CARI CAYA CHI1	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 ce: Septembe 25.96 19.59 78.68 142.40 62.41 57.76 117.92	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21 1.48 2.37 8.09	VII IX IX VII IX VII VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VIII VIII V V V V VIII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAII CHIL COPL COYC CUER CUP1 IGUA MAD1 MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA Ea ACAJ AGCA ATYC CAIG	13:93 58:94 314.63* 57.99 ke: Septembol 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju 5.69 11.14 7.25 4.50	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 ne 15, 1999 0.52 1.90 1.77 0.43	IV VII VII VI IV III III III III	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI SOLI TEAC VIGA	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18 2.55 8.77 67.54	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline ember 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \hline 0.57\\ \hline 2.96\\ \hline 4.01\\ \hline \end{array}$	III IV V VI V VIII IV III IV VIII IV VIII III IV VIII III III III III VI VI VIII III III III III VI VI
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquał ACAP APAT ATYC AZIH CAYA CHI1 COYC	155.26 155.26 152.21 84.25 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 cc: Septemble 25.96 19.59 78.68 142.40 62.41 57.76 117.92 47.05	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21 1.48 2.37 8.09 3.91	VII IX IX VII VII VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VIII VIII V V V V V VIII VII VII VIII VII VII VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MAD1 MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA Ea ACAJ AGCA ATYC CAIG CARI	13:33 58:94 314.63* 57.99 ke: Septembol 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.70 11.55 100.06 arthquake: Ju 5.69 11.14 7.25 4.50 16.29	3.70 7.12 24.19* 5.82 er 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 ne 15, 1999 0.52 1.90 1.77 0.43 1.52	IV VII VII VI V IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI SOLI TEAC VIGA	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18 2.55 8.77 67.54 7.15	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline ember 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.61\\ \hline 1.52\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \hline 0.57\\ \hline 2.96\\ \hline 4.01\\ \hline 1.03\\ \hline \end{array}$	III JV IV V VI V VIII IV III IV VIII III IV VIII III IV VIII III III III III III III IV VI III III IV VI IV
AZIH CALE CAMI CHI1 COYC CPDR CUIP FICA INMD MADI MSAS OCTT PAPN PARS SUCH SXPU TEAC UNIO VILE VNTA XALT ZACA Earthquał ACAP APAT ATYC AZIH CAYA CHI1 COYC CPDR	155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 155.26 177.08 42.00 25.80 33.10 69.15 142.00 9.78 22.30 54.66 151.61 103.92 107.03 32.60 49.11 191.90 103.53 18.81 23.63 273.16 cc: Septemble 25.96 19.59 78.68 142.40 62.41 57.76 117.92 47.05 13.28	21.61 34.52 5.49 17.22 7.81 3.89 9.45 4.62 8.25 2.40 4.13 5.68 8.69 10.20 14.32 7.09 8.52 35.16 42.51* 8.77 7.65 35.96 r 21, 1985 0.88 1.07 9.73 23.21 1.48 2.37 8.09 3.91 1.89	VII IX IX VII VII VII VII VII VII VIII VIII VIII VIII VIII VIII VIII VIII VIII V V V V V VIII VII VII	VNTA VIGA XALT Earthqua ACAJ ATYC CAIG CAIG CAMI CHIL COPL COYC CUER CUP1 IGUA MADI MEZC OAXM OCLL OCTT POZU RIPC RITC TEAC TNLP VIGA Ea ACAJ AGCA ATYC CAIG CARI CENA	13:33 58:94 314.63* 57.99 ke: Septembol 13.80 7.32 6.04 9.50 29.09 75.03 12.10 12.90 11.80 7.78 5.76 13.20 42.63 11.70 60.10 41.70 13.80 5.90 11.55 100.06 arthquake: Ju 5.69 11.14 7.25 4.50 16.29 7.42	3.70 7.12 24.19* 5.82 pr 14, 1995 1.84 0.94 1.08 1.18 2.65 11.94 1.45 3.36 4.19 1.32 1.30 1.05 3.52 1.29 3.23 1.38 3.95 0.88 1.70 2.66 10.05 n.52 1.90 1.77 0.43 1.52 1.05	IV VII VII VI V IV III III III III IV IV	Earth ACAJ ANGI CAIG CARI CENA CHII CHIL COIG COPL COYC COYQ CSER CUER HUIG IGUA INMI LVIG MEZC MOIG OCLL OXIG PENI PET2 PNIG POZU SLUI SOLI TEAC VIGA VNTA YAIG	1.98 quake: Septe 9.29 3.59 5.18 10.13 9.35 6.84 17.53 0.72* 31.41 15.20 22.18 41.75 16.92 141.54 6.05 4.09 3.59 12.75 3.00 11.01 186.23 6.08 4.58 32.30 26.30 3.18 2.55 8.77 67.54 7.15 17.40	$\begin{array}{c} 0.36\\ \hline 0.36\\ \hline 0mber 30, 19\\ \hline 0.65\\ \hline 0.30\\ \hline 0.38\\ \hline 0.97\\ \hline 4.89\\ \hline 0.47\\ \hline 1.26\\ \hline 0.20^*\\ \hline 4.21\\ \hline 1.22\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.90\\ \hline 6.00\\ \hline 2.13\\ \hline 3.77^*\\ \hline 1.86\\ \hline 0.23\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.90\\ \hline 1.31\\ \hline 5.85\\ \hline 0.91\\ \hline 0.69\\ \hline 0.69\\ \hline 1.24\\ \hline 0.60\\ \hline 0.57\\ \hline 2.96\\ \hline 4.01\\ \hline 1.03\\ \hline 1.05\\ \hline \end{array}$	III IV III IV V VI V VIII III IV VIII III IV VIII III IV VIII III III IV VIII III IV VIII III IV VIII IV VI

Table 4.2 Dates used in this study for estimate the relations between MMI and PGA or PGV



(2)

4.1.Correlation of records and predictive equations

Table 4.2 contains information about PGA and PGV calculated from the acceleration records of stations located in the Guerrero State. This data, of the earthquakes of Table 4.1, was used for estimate the relations between MMI and PGA_H and between MMI and PGV_H . The data correspond to subduction earthquakes (interplate), and deep earthquakes (intraplate).

In order to observe the variability of the data displayed in Table 4.2, in Figure 2 are plotted PGA and PGV values against MMI. The used data are between intensities of III and IX. It can be observed that the maximum acceleration value is 273.16 cm/sec², while the maximum PGV is 35.96 cm/sec.



Figure 2. Distribution of data used in this study: PGA vs MMI and PGV vs MMI.

The ground motion predictions must be in the form of relatively simple equations, in this case, in terms of intensity. The functional forms adopted here are similar to the model used previously by Trifunac y Brady (1975), and by Wald, et al. (1999):

$$\mathbf{IMM} = \mathbf{C}_1 \log \left(\mathbf{PGA}_{\mathbf{H}} \right) + \mathbf{C}_2 \tag{1}$$

$$\mathbf{IMM} = \mathbf{C}_3 \log \left(\mathbf{PGV}_{\mathbf{H}} \right) + \mathbf{C}_4$$

When PGA is in cm/sec² and PGV in cm/sec. Using the data of table 4.2, we obtained that:

 $IMM = 3.0262*log(PGA_{H}) + 1.0195; \qquad \sigma=0.523; \text{ Bias} = 0.0$ (3) (for the intervalue of: III ≤ IMM ≤ IX).

 $IMM = 2.7451*log(PGV_{H}) + 4.0785; \qquad \sigma = 0.933; \quad Bias = 0.0$ (4) (for a intervalue of: III ≤ IMM ≤ IX)

Figure 3, shows our results, for the predicted relation between PGA (right) and PGV (left), besides these relations are compared with the equations obtained by Trifunac and Brady (1975), and by Wald, et al. (1999). In the case of the PGA, the equation obtained in this study estimates that, for the same intensity Mexican earthquakes produce less accelerations than the calculated with the equations obtained by Trifunac and Brady (1975), and by Wald, et al. (1999). While, in the case of PGV, the situation is similar for intensities less than VII, however, for values of intensity greater than VIII, with the Trifunac and Brady equation, are obtained greater velocities.





Figure 3. Correlation of PGA and PGV with the intensities from the ten subduction earthquakes of Table 3.2.

4.2. Response Spectra in Chilpancingo Guerrero

During the July, 18, 1957, Guerrero Earthquake, Chilpancingo city was severely damaged, it was estimated that approximately one third of the buildings were damaged. A value of VIII in MMI intensity was assigned in this city. This earthquake was the largest event to have occurred in the Chilpancingo region in the last 50 years. This event was not recorded, nevertheless, in the last 20 years an important acceleration data from several close moderate earthquakes, and from some far large earthquakes has been recorded. Motivated for this situation we developed MMI-spectral relations. The functional forms adopted here is the give by the equation (5):

$$\mathbf{MMI} = \alpha_1(T) \log \left(\mathbf{SA}(\mathbf{T}) \right) + \alpha_2(T)$$
(5)

Where MMI is the observed intensity in Chilpancingo. In order to estimate the response spectra, we used data from 10 recorded earthquakes in the soft soil of the valley. In the left part of Figure 4 are presented the 5% critical damping response spectra for the 10 studied events; whereas in the right part of Figure 4, are presented the expected spectra calculated with the regression equation 5, using 3 different intensities, including the MMI=VIII as the intensity assigned during the July, 18, 1957 earthquake.



Figure 4. Observed Response Spectra from the studied earthquakes. And, calculated spectra at soft soil in Chilpancingo for tree different intensities.

CONCLUSIONS

In this study we developed regression relationships between Mercalli Modified Intensity (MMI) and peak ground acceleration (PGA), and between MMI and peak ground velocity (PGV), for ten Mexican earthquakes. Correlations were developed for the MMI range of III \leq IMM \leq IX. When these relationships are compared with



others correlations obtained in other regionns such as California in USA, we found a significant difference both for PGA and PGV. Relationship of peak ground acceleration, reported by previous investigators, are higher than those obtained in this study over the intensity range. But relations of peak ground velovity are similars in higher intensities.

An important variability of the correlated data was observed for the studied earthquakes, between MMI and PGA, and with PGV. In accelerations, with respect to Trifunac and Brady (1975); a significant difference is observed in low intensities, but there are coincidences in high intensities, considering an interval of IV \leq IMM \leq X. But with respect to Wald et al. (1999), significant differentiates in all the rank from intensities is observed, being a little more pronounced this difference in high intensities, considering the rank V \leq IMM \leq VIII. In the case of PGV, similarity for high intensities exists if it is compared with Wald et al. (1999); whereas a significant differences is observed in low intensities, in the interval of V \leq IMM \leq IX. In the other hand, respect to Trifunac and Brady (1975), it exist similarity for average intensities, but significant difference both with high as with low intensities, considering a rank of IV \leq IMM \leq X. Finally, in order to estimate expected response spectra for the July, 18, 1957, Guerrero Earthquake, period dependence was associated, using results from regressions of observed response spectra with MMI, using acceleration from ten earthquakes.

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