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BASIC AND APPLIED RESEARCH IN THE EARTH SCIENCES

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OBSERVED SEISMIC DATA

MILROW EVENT

MASTER

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DATE 4/16/70

ENVIRONMENTAL RESEARCH CORPORATION
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ABSTRACT

This report presents the results of the processing of the observed ground motions from the Milrow event. The exact yield of the Milrow event is not known. For the purpose of comparing the observed Milrow ground motions with the ground motions that would be predicted on the basis of data from events detonated at the Nevada Test Site (NTS), the Milrow yield has been assumed to be 1,000 kt (Reference 1). On this basis, the 5% horizontal component Pseudo-Relative Velocity (PSRV) spectra (peak response) calculated from the observed Milrow seismograms are compared with predicted horizontal PSRV spectra for a 1,000 kt event (Reference 2). Similarly, the observed peak particle vector amplitudes as a function of distance are also compared to those predicted for a 1,000 kt event (Reference 3).

Data recorded at nine instrument stations, installed and operated by the U. S. Coast and Geodetic Survey (USC&GS) were processed by Environmental Research Corporation's (ERC) Data Processing Laboratory.

INTRODUCTION

The Milrow event was detonated on Thursday, October 2, 1969 at 12:06:0.039 Bering Daylight Time (22:06:0.039 Zenith) on Amchitka Island (Figure 1), one of the southern-most islands in the central portion of the arcuate Aleutian chain.

The explosive was emplaced 3,992 feet below ground surface in emplacement hole UA-2. The hole was collared at an elevation of about 130 feet above sea level at Drill Site "B". The approximate coordinates for this location (based upon 1,000 meter Universal Transverse Mercator grid, Zone 60) are N 5,698,250 and E 651,750 (Reference 4).

The detonation occurred in Pillow Lavas and Breccias of Kirilof Point, Tertiary age (References 5 and 6). The yield of the device was approximately 1,000 kt.

INSTRUMENTATION AND DATA PROCESSING

Seismic instrument stations were located on Amchitka, Shemya and Adak; all islands in the Aleutian chain (Figures 1 and 2). Three-component instruments were used at all stations. Installation and operation of the instruments (L-7 velocity meters) were the responsibility of USC&GS.

Data from nine L-7 velocity meters were collected by the USC&GS and transmitted to ERC for processing. Acceleration and displacement time-history records were derived by differentiating and integrating the velocity data. These data were transformed onto paper records and component and vector peaks, times of arrivals and periods of peaks were measured. PSRV spectra were calculated by passing the seismic signals recorded from Milrow through a series of linear oscillators (5% damping).

OBSERVED DATA COMPARED WITH PREDICTIONS

A comparison of the horizontal component of ground motion having the greatest PSRV response and the horizontal component PSRV spectral prediction for a yield of 1,000 kt (Reference 2) is shown in Figures 12 through 20. For one station, Shemya - MO8, the radial and transverse components of the seismogram were clipped and unusable so the PSRV spectrum derived from the vertical component is compared with the predicted horizontal PSRV. The observed response spectra compare quite favorably with the predictions.

Figures 21 through 23 show a comparison of the observed peak particle motions compared to the predictions of peak ground motion versus distance for a 1,000 kt event (Reference 3). The observed data again compare quite closely with the predictions.

STATION SYMBOLS.

(These symbols are used on the following maps and graphs)

STATION	SYMBOL
Constantine Harbor	M01
LASL Compound (1) (South Camp)	M02
LASL Compound (2) (North Hangar)	M03
S-6	M04
ASB	M05
ASD	M06
ANB	M07
Shemya	M08
Adak	M09

SUMMARY OF DATA

Peak particle resultant vector amplitudes of ground motion versus slant distance are shown in Figures 21 through 23. The resultant vectors were obtained by analyzing simultaneously the vertical, radial and transverse components of motion (Z, R, T respectively) at a station in order to determine the instantaneous maximum amplitude of the ground motion. For stations where only two components of motion were recorded, peak resultant vectors were calculated using the two observed components. In these instances, the vector values are shown in parentheses in Tables A-1, A-2 and A-3, and the station names are enclosed in parentheses on the peak motion graphs. Only the vertical component was recorded at Shemya.

The 5% PSRV spectra for the vertical, radial and transverse components were calculated from the observed Milrow seismograms and are shown in Figures 3 through 6, 8 and 9. On Figures 7, 10 and 11, only one or two components

are shown. The missing components were not digitized because of clipped signal or power failure during recording.

Peak amplitudes, periods, and peak arrival times of particle velocity and of derived acceleration and displacement are listed in Tables A-1 through A-3. These tables also show the peak particle resultant vector (V). Arrival times of the peak motions were measured from shot time except in cases where shot time was not properly recorded on the magnetic tape. In these instances the times to the peaks were measured from time of first recorded motion and are shown in parentheses in the peak motion tables.

DATA SUMMARY

Figure 1. Map Showing Locations of Shemya and Adak Seismic Stations Relative to Milrow Event Ground Zero (GZ)

Figure 2. Map Showing Locations of Amchitka Seismic Stations and Milrow Ground Zero (GZ)

Figure 3. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 4. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 5. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 6. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 7. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 8. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 9. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 10. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 11. PSRV Spectra (5%) Calculated from Observed Milrow Seismogram

Figure 12. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 13. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 14. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 15. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 16. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 17. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 18. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 19. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Maximum Horizontal Component) Calculated from Observed Milrow Seismogram

Figure 20. Comparison of Predicted 5% PSRV Spectrum with PSRV Spectrum (Vertical Component) Calculated from Observed Milrow Seismogram

Figure 21. Observed Peak Acceleration Compared with Predictions for Hard Rock, Milrow Event

Figure 22. Observed Peak Velocity Compared with Predictions for Hard Rock, Milrow Event

Figure 23. Observed Peak Displacement Compared with Predictions for Hard Rock, Milrow Event

TABLE A-1. PEAK ACCELERATIONS, MILROW EVENT

STATION	SLANT DISTANCE (km)	COMPONENT	PEAK ACCELERATION (g)	FIRST ARRIVAL TIME (sec)	PEAK ARRIVAL TIME (sec)	PEAK PERIOD (sec)
MO2	7.0	Z	6.93×10^{-1}	3.30	3.38	0.16
LASL		R	4.94×10^{-1}	3.30	3.34	0.08
Compound (1)		T	3.60×10^{-1}	3.30	3.48	0.10
(South Camp)		V	8.00×10^{-1}	--	3.34	--
MO3	7.0	Z	6.57×10^{-1}	3.31	3.48	0.13
LASL		R	4.65×10^{-1}	3.31	3.43	0.10
Compound (2)		T	3.01×10^{-1}	3.31	3.59	0.15
(North Hangar)		V	8.21×10^{-1}	--	3.41	--
MO1	8.0	Z	4.75×10^{-1}	4.76	4.96	0.35
Constantine		R	3.06×10^{-1}	4.76	4.98	0.70
Harbor		T	1.92×10^{-1}	4.76	5.20	0.55
		V	5.60×10^{-1}	--	4.88	--
MO5	8.0	Z	--	--	--	--
ASB		R	3.59×10^{-1}	--	(0.10)	0.20
		T	4.48×10^{-1}	--	(0.30)	0.05
		V	(4.98×10^{-1})	--	(0.30)	--
MO4	9.8	Z	3.10×10^{-1}	3.71	3.95	0.20
S-6		R	2.96×10^{-1}	3.71	4.31	0.15
		T	2.20×10^{-1}	3.71	3.91	0.10
		V	3.30×10^{-1}	--	3.86	--
MO6	11.5	Z	3.63×10^{-1}	--	(0.30)	0.20
ASD		R	2.59×10^{-1}	--	(0.50)	0.14
		T	1.33×10^{-1}	--	(1.05)	0.20
		V	4.07×10^{-1}	--	(0.25)	--
MO7	28.5	Z	4.34×10^{-2}	6.71	8.91	0.50
ANB		R	3.95×10^{-2}	6.71	9.06	0.30
		T	4.44×10^{-2}	6.71	8.91	0.85
		V	5.90×10^{-2}	--	12.26	--
MO9	300.0	Z	--	--	--	--
ADAK		R	1.61×10^{-3}	42.74	46.91	0.45
		T	1.34×10^{-3}	42.74	46.81	0.60
		V	(1.62×10^{-3})	--	50.24	--
MO8	377.0	Z	4.86×10^{-4}	52.51	58.11	0.20
SHEMYA		R	--	--	--	--
		T	--	--	--	--
		V	(4.86×10^{-4})	--	--	--

TABLE A-2. PEAK VELOCITIES, MILROW EVENT

STATION	SLANT DISTANCE (km)	COMPONENT	PEAK VELOCITY (cm/sec)	FIRST ARRIVAL TIME (sec)	PEAK ARRIVAL TIME (sec)	PEAK PERIOD (sec)
MO2 LASL Compound (1) (South Camp)	7.0	Z	3.40×10^1	3.30	3.46	0.20
		R	2.54×10^1	3.30	4.96	1.85
		T	2.30×10^1	3.30	4.90	1.20
		V	3.91×10^1	--	3.46	--
MO3 LASL Compound (2) (North Hangar)	7.0	Z	3.53×10^1	3.31	3.43	0.30
		R	2.76×10^1	3.31	4.98	1.90
		T	1.46×10^1	3.31	5.19	0.80
		V	3.76×10^1	--	3.43	--
MO1 Constantine Harbor	8.0	Z	2.32×10^1	4.76	4.98	0.32
		R	3.02×10^1	4.76	5.06	0.60
		T	8.89×10^0	4.76	5.91	0.60
		V	3.05×10^1	--	5.06	--
MO5 ASB	8.0	Z	--	--	--	--
		R	1.87×10^1	--	(3.65)	2.00
		T	1.16×10^1	--	(1.95)	0.70
		V	(2.03×10^1)	--	(3.15)	--
MO4 S-6	9.8	Z	1.99×10^1	3.71	3.89	0.38
		R	2.12×10^1	3.71	4.29	0.68
		T	9.00×10^0	3.71	9.21	1.30
		V	2.62×10^1	--	3.89	--
MO6 ASD	11.5	Z	1.26×10^1	--	(0.15)	0.30
		R	1.20×10^1	--	(4.72)	0.82
		T	6.61×10^0	--	(1.10)	0.78
		V	1.68×10^1	--	(0.50)	--
MO7 ANB	28.5	Z	4.28×10^0	6.71	9.06	0.70
		R	3.01×10^0	6.71	10.47	0.70
		T	5.31×10^0	6.71	19.46	2.75
		V	5.31×10^0	--	19.46	--
MO9 ADAK	300.0	Z	--	--	--	--
		R	9.50×10^{-2}	42.74	47.96	1.12
		T	9.62×10^{-2}	42.74	80.79	1.92
		V	(1.02×10^{-1})	--	80.79	--
MO8 SHEMYA	377.0	Z	6.07×10^{-2}	52.51	66.16	1.45
		R	--	--	--	--
		T	--	--	--	--
		V	(6.07×10^{-2})	--	--	--

TABLE A-3. PEAK DISPLACEMENTS, MILROW EVENT

STATION	SLANT DISTANCE (km)	COMPONENT	PEAK DISPLACEMENT (cm)	FIRST ARRIVAL TIME (sec)	PEAK ARRIVAL TIME (sec)	PEAK PERIOD (sec)
MO2	7.0	Z	5.59×10^0	3.30	6.55	2.45
LASL		R	7.49×10^0	3.30	6.33	1.70
Compound (1)		T	4.43×10^0	3.30	6.30	2.42
(South Camp)		V	9.67×10^0	--	6.40	--
MO3	7.0	Z	5.62×10^0	3.31	6.63	2.50
LASL		R	7.84×10^0	3.31	6.40	1.78
Compound (2)		T	3.07×10^0	3.31	6.88	.75
(North Hangar)		V	9.03×10^0	--	6.46	--
MO1	8.0	Z	3.40×10^0	4.76	8.31	2.35
Constantine		R	5.02×10^0	4.76	7.88	2.40
Harbor		T	1.16×10^0	4.76	7.96	2.21
		V	5.55×10^0	--	7.92	--
MO5	8.0	Z	--	--	--	--
ASB		R	6.14×10^0	--	(3.18)	2.10
		T	2.95×10^0	--	(3.50)	2.38
		V	(6.39×10^0)	--	(3.23)	--
MO4	9.8	Z	4.51×10^0	3.71	9.21	2.35
S-6		R	5.58×10^0	3.71	8.61	2.45
		T	2.61×10^0	3.71	9.39	3.05
		V	5.70×10^0	--	8.53	--
MO6	11.5	Z	3.48×10^0	--	(5.67)	2.48
ASD		R	4.20×10^0	--	(5.10)	1.70
		T	1.19×10^0	--	(3.90)	1.84
		V	4.20×10^0	--	(5.15)	--
MO7	28.5	Z	1.12×10^0	6.71	20.66	2.17
ANB		R	8.53×10^{-1}	6.71	20.63	2.32
		T	1.77×10^0	6.71	21.26	2.12
		V	1.77×10^0	--	21.26	--
MO9	300.0	Z	--	--	--	--
ADAK		R	2.68×10^{-2}	42.74	93.94	3.00
		T	2.78×10^{-2}	42.74	81.14	2.00
		V	(2.82×10^{-2})	--	81.14	--
MO8	377.0	Z	1.10×10^{-2}	52.51	65.84	1.25
SHEMYA		R	--	--	--	--
		T	--	--	--	--
		V	(1.10×10^{-2})	--	--	--

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