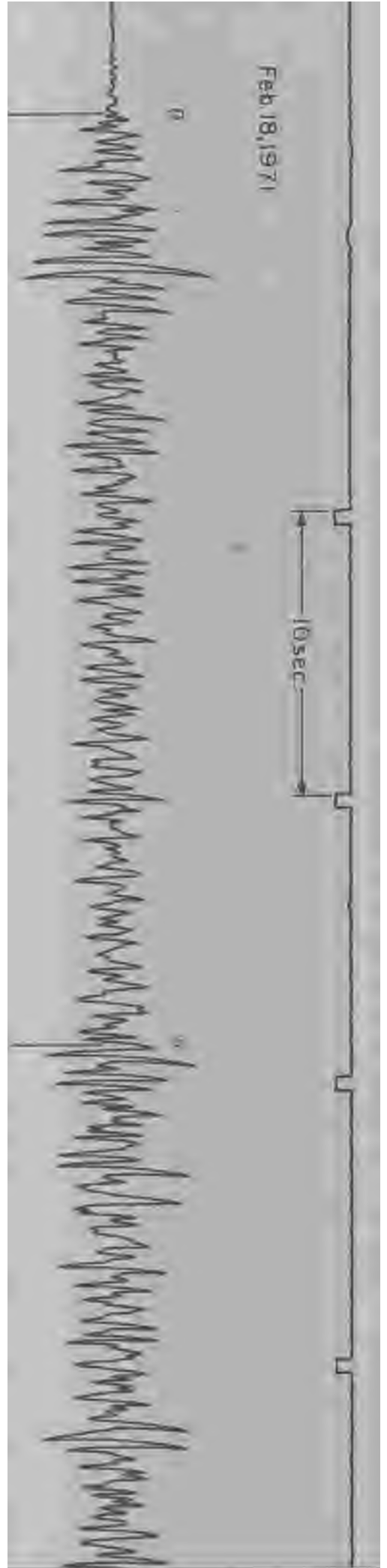


CIRCULAR 126

Instrumental Study of New Mexico Earthquakes January 1968 Through June 1971

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NEW MEXICO STATE BUREAU OF MINES AND MINERAL RESOURCES

1972

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New Mexico State Bureau of Mines and Mineral Resources

Circular 126

INSTRUMENTAL STUDY OF NEW MEXICO EARTHQUAKES
January 1968 through June 1971

by
Tousson R. Topozada and Allan R. Sanford

Socorro
1972

New Mexico State Bureau of Mines and Mineral Resources

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ABSTRACT

Seismic activity in and bordering New Mexico is tabulated for the period January 1, 1968 through June 30, 1971. Origin times, magnitudes, and locations are given for all earthquakes having local magnitudes greater than, or equal to, 2.7. A total of 19 earthquakes are listed, 11 located by the National Earthquake Information Center and 8 by the New Mexico Institute of Mining and Technology (NMIMT). Arrival times for shocks located by NMIMT are given. During this 3 1/2 year interval the earthquake epicenters were concentrated in the vicinity of the Rio Grande valley. This distribution of seismic activity is in better agreement with the historical record of felt shocks than was the distribution obtained from the preceding 6 years of instrumental data.

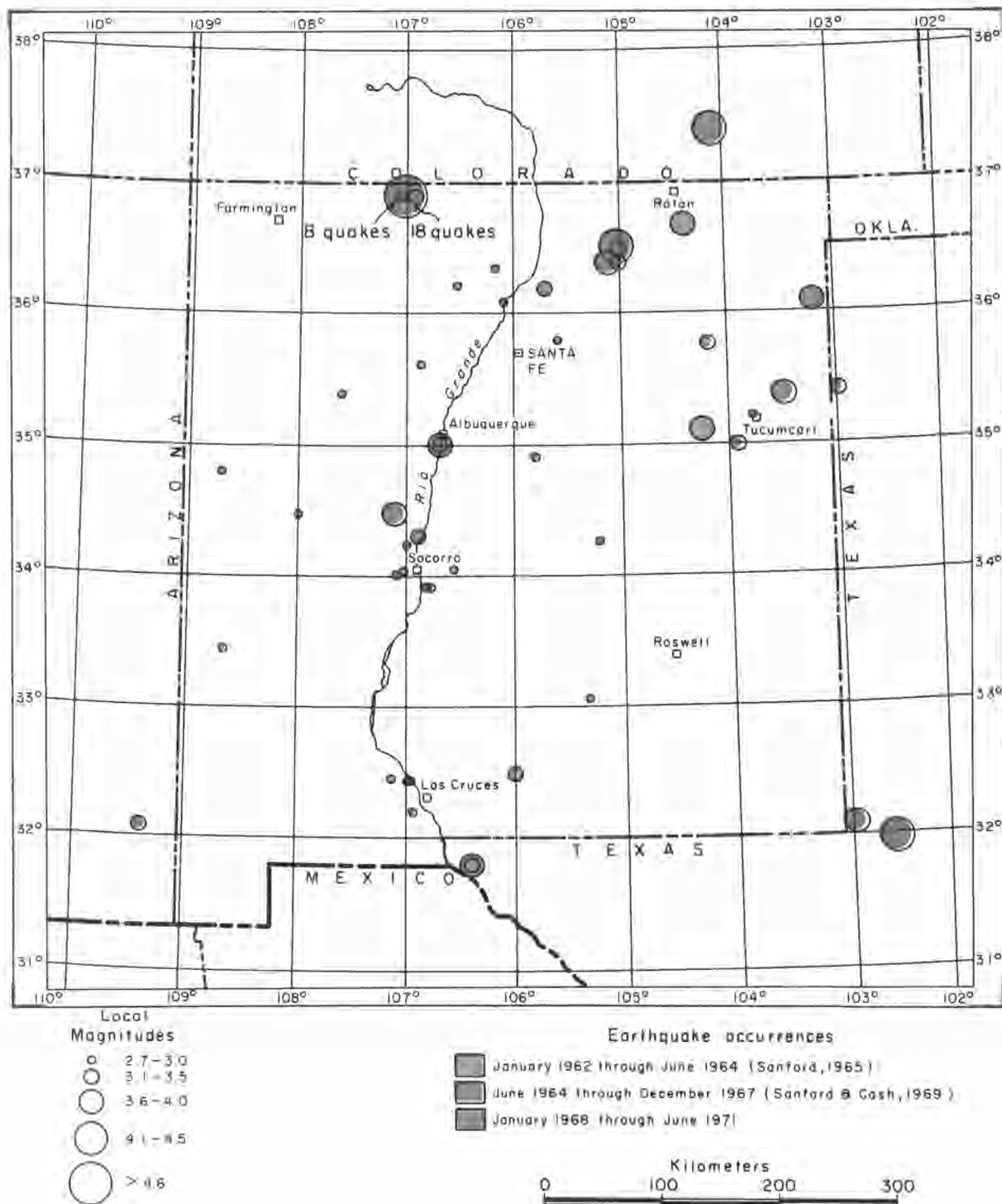


Figure 1 — Locations of New Mexico Earthquakes having $M_L \geq 2.7$ January 1, 1962 through June 30, 1971.

INTRODUCTION

This circular reports the natural seismic activity in, and bordering, New Mexico for the period January 1, 1968 through June 30, 1971. Earlier published studies on earthquakes in the state, based on instrumental data, cover the periods January 1, 1962 through June 30, 1964 (Sanford, 1965) and July 1, 1964 through December 31, 1967 (Sanford and Cash, 1969).

The earthquake locations, origin times, and magnitudes listed are from two sources: 1) reports published by the National Earthquake Information Center (NEIC), Environmental Research Laboratories, National Oceanic and Atmospheric Administration, U. S. Department of Commerce, and 2) studies by the New Mexico Institute of Mining and Technology (NMIMT). The principal stations used in the NMIMT study are located at Socorro (SNM) and Albuquerque (ALQ). Because of the location of these seismic stations, weak shocks in the central part of the state can be located with relative ease whereas earthquakes of similar strength located in the far corners of the state may not be clearly recorded at a sufficient number of stations for a location. To obtain a geographical distribution of seismic activity free of any station location bias, only shocks with local magnitudes greater than, or equal to, 2.7 have been tabulated. We believe few, if any, shocks of this strength have been missed, even in the remotest areas of the state.

EARTHQUAKE DATA

Table 1 (tables at rear) lists the 19 shocks with local magnitudes M_L 2.7 that occurred in, and bordering New Mexico in the 3 1/2 year period ending June 30, 1971. Given in this table are dates, origin times, epicentral coordinates, magnitudes, and sources of data. Information for 11 earthquakes was obtained from the Preliminary Determination of Epicenter (PDE) data sheets published by the National Earthquake Information Center (NEIC). The earthquakes reported by the NEIC generally have local magnitudes greater than 3.2.

The information on the remaining 8 shocks in table 1 was obtained by NMIMT using a procedure described by Sanford (1965). This procedure assumes a depth of focus of 8 kilometers. In table I, both NMIMT and NEIC locations and origin times are given for the 2 earthquakes on March 9, 1968, and February 18, 1971. For the 1968 shock, the locations differ by 11 kilometers and the origin times by 2.7 seconds; for the 1971 shock, the locations differ by 6 kilometers and the origin times by 0.3 seconds. Despite these differences we believe that the NMIMT locations are as reliable as the NEIC locations.

The arrival times used for every event located by NMIMT are given in table 2. In this table, "p" and "s" indicate direct phases, and "e_n" and "S_n" indicate conical waves generated along the base of the crust. When these phases are preceded by an "e" (emergent) or an "i" (impulsive), the records were read at NMIMT, otherwise the readings were obtained from the stations. Data on stations used in the study are given in table 3.

Three magnitudes are listed in table 1, NEIC, ALQ, and SNM. The NEIC magnitude is a body wave magnitude (mb) based on the maximum amplitude of the P phase. The ALQ and SNM magnitudes, calculated by NMIMT, are local magnitudes based on the phase, usually direct S, having the maximum amplitude on the seismogram. Within the range of local magnitudes observed, $2.7 < M_L < 4.2$, the local magnitude is an average of 0.7 less than the body wave magnitude. The local magnitudes calculated from SNM records are an average of 0.2 greater than those calculated from ALQ records. This discrepancy is probably caused by differences in near-surface or crustal structure beneath the two stations. For the purpose of sorting the earthquakes into successive magnitude ranges in fig. 1 and to define the minimum size earthquake, $M_L=2.7$, the average of the ALQ and SNM magnitudes was used.

The 19 earthquakes listed in table 1 are plotted as red circles in fig. 1. The yellow circles are locations of earthquakes (ML 2.7) for the period January 1, 1962 through June 30, 1964 (Sanford, 1965); the blue circles, locations for the period July 1, 1964 through December 31, 1967 (Sanford and Cash, 1969).

DISCUSSION

The distribution of epicenters for the period January 1, 1968 through June 30, 1971 (red circles in fig. 1) differs in important respects from the distribution of epicenters for the previous 6 years (yellow and blue circles). The main activity has shifted from the northeastern quadrant of the state to the western half. Twelve of the shocks lie in, or near, the Rio Grande rift zone; 2 at El Paso; 3 near Socorro; 2 at Albuquerque; and 5 in the vicinity of Santa Fe. The Rio Grande rift zone is a very large structural feature with geologic evidence of very recent tectonic movement (Sanford, and others, 1972), therefore, the shift of activity to this region is not surprising. In addition, the historical information on earthquakes in New Mexico (Northrop, 1945, 1947, and 1961; Sanford, 1963) indicates the Rio Grande rift zone, particularly the segment from Albuquerque to Socorro, has had the strongest earthquakes in the past.

The Dulce earthquake of January 23, 1966 remains the strongest earthquake for the 9 1/2 years covered in fig. 1. However, the region around Dulce has been quiescent since the last of the stronger aftershocks in 1967. The extreme northwestern, southwestern, and southeastern corners of the state remain essentially aseismic.

ACKNOWLEDGMENTS

This study was made possible through cooperation of the following organizations that made seismograms and other data available to us: Albuquerque Seismological Center, Albuquerque, New Mexico; National Earthquake Information Center, Rockville, Maryland; USAF AFTAC/VELA Seismological Center, Alexandria, Virginia; Teledyne Geotech Alexandria Laboratories, Alexandria, Virginia; Seismological Station, Colorado School of Mines, Golden, Colorado; Seismological Observatory, Texas Technological College, Lubbock, Texas; Seismological Observatory, University of Texas at El Paso, El Paso, Texas; University of Utah Seismograph Stations, Salt Lake City, Utah; Seismological Station, Trinidad State Junior College, Trinidad, Colorado.

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Table 1 – New Mexico earthquakes from January 1, 1968 through June 30, 1971

DATE			Located by	ORIGIN TIME			EPICENTER		MAGNITUDE		
Year	Month	Day		Hr.	Min.	Sec.	Lat.	Long.	NEIC	ALQ	SNM
1968	Mar	9	NEIC	21	54	26.0	32.5	106.0		3.0	3.4
1968	Mar	9	NMIMT	21	54	23.3	32.6	106.1		3.0	3.4
1968	May	2	NMIMT	02	56	44.8	33.1	105.3		2.7	3.0
1968	May	19	NMIMT	11	02	56.0	34.5	108.0			2.7
1969	Jan	30	NEIC	05	17	37.8	34.3	106.9	4.1	3.4	3.3
1969	May	12	NEIC	08	26	18.7	31.8	106.4	4.5	3.6	3.9
1969	May	12	NEIC	08	49	16.3	31.8	106.4	4.3	3.3	3.6
1969	June	8	NMIMT	11	36	02.3	34.3	105.2		2.6	2.8
1969	July	4	NEIC	14	43	34.0	36.1	106.1	4.4	2.7	3.2
1969	Aug	23	NEIC	21	41	54.2	34.8	108.7	3.9	2.9	3.1
1970	Jan	12	NEIC	11	21	15.4	36.1	103.2	3.5	3.9	4.2
1970	Nov	28	NEIC	07	40	11.6	35.0	106.7	4.5	3.5	3.5
1970	Nov	30	NMIMT	05	35	21.7	36.3	106.2		2.7	3.2
1971	Jan	4	NEIC	07	39	06.7	35.0	106.7	4.7		3.8
1971	Jan	6	NMIMT	10	56	31.5	34.2	107.0			3.0
1971	Jan	27	NMIMT	07	56	28.4	34.1	106.6		2.8	2.7
1971	Feb	18	NEIC	11	28	13.7*	36.2	105.7	3.7		3.3
1971	Feb	18	NMIMT	11	28	14.1	36.3	105.7	3.7		3.3
1971	April	28	NEIC	11	36	52.7*	35.8	105.6	4.0		2.9
1971	May	22	NMIMT	22	31	19.8	35.4	107.6			2.8
1971	June	4	NMIMT	03	55	13.0	36.3	106.6			2.9

* Epicenter determined from incomplete or less reliable data.

Table 2 follows

Table 2 – Arrival time data for earthquakes located by NMIMT

Year	Month	Day	ORIGIN TIME			Station	Phase	ARRIVAL TIME			DELTA
			Hr.	Min.	Sec.			Hr.	Min.	Sec.	Kilometers
1968	Mar	9	21	54	23.3	ALQ	iPn	21	55	04.4	267
							iSn	21	55	35.4	
						GOL	p	21	56	35.7	795
						SNM	iPn	21	54	54.0	185
							iSn	21	55	16.5	
						TFO	ePn	21	55	37.6	534
						TUC	ePn	21	55	26.5	443
							iSn	21	56	12.5	
						UBO	p	21	57	00.0	940
						WMO	Pn	21	56	03.3	738
1968	May	2	02	56	44.8	ALQ	iPn	02	57	23.3	246
							iSn	02	57	50.9	
						SNM	ip	02	57	16.1	188
							is	02	57	39.4	
						TFO	ep	02	58	17.7	557
							es	02	59	24.1	
						TJC	p	02	58	00.4	454
1968	May	19	11	02	56.0	ALQ	ip	11	03	20.5	147
							is	11	03	37.4	
						LUB	p	11	04	30	564
						SNM	ip	11	03	13.4	105
							is	11	03	25.5	
						TFO	ip	11	03	46.6	304
						TUC	ep	11	03	55.0	354
							es	11	04	38.0	
1969	June	8	11	36	02.3	UBO	Pn	11	04	28.7	680
						ALQ	ip	11	36	25.4	139
							is	11	36	42.5	
						GOL	p	11	37	44.5	615
						LUB	Pn	11	36	52	328
						SNM	ip	11	36	28.8	159
							is	11	36	47.9	
						SRM	ip	11	36	28.5	157
1970	Nov	30	05	35	21.7		is	11	36	48.0	
						TFO	ep	11	37	36.0	562
						TUC	ep	11	37	34.5	554
						ALQ	ip	05	35	48.1	159
							is	05	36	06.8	
						GOL	p	05	36	22.4	364
							s	05	37	07.0	
						SBB	ip	05	35	58.8	228
							is	05	36	25.8	
						SNM	ep	05	36	05.2	261
							es	05	36	37.2	
						TFO	ip	05	36	47.3	514
							is	05	37	50.8	

Table 2, *concluded*

Year	Month	Day	ORIGIN TIME			Station	Phase	ARRIVAL TIME			DELTA
			Hr.	Min.	Sec.			Hr.	Min.	Sec.	Kilometers
1971	Jan	6	10	56	31.5	ALQ	p	10	56	47.3	95
							s	10	56	57.7	
						DUG	p	10	58	55.3	854
						GCA	p	10	57	57.8	517
						GOL	p	10	58	16.6	631
							s	10	59	29.0	
						SNM	ip	10	56	34.8	18
							is	10	56	37.2	
						TUC	Pn	10	57	29.9	405
1971	Jan	27	07	56	28.4	ALQ	p	07	56	45.0	99
							s	07	56	56.2	
						EPT	p	07	57	10.0	250
							s	07	57	41.2	
						LUB	p	07	57	39.5	426
							s	07	58	31.0	
						SCC	ip	07	56	37.0	52
							is	07	56	43.3	
						SNM	ip	07	56	34.1	33
							is	07	56	38.4	
						TFO	ep	07	57	40.0	430
							es	07	58	27.9	
1971	Feb	18	11	28	14.1	TJC	p	07	57	34.0	393
						ALQ	p	11	28	40.8	160
							s	11	29	00.2	
						GOL	p	11	29	17.5	380
							s	11	30	06.0	
						LUB	p	11	29	31	461
							s	11	30	23.5	
						SNM	ip	11	28	58.7	268
							is	11	29	31.3	
						TFO	iPn	11	29	30.4	549
1971	May	22	22	31	19.8	ALQ	p	22	31	38.6	113
							s	22	31	52.3	
						DUG	p	22	33	16.5	700
						GOL	p	22	32	44	505
						SNM	ip	22	31	46.4	160
							is	22	32	06.2	
						TJC	p	22	32	14.7	329
1971	June	4	03	55	13.0	ALQ	p	03	55	37.2	143
							s	03	55	53.0	
						DUG	p	03	57	10.0	699
						GOL	p	03	56	19.4	395
						SNM	ep	03	55	53.8	242
							es	03	56	22.8	
						TJC	p	03	55	46.4	197
						LUB	Pn	03	56	26.0	518

Table 3 follows

Table 3 - Seismograph stations used in making the NMIMT locations

STATION	LC CATION	LAT. (N)	LONG. (W)	ELEVATION (meters)
ALQ	Albuquerque, New Mexico	34° 56.5'	106° 27.5'	1853
DUG	Dugway, Utah	40° 11.7'	112° 48.8'	1477
EPT	El Paso, Texas	31° 46.3'	106° 30.4'	1186
GCA	Glen Canyon, Arizona	36° 58.4'	111° 35.6'	1339
GOL	Golden, Colorado	39° 42.0'	105° 22.3'	2359
LUB	Lubbock, Texas	33° 35.0'	101° 52.0'	979
SBB*	East of Bernardo, New Mexico	34° 24.5'	106° 44.7'	1525
SCC*	Magdalena Mountains, New Mexico	34° 01.0'	107° 08.5'	2200
SNM	Socorro, New Mexico	34° 04.2'	106° 56.6'	1511
SRM	La Joya, New Mexico	34° 20.5'	106° 53.9'	1522
TFO	Tonto Forest, Arizona	34° 16.1'	111° 16.2'	1402
TJC	Trinidad, Colorado	37° 13.0'	104° 41.5'	2103
TUC	Tucson, Arizona	32° 18.6'	110° 46.9'	985
U130	Vernal, Utah	40° 19.3'	109° 34.1'	1596
WMO	Ft. Sill, Oklahoma	34° 43.1'	98° 35.3'	505
Local station designation				

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