

# EARTHQUAKE NOTES

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SEISMICITY OF COLORADO

1969 - 1970 - 1971

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The last three years of Colorado seismic events closely resemble those of the preceding three years, from 1966, when these studies began.<sup>1</sup> Epicentral locations are approximately the same, with one or two new sites each year, and an absence of activity at one or two previously active sites, so that the number of locations remains about 30 in the state.

In 1971 the new Colorado network of short period seismograph stations was set up under joint auspices of NOAA and CSM. These stations: Alamosa, Craig, Durango, Eagle, Grand Junction, Montrose, and Trinidad, have operated intermittently since June 1971. Using arrival times from at least three of these stations recording simultaneously, 48 events of Mag 2-4.5 were located with an accuracy of 1-5 km, in the second half of 1971. (See map attached). The accuracy of locations using the two standard stations, GOL seismograms, and UBO bulletins, has been 15 km.

Telemetered recordings are received at CSM and three of the stations are telemetered also at NOAA Earthquake Research Laboratory in Boulder. Stringent financial problems, however, make future operation of the network for the rest of 1972 doubtful. This is regrettable as seismic velocity studies in the complex Rocky Mountain region had barely begun. The need for carefully timed, well-recorded data over a long period of time is essential.

Table 1 lists the epicentral locations, their distances and azimuths from GOL (the Cecil H. Green Geophysical Observatory at Bergen Park) and UBO (the Uinta Basin Observatory at Vernal, Utah). This table lists also the numbers of events at each location for the years 1969, 1970, and 1971. In 1969 there was one event, at Montrose, with a magnitude of 4.0, but no events in 1970 of this magnitude. The AEC Plowshare explosion at Rulison on September 10, 1969, had a Mag 5.0, but its aftershocks were all much smaller than 4.0. In 1971 there were seven locations with events greater than Mag 4.0. Maps for these years are attached.

Table 2 lists all seismic events for three years according to hour of day of occurrence. It is not possible to distinguish blasting activities from natural earthquakes on seismograms. Assuming that most mining operations are conducted during daylight hours, there should be an increase in numbers of events from 8 a.m., 1400 GCT to 5 p.m., 2300 GCT ± 1 hour. Plotting Table 2, Figure 1 shows that the increase in activity begins about three hours later than the working day, 11 a.m. MST, 1700 GCT, and decreases abruptly about 8 p.m. MST, 0200 GCT, for all three years. This

<sup>1</sup>Simon, Ruth B., Seismicity of Colorado: Consistency of Recent Earthquakes with Those of Historical Record, Science, Aug. 29, 1969, Vol. 165, pp 897-899.

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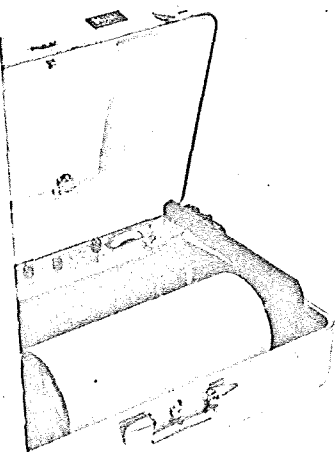
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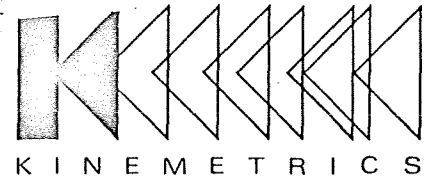
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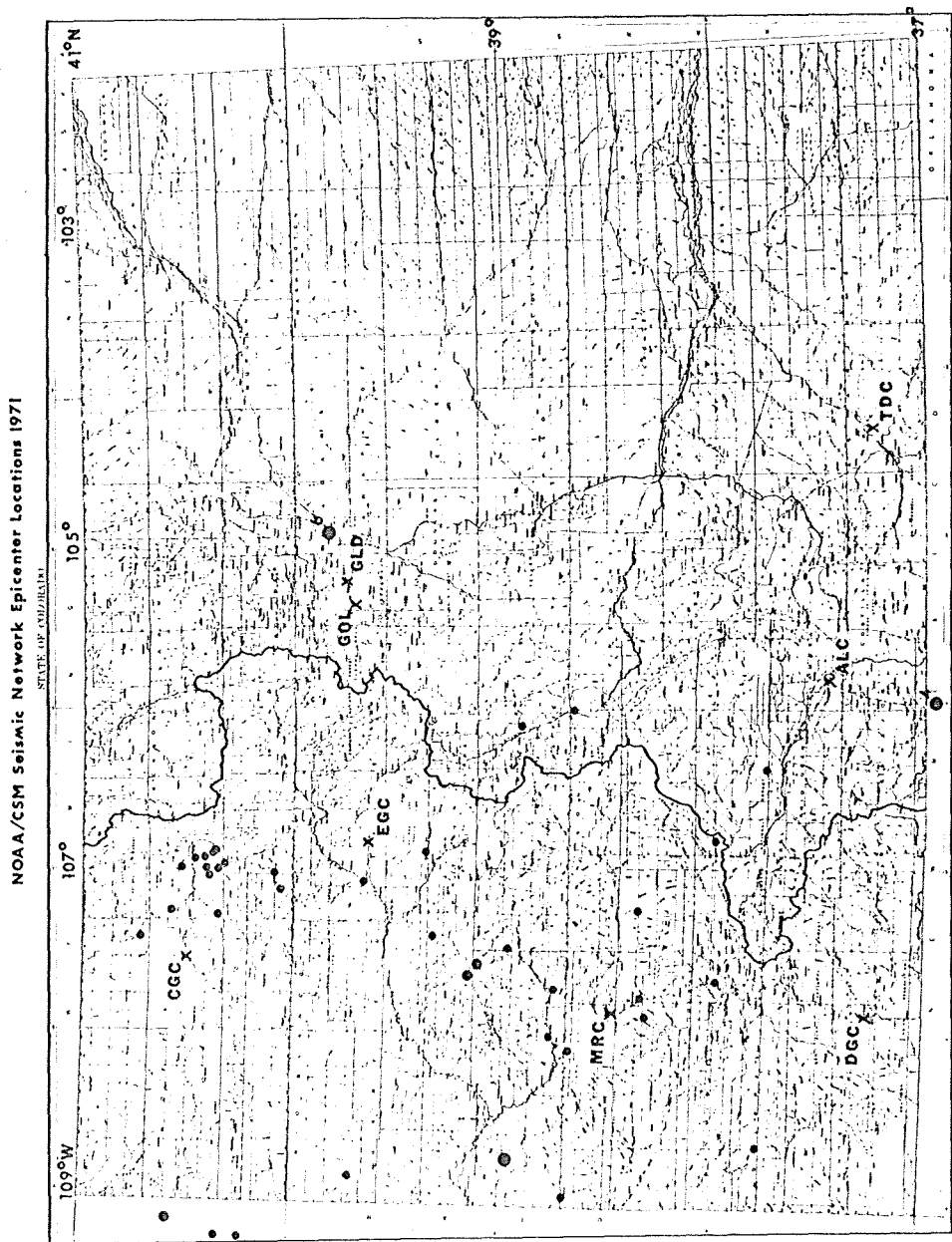


Figure 1

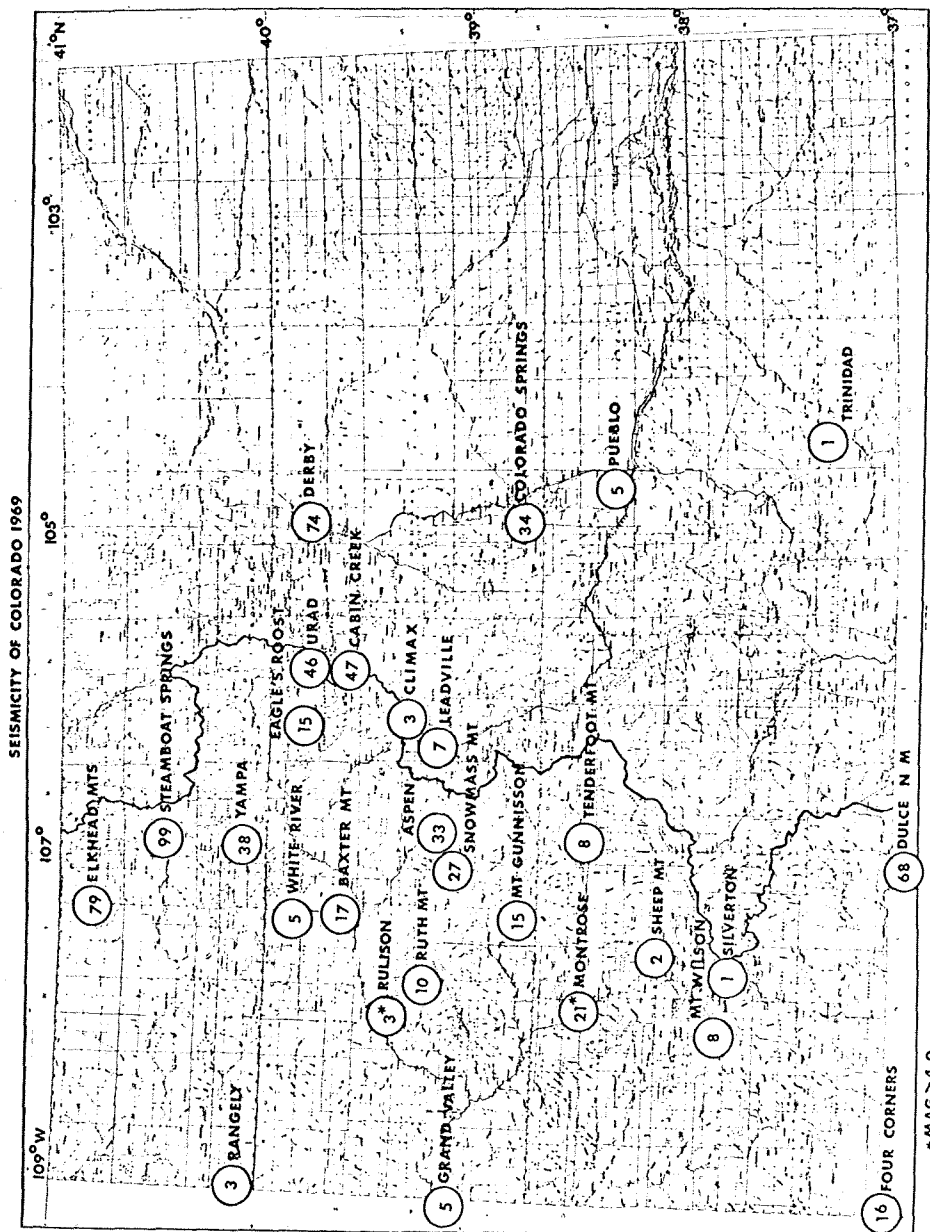


Figure 2

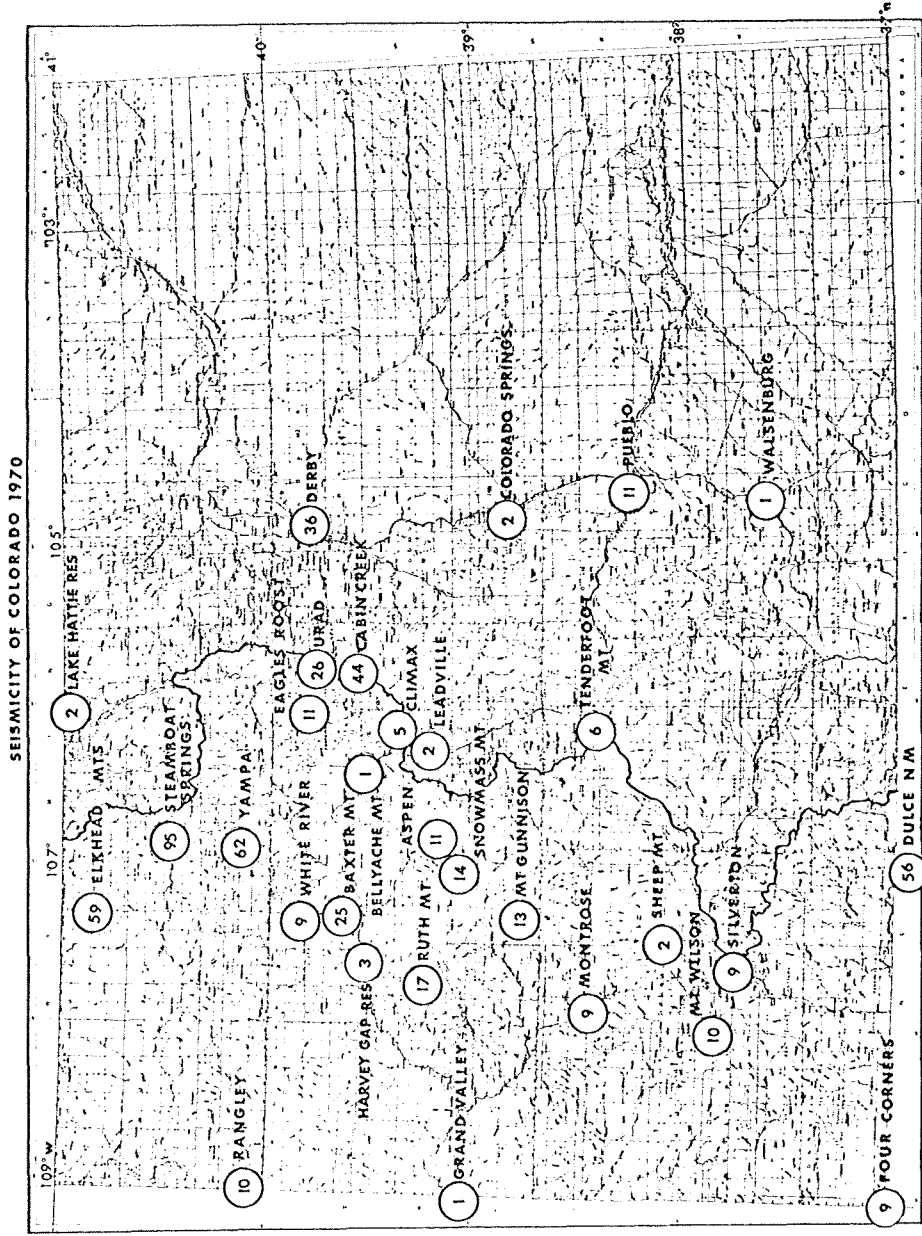
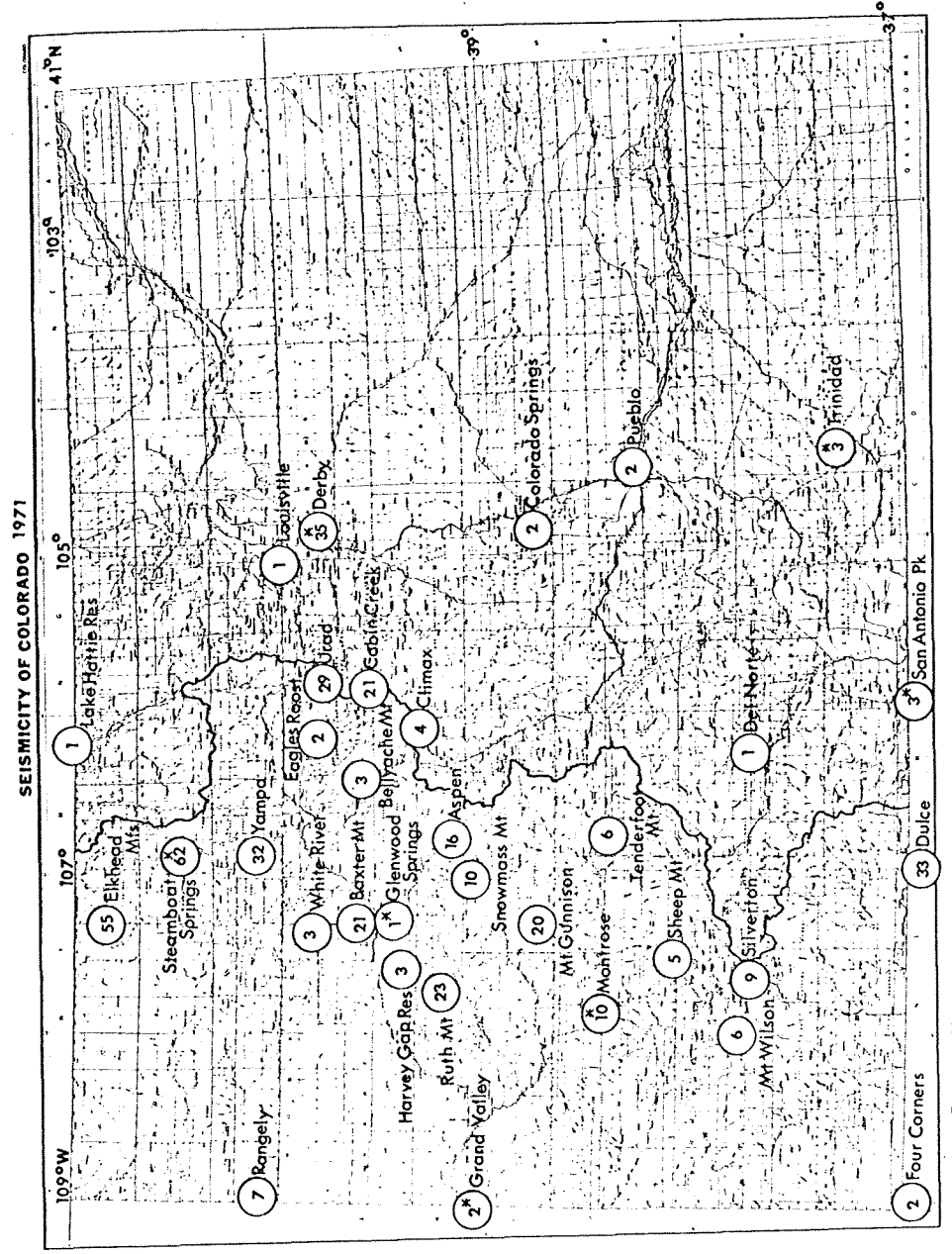


Figure 3



\* Events > Mag 4.0  
433 events located from GOL & UBO

Figure 4

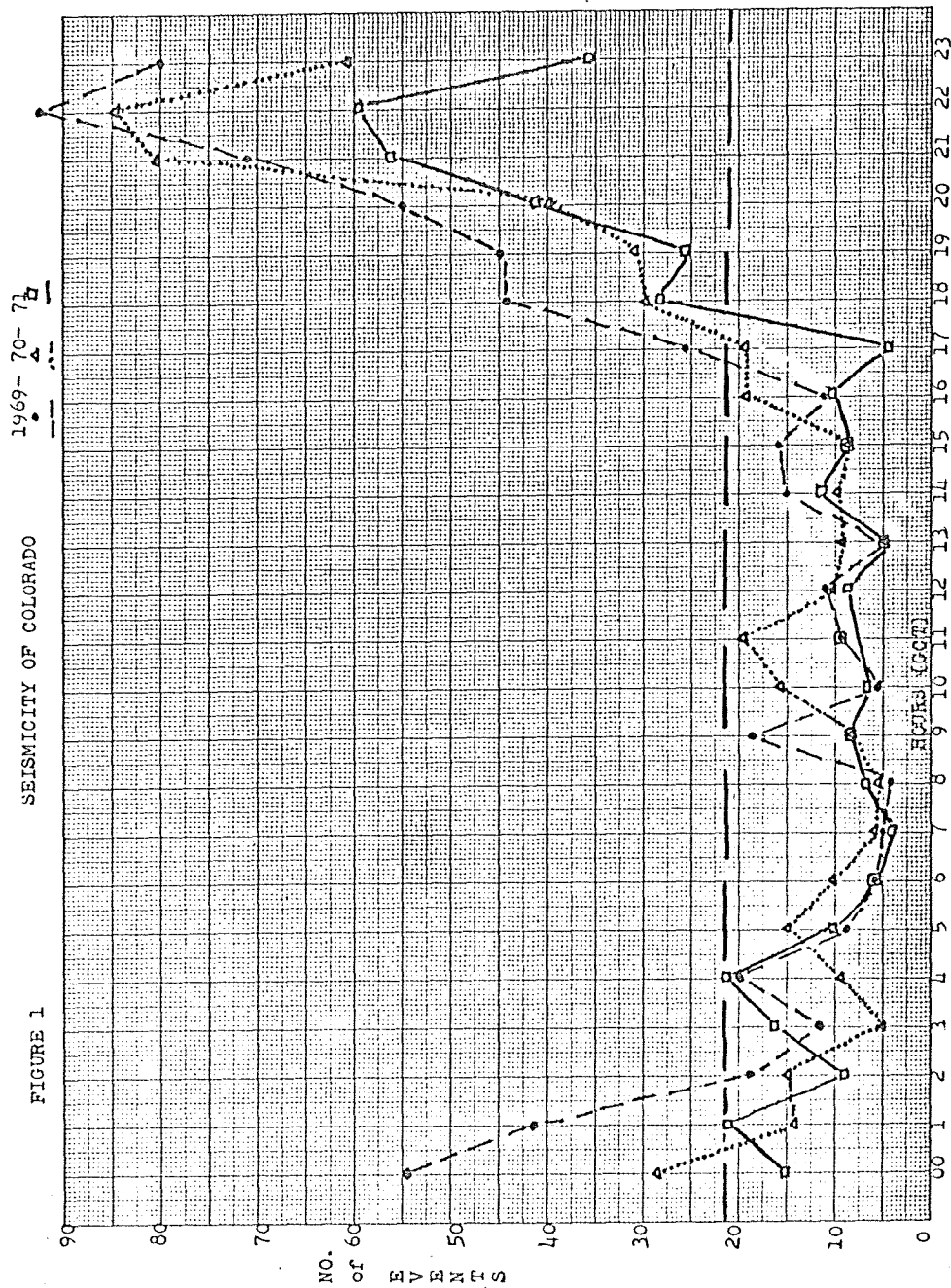


FIGURE 1

Figure 5

Location	& AZ GOL	& AZ UBO	No. of Events		
			1969	1970	1971
Aspen	130 Km SW	266 Km SE	33	11	16
Baxter Mt.	175 Km W	188 Km E	17	25	21
Bellyache Mt.	110 Km W	250 Km E	0	1	3
Cabin Creek	35 Km W	350 Km E	47	44	21
Climax	80 Km SW	325 Km ESE	3	5	4
Colo. Sprgs. Vic.	100 Km SSE	500 Km ESE	34	2	2
Del Norte	235 Km SSW	455 Km SE	0	0	1
Derby (Denver)	45 Km NE	400 Km ESE	74	36	35*
Dulce	320 Km SSW	520 Km SSE	68	56	33
Eagle's Roost	55 Km WNW	300 Km ESE	15	11	2
Elkhead Mts.	200 Km NW	233 Km NE	79	59	55
Four Corners	420 Km SW	400 Km S	16	9	2
Glenwood Sprgs. Vic.**	160 Km W	220 Km ESE	0	0	1*
Grand Valley	325 Km WSW	180 Km E	5	1	2*
Harvey Gap Res.	175 Km W	190 Km E	0	3	3
Lake Hattie Res.	180 Km NNW	370 Km E	0	2	1
Leadville	90 Km SW	350 Km ESE	7	2	0
Louisville	46 Km NNE	330 Km E	0	0	1
Montrose	250 Km SW	250 Km SE	21*	9	10*
Mt. Gunnison	200 Km SW	250 Km SE	15	13	20
Mt. Wilson	300 Km SW	300 Km SE	8	10	6
Pueblo	175 Km SSE	445 Km SSE	5	11	2
Rangely	320 Km WNW	65 Km ESE	3	10	7
Ruth Mt.	200 Km SW	200 Km SE	10	17	23
San Antonio Peak	390 Km SSW	495 Km SSE	0	0	3*
Sheep Mt.	260 Km SW	330 Km SE	2	2	5
Silverton	280 Km SW	300 Km SE	1	9	9
Snowmass Mt.	160 Km SW	235 Km SE	27	14	10
Steamboat Sprgs.	150 Km NW	225 Km NE	99	95	62*
Tenderfoot Mt.	180 Km SW	320 Km SE	8	6	6
Trinidad	300 Km SSE	520 Km SE	1	0	3*
Urad	50 Km W	310 Km E	46	26	29
Walsenberg	225 Km SSE	550 Km SE	0	1	0
White River	175 Km WNW	175 Km E	5	9	3
Yampa	133 Km NW	235 Km NE	38	62	32
Totals			690 (at 28 loca- tions)	561 (at 30 loca- tions)	433 (at 33 loca- tions)

\* Magnitude 4.0  
\*\* Dotsero

AEC Plowshare Program Explosion - September 10, 1969, Mag 5.0

can possibly be accounted for by the fact that blasting may be conducted mainly between shifts, or at the conclusion of the working day. The dashed line through 23 events across the plot of Figure 1 probably represents the level of naturally occurring earthquakes throughout the day for three years of data. A small percentage of these could be blasts, but also a percentage of the events during working-day hours must be included as natural seismicity. Frequently, many small blasts not recorded will cause rockfalls, coal-bumps, etc., which occur naturally, are larger than blasts, and therefore are recorded on seismograms. No statistical estimate of the percentage of blasts, as compared with naturally occurring earthquakes in Colorado, can be accurate because of the uncertainty of interpretation.

TABLE 2

Events per hour/day

GCT	1969	1970	1971
00	54	28	15
01	43	14	22
02	18	15	8
03	13	5	17
04	20	9	23
05	8	15	10
06	7	11	7
07	5	7	4
08	4	7	8
09	18	7	7
10	6	17	7
11	9	20	9
12	12	11	8
13	5	9	5
14	15	10	13
15	17	8	8
16	12	19	11
17	26	19	4
18	44	30	27
19	45	32	26
20	55	40	42
21	72	81	57
22	102	85	59
23	80	62	36

## THE SOUTH CAROLINA EARTHQUAKE OF FEBRUARY 3, 1972

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The South Carolina earthquake of February 3, 1972, was located at 33.46°N, 80.58°W, approximately 27 km east of Orangeburg. It occurred at 6:11 p.m. EST (23:11:08.24 GMT) with a magnitude ( $m_b$ ) of 4.5 within a range of 0.2 units. Macroseismic data show a maximum intensity (MM) of V in Bowman and Cameron, S. C., and a total felt area of 26,000 square miles. Two aftershocks with intensity III occurred on February 7, 1972, at 02:46 and 02:53 GMT.

Introduction

On February 3, 1972, at 6:11 p.m. EST, some 26,000 square miles of South Carolina and neighboring portions of Georgia and North Carolina experienced the largest of an 18 month sequence of four events with epicenters near Orangeburg, South Carolina. No events have been reported within a radius of 50 km of this epicenter prior to the initiation of the sequence. However, the epicenter is in a belt of numerous moderate events extending from the Charleston-Summerville area into the Appalachian mountains.

Location

The NOAA-ERL lists the epicenter at 33.476N, 80.434W, 5 km west of Santee, South Carolina, and near the western end of Lake Marion. However, the southeastern stations ATL, ORT, BLA, and CPO show generally negative residuals. Recomputation of the epicenter using only the southeastern stations yield an epicenter of 33.46N, 80.58W, ( $\pm 5$  km) approximately 10 km south of Elloree and 27 km east of Orangeburg.

TABLE 1

Southeastern Travel Time

Station	EDR Residuals	Revised	EDR Epicenter Solution
ATL	-1.8	-0.2	H = 23:11:08.24 $\pm 0.53$ sec
ORT	-0.9	+0.25	LAT = 33.476N $\pm 6.3$ km
BLA	0.0(reinterpreted)	-0.15	LONG = 80.434W $\pm 5.4$ km
CPO	-1.4	+0.1	DEPTH = 5 km (Geophysist)