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by

R. M. Hamilton, B. E. Smith and J. H. Healy

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Seismic monitoring of the RULISON underground nuclear Explosion near Rifle, Colorado, on 10 September 1969

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Five seismograph stations located within 15 km of ground zero monitored seismic activity at the RULISON site from 72 hours before until 18 hours after the explosion. No earthquakes were recorded in the period preceding the shot; 16 were recorded after the shot, all within the first 43 minutes. These aftershocks, all of which had Richter magnitude of less than 1, were located within 1 km of the explosion.

Portable seismograph systems (Eaton et al., in press) were centered around ground zero (Fig. 1 and Table 1). Recorded earthquakes were located by the computer program HYPOLAYR (Eaton, 1969 and Eaton et al., in press) using a crustal model (Table 2) derived from Jackson and Pakiser (1965). The epicenters of the 16 earthquakes detected (Table 3) are shown in Figure 2. The fact that both compressional and dilatational first motions were recorded for the 16 aftershocks indicates that a simple volume change did not cause the aftershocks, as would have been the case for cavity relaxation.

The seismograms showed numerous signals similar to the emergent seismic events observed after underground explosions at Nevada Test Site and believed to be associated with cavity deterioration. The signals in the Rulison area, however, were observed before as well as after the detonation, thus ruling out cavity deterioration as the cause. They are believed to have been caused by vehicular traffic.

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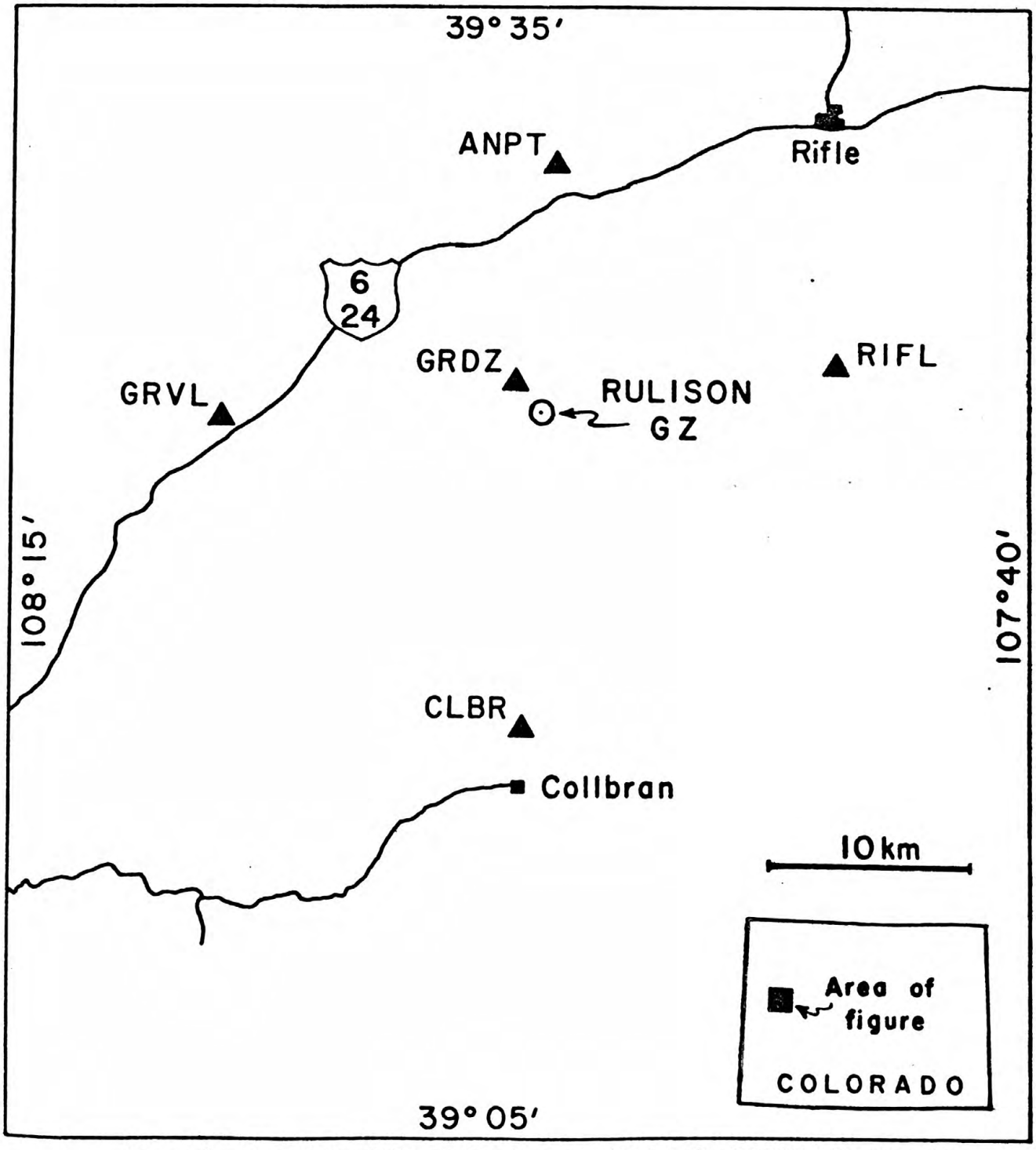

Figure 1. Map of the Rifle, Colorado, area showing the RULISON site location and seismograph station locations (triangles).

Table 1. Seismograph station locations and arrival time corrections

Station name	Latitude, N. deg	min	Longitude, W. deg	min	Elevation, m	Station* correction
GRDZ	39	25.10	107	57.61	2,271	-0.09
ANPT	39	30.92	107	56.22	1,993	0.15
CLBR	39	15.65	107	57.31	1,963	0.24
GRVL	39	24.00	108	07.77	1,573	0.17
RIFL	39	25.67	107	46.67	2,220	0.27

* Station corrections, which are added to the observed arrival times, were derived from the P-wave arrival times of RULISON.

Table 2. Crustal model used for locating the RULISON aftershocks

Velocity, km/sec	Depth to top of layer, km
4.00	0.0
6.05	3.0
6.85	23.5
7.90	42.5

Table 3. Origin times, locations and magnitudes of RULISON aftershocks, 10 September 1969 (GMT)

Origin time, hr	min	sec	Latitude, N. deg	min	Longitude, W. deg	min	Depth, km	Magnitude	Number Stations
21	07	01.17	39	23.66	107	56.90	1.9	0.3	3
	08	39.26		24.38		56.80	2.5	0.6	4
	09	38.49		24.21		56.91	2.4	0.4	4
	10	43.82		24.47		56.82	2.3	0.6	5
	11	26.11		24.06		56.76	2.3	0.3	4
	12	16.30		24.50		56.84	2.5	0.8	5
	13	07.21		24.29		56.81	2.2	0.0	4
	13	53.20		24.45		56.77	2.5	0.7	5
	14	54.31		24.30		56.66	2.6	0.6	3
	16	05.51		24.77		57.36	2.4	0.4	4
	18	18.89		24.24		56.82	2.2	0.3	4
	19	04.90		24.42		56.77	2.5	0.6	5
	19	53.48		24.39		56.78	2.4	0.6	4
	28	39.75		24.30		56.90	2.6	0.3	4
	32	12.76		24.25		56.76	2.6	0.4	3
	42	20.42		24.31		56.79	2.3	0.5	4
RULISON									
21	00	00.11	39	24.35	107	56.88	2.6	5.0	

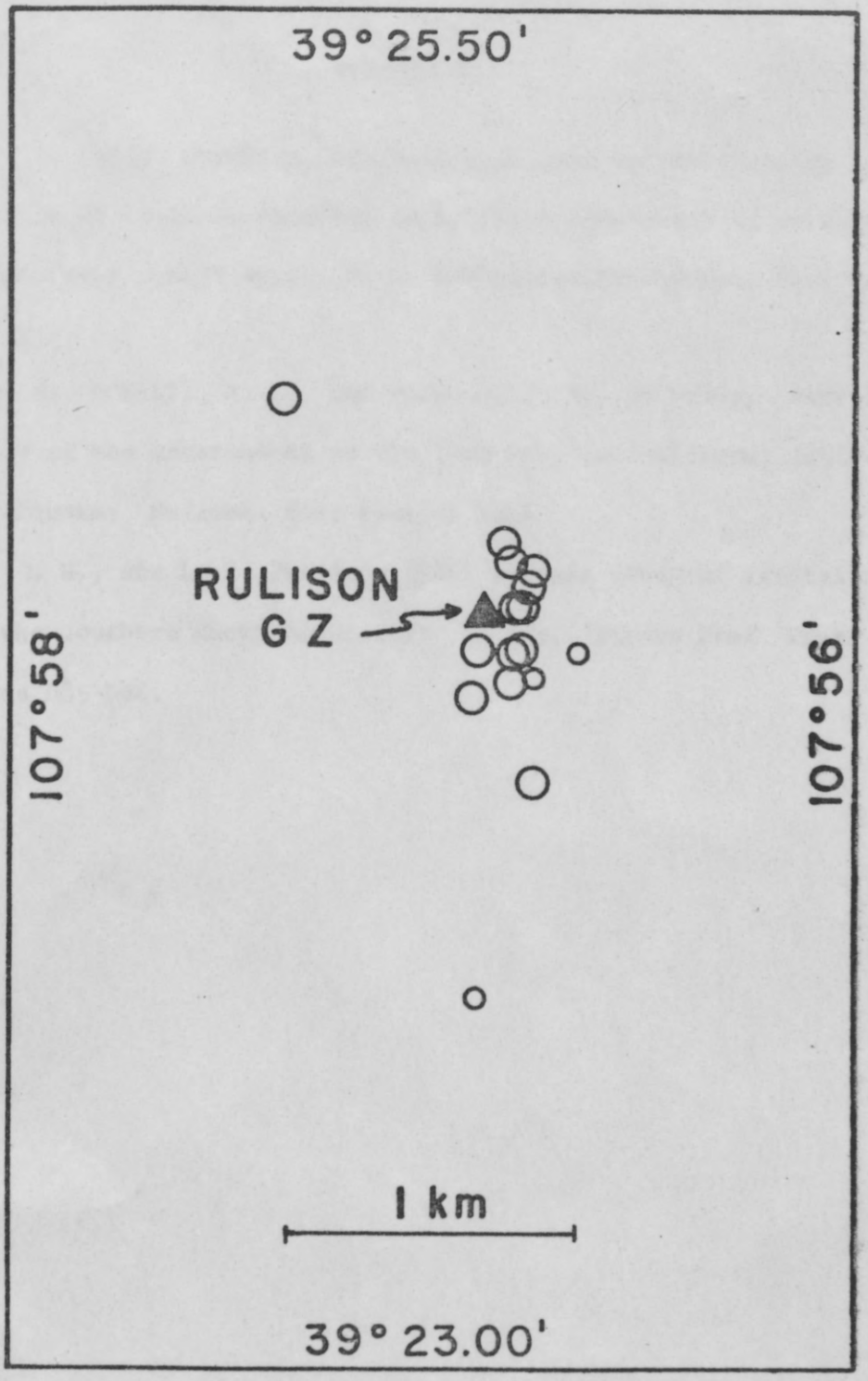

Figure 2. Epicenter map of the RULISON aftershocks. Large circles represent events located by 4 or 5 stations, small circles represent events located by only 3 stations.

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