UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ALBUQUERQUE BASIN SEISMIC NETWORK

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ABSTRACT

The U.S. Geological Survey has recently completed the installation of a seismic network around the Albuquerque Basin in New Mexico. The network consists of two seismometer arrays, a thirteen-station array monitoring an area of approximately 28,000 km² and an eight-element array monitoring the area immediately adjacent to the Albuquerque Seismological Laboratory. This report describes the instrumentation deployed in the network.

INTRODUCTION

The U.S. Geological Survey is conducting seismotectonic studies in the Rio Grande Rift, New Mexico. The study concentrates, at this time, on the Albuquerque Basin. The Albuquerque Basin is one of about a dozen structurally linked depressions that in aggregate constitute the Rio Grande Rift. This report describes the seismic instrumentation deployed to collect data for the investigation.

ARRAY RATIONALE

Geophysical techniques exist that allow the deduction of a considerable body of knowledge from operating an array of seismographs. Data from a seismic array can be used to infer characteristics of the crustal structure, (Aki and others, 1976), upper mantle structure, (Nuttli and Bolt, 1969), and contemporary seismicity and tectonics (Freidline and others, 1976). In general, the instrumentation requirements for these kind of studies are quite straight forward. The maximum possible number of seismic stations, with the proper frequency response, are deployed around and within the study area and operated until sufficient data for the study are accumulated. In the particular case of the Albuquerque Basin, twenty short-period seismometers in two arrays are operational.
The "Basin Array" consists of thirteen seismic stations monitoring an area approximately 200 km by 140 km that includes the Albuquerque Basin and parts of the Estancia, Socorro, and Santo Domingo Basins. The "Local Array" consists of eight seismic stations monitoring the area immediately adjacent to the Albuquerque Seismological Laboratory (ASL).

**BASIN ARRAY**

The study area is shown within the Rio Grande Rift in Figure 1. Station locations relative to the Albuquerque Basin are shown in Figure 2 and pertinent data listed in Table 1. Stations MTL, TSP, and EUM are operated and maintained by the Los Alamos Scientific Laboratory and are received at ASL by telephone line telemetry. The station at Socorro (WTX) is installed in facilities maintained by the New Mexico Institute of Mining and Technology. The station at Albuquerque (ABQ) will be discussed with the Local Array later in this report.

The nine remote stations operated by the USGS transmit real time seismic data to ASL by radio telemetry. Five stations are received at the Manzano lookout tower (Figure 3) six miles east of ASL. These data are multiplexed at the tower and sent to the ASL on a hard-wire link. A block diagram of a typical remote seismic system is given in Figure 4. The remaining four remote sites transmit directly to ASL. The electronic configuration for these sites is identical to that shown in Figure 4 excluding the hardware at the lookout tower.

The entire basin array is recorded on a 16-mm film recorder at ASL (Figure 5). Timing for the system is provided by a quartz crystal controlled oscillator that drifts less than 50 milliseconds per day. Signal monitor circuits enable any data channel to be displayed on a visible drum recorder for test and calibration purposes.
TABLE I
ASL RIO GRANDE TELEMETRY NETWORK

<table>
<thead>
<tr>
<th>STATION NAME</th>
<th>STATION ID</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>ELEVATION (METERS)</th>
<th>ROCK TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuquerque</td>
<td>ABQ</td>
<td>34°56.55'</td>
<td>106°27.45'</td>
<td>1849</td>
<td>Granite</td>
</tr>
<tr>
<td>Golden</td>
<td>GNM</td>
<td>35°14.98'</td>
<td>106°11.56'</td>
<td>2417</td>
<td>Limestone</td>
</tr>
<tr>
<td>Cochiti</td>
<td>COH</td>
<td>35°34.81'</td>
<td>106°18.29'</td>
<td>1646</td>
<td>Basalt</td>
</tr>
<tr>
<td>Estancia</td>
<td>EST</td>
<td>34°51.87'</td>
<td>105°43.36'</td>
<td>2055</td>
<td>Limestone</td>
</tr>
<tr>
<td>Cerro del Durazano</td>
<td>CDN</td>
<td>35°27.28'</td>
<td>107°20.91'</td>
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<tr>
<td>Mesa Lucero</td>
<td>MLM</td>
<td>34°48.86'</td>
<td>107°08.70'</td>
<td>2088</td>
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<tr>
<td>Los Pinos</td>
<td>LPM</td>
<td>34°18.46'</td>
<td>106°38.02'</td>
<td>1737</td>
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<td>Ladron</td>
<td>LAD</td>
<td>34°27.50'</td>
<td>107°02.25'</td>
<td>1768</td>
<td>Gneiss</td>
</tr>
<tr>
<td>Volcanoes</td>
<td>VOL</td>
<td>35°07.50'</td>
<td>106°46.05'</td>
<td>1782</td>
<td>Basalt</td>
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<td>Socorro^1</td>
<td>WTX</td>
<td>34°04.33'</td>
<td>106°56.75'</td>
<td>1555</td>
<td>Granite</td>
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<tr>
<td>Mount Taylor^2</td>
<td>MTL</td>
<td>35°15.10'</td>
<td>107°36.52'</td>
<td>3333</td>
<td>Basalt</td>
</tr>
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<td>Tesuque Peak^2</td>
<td>TSP</td>
<td>35°47.10'</td>
<td>105°46.90'</td>
<td>3426</td>
<td>Diorite</td>
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<tr>
<td>Eureka Mesa^2</td>
<td>EUM</td>
<td>36°00.78'</td>
<td>106°50.63'</td>
<td>2750</td>
<td>Limestone</td>
</tr>
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</table>

1 - Operated in conjunction with New Mexico Institute of Mining and Technology
2 - Operated by Los Alamos Scientific Laboratory
<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>$T_0$</th>
<th>$T_g$</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>ELEVATION (METERS)</th>
<th>ROCK TYPE</th>
</tr>
</thead>
<tbody>
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<td>0.2</td>
<td>34°56.55'</td>
<td>106°27.45'</td>
<td>1849</td>
<td>Granite</td>
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<td>106°26.77'</td>
<td>1825</td>
<td>Granite</td>
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<td>$Z_3$</td>
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<td>Schist</td>
</tr>
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<td>$Z_4$</td>
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<td>106°27.59'</td>
<td>1824</td>
<td>Schist</td>
</tr>
<tr>
<td>$Z_5$</td>
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<td>0.2</td>
<td>34°56.15'</td>
<td>106°27.86'</td>
<td>1814</td>
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<td>$Z_6$</td>
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<td>0.05</td>
<td>34°56.60'</td>
<td>106°28.12'</td>
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<td>Limestone</td>
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<td>$Z_7$</td>
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<td>0.2</td>
<td>34°56.03'</td>
<td>106°27.47'</td>
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<td>Schist</td>
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<tr>
<td>$Z_8$</td>
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<td>0.2</td>
<td>34°56.83'</td>
<td>106°27.49'</td>
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<td>Granite</td>
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<td>$N^*$</td>
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<td>0.2</td>
<td>34°56.55'</td>
<td>106°27.45'</td>
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<tr>
<td>$E^*$</td>
<td>0.8</td>
<td>0.2</td>
<td>34°56.55'</td>
<td>106°27.45'</td>
<td>1849</td>
<td>Granite</td>
</tr>
</tbody>
</table>

1 - Seismometer Period in Seconds
2 - Galvanometer Period in Seconds

* - N and E are horizontal seismometers
   All others are vertical
SUMMARY

This report describes the seismic instrumentation scheme operating around the Albuquerque Basin. The network consists of two seismometer arrays: (1) a thirteen-element array monitoring seismic activity in the Albuquerque Basin and portions of the Estancia, Socorro, and Santo Domingo Basins, and (2) an eight-element array monitoring seismic activity in the immediate vicinity of the Albuquerque Seismological Laboratory. The configuration of these arrays is designed to accumulate data concerning the contemporary seismotectonics of the central Rio Grande Rift.
REFERENCES


ACKNOWLEDGEMENTS

We wish to thank Mr. Ed Tilgner, ASL, for providing the photography for this report.
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Figure 6. DRILLING INTO BEDROCK
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Figure 9. MUCKING OUT THE SITE
Figure 10. INSTALLATION OF UNDERGROUND INSTRUMENTS
Figure 11. SITE COMPLETE EXCEPT FOR BACKFILLING AND WIRE ON CATTLE FENCE
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1 km between array sites

Figure 14. CONFIGURATION OF LOCAL ARRAY
Figure 15. GEOLOGY OF LOCAL ARRAY AREA
Key to Preceding Map

Qal - Quaternary alluvium

Pml - Middle Pennsylvanian Madera Limestone, lower part

Ps - Middle Pennsylvanian Sandia Formation

Pg - Precambrian granite and gneiss

Ps - Precambrian phyllite and schist

Pcmr - Precambrian Sevilleta Metarhyolite of Reich (1949)

Fault - Dashed where approximately located, short dashed where indefinite. U, upthrown side; D, downthrown side.

Figure 15a. KEY TO PRECEDING MAP
Figure 16. A TYPICAL ARRAY ELEMENT
Figure 17. FREQUENCY RESPONSE CURVE FOR Z₁ OF LOCAL ARRAY
Figure 18. FREQUENCY RESPONSE CURVE FOR $Z_2$ OF LOCAL ARRAY