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ALBUQUERQUE BASIN SEISMIC NETWORK

by

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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 km^2 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

STATION NAME	STATION ID	LATITUDE	LONGITUDE	ELEVATION (METERS)	ROCK TYPE
Albuquerque	ABQ	34°56.55'	106°27.45'	1849	Granite
Golden	GNM	35°14.98'	106°11.56'	2417	Limestone
Cochiti	COH	35°34.81'	106°18.29'	1646	Basalt
Estancia	EST	34°51.87'	105°43.36'	2055	Limestone
Cerro del Durazano	CDN	35°27.28'	107°20.91'	2591	Basalt
Mesa Lucero	MLM	34°48.86'	107°08.70'	2088	Basalt
Los Pinos	LPM	34°18.46'	106°38.02'	1737	Granite
Ladron	LAD	34°27.50'	107°02.25'	1768	Gneiss
Volcanoes	VOL	35°07.50'	106°46.05'	1782	Basalt
Socorro[1]	WTX	34°04.33'	106°56.75'	1555	Granite
Mount Taylor[2]	MTL	35°15.10'	107°36.52'	3333	Basalt
Tesuque Peak[2]	TSP	35°47.10'	105°46.90'	3426	Diorite
Eureka Mesa[2]	EUM	36°00.78'	106°50.63'	2750	Limestone

1 - Operated in conjunction with New Mexico Institute of Mining and Technology

2 - Operated by Los Alamos Scientific Laboratory

TABLE II

ASL LOCAL ARRAY

COMPONENT	To[1]	Tg[2]	LATITUDE	LONGITUDE	ELEVATION (METERS)	ROCK TYPE
Z_1	0.8	0.2	34°56.55'	106°27.45'	1849	Granite
Z_2	0.8	0.05	34°56.68'	106°26.77'	1825	Granite
Z_3	0.8	0.2	34°56.07'	106°27.11'	1926	Schist
Z_4	0.8	0.05	34°55.52'	106°27.59'	1824	Schist
Z_5	0.8	0.2	34°56.15'	106°27.86'	1814	Schist
Z_6	0.8	0.05	34°56.60'	106°28.12'	1816	Limestone
Z_7	0.8	0.2	34°56.03'	106°27.47'	1860	Schist
Z_8	0.8	0.2	34°56.83'	106°27.49'	1830	Granite
N*	0.8	0.2	34°56.55'	106°27.45'	1849	Granite
E*	0.8	0.2	34°56.55'	106°27.45'	1849	Granite

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

Aki, K., Christoffersson, A., and Husebye, E.S., 1976, Three dimensional seismic structure of the lithosphere under Montana LASA, Bull. Seismol. Soc. Amer., 66, 501-524.

Chapin, C.E., 1971, The Rio Grande Rift, part 1: modifications and additions, in New Mexico Geol. Soc. Guidebook 22nd Field Conf., San Luis Basin, Colorado, p. 191-201.

Freidline, R.A., Smith, R.B., and Blackwell, D.D., 1976, Seismicity and contemporary tectonics of the Helena, Montana area, Bull. Seismol. Soc. Amer., 66, 81-96.

Myers, Donald A., and McKay, E.J., 1970, Geologic map of the Mount Washington quadrangle, Bernalillo and Valencia Counties, New Mexico, USGS.

Nuttli, O.W., and Bolt, B.A., 1969, P Wave residuals as a function of azimuth, Z_1 undulations of the mantle low-velocity layer as an explanation, J. Geophys. Res., 74, 6594-6602.

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ACKNOWLEDGEMENTS

We wish to thank Mr. Ed Tilgner, ASL, for providing the photography for this report.

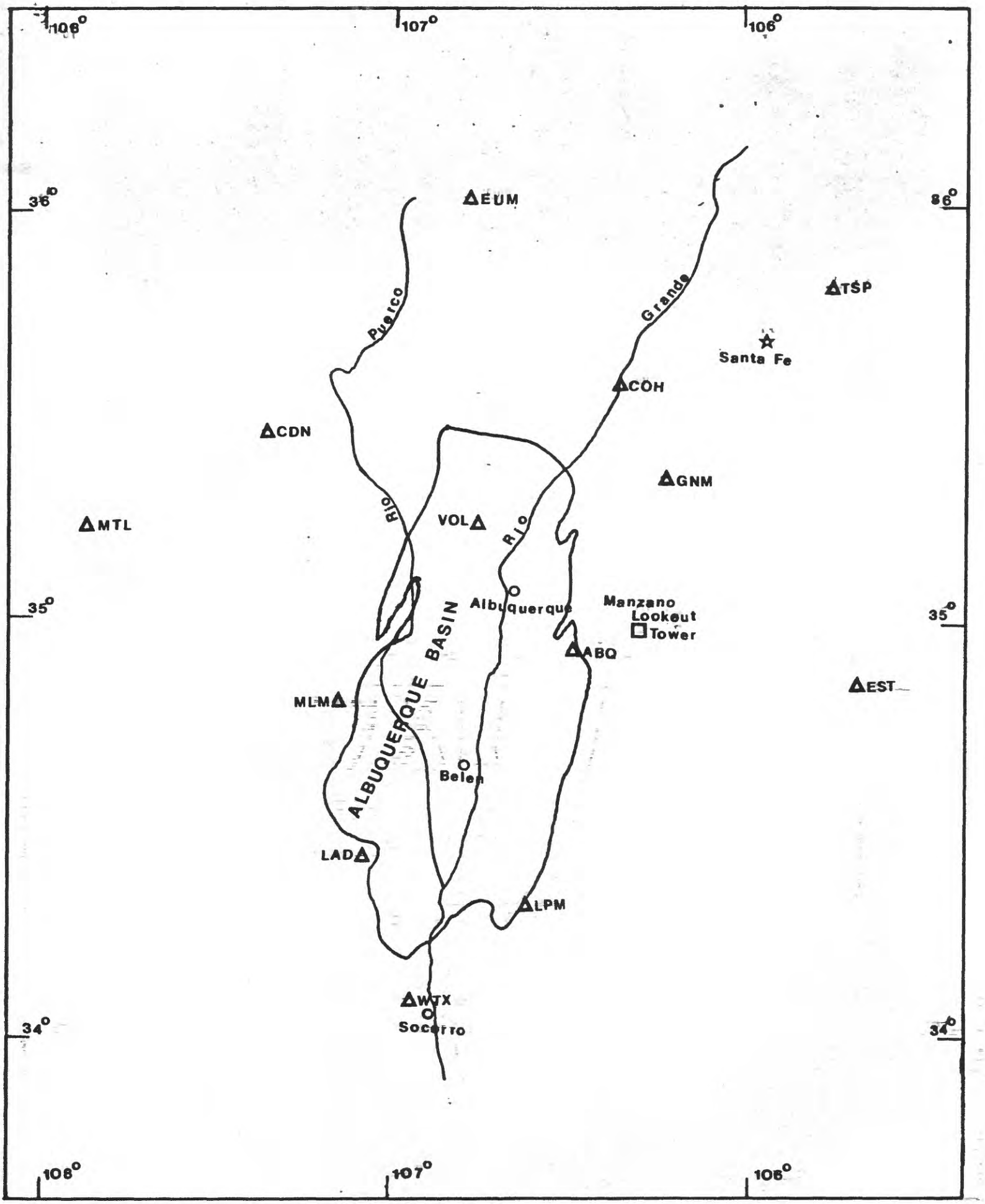


Figure 2. ALBUQUERQUE BASIN AND BASIN ARRAY

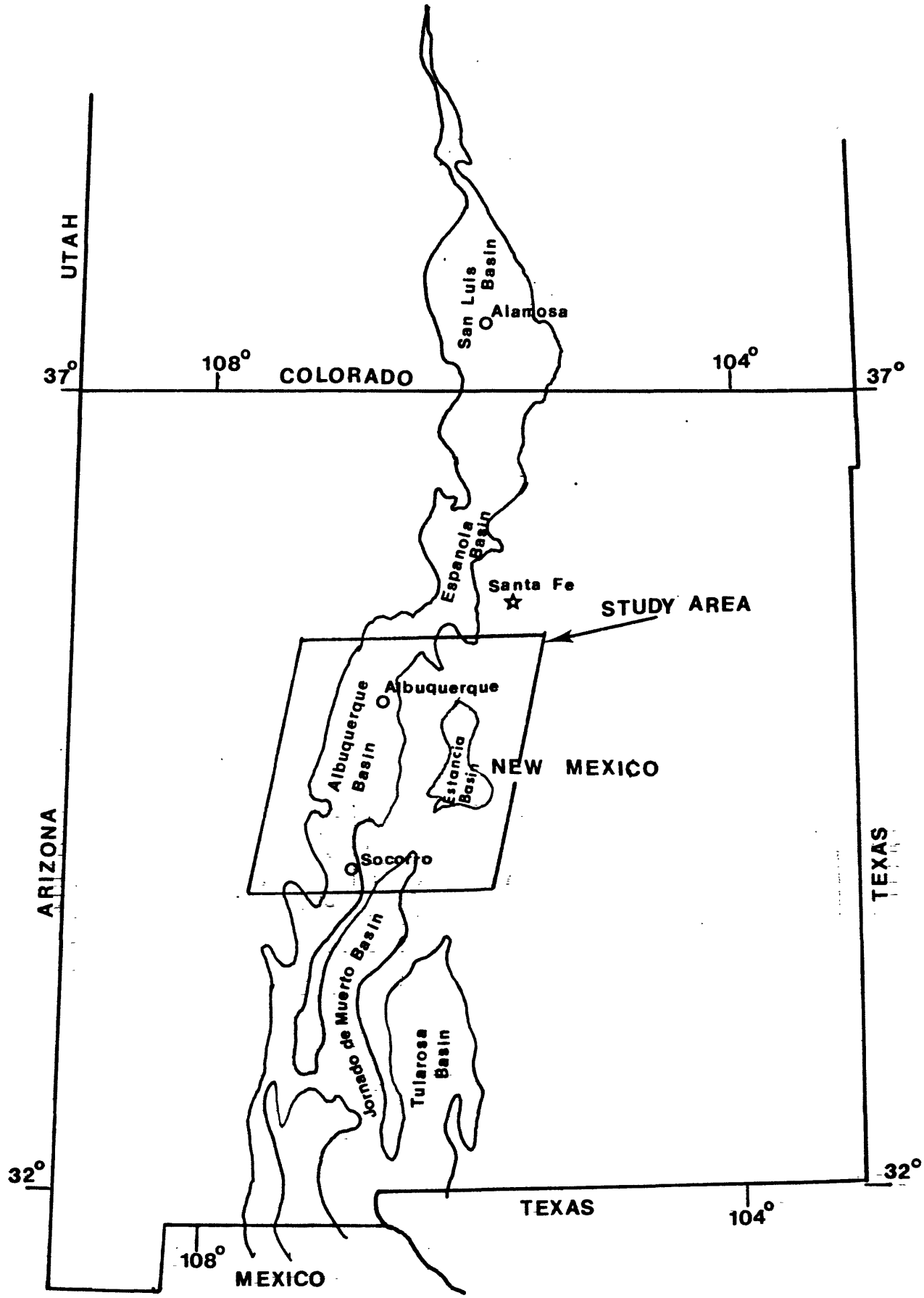


Figure 1. RIO GRANDE RIFT and MAJORS BASINS
(modified from CHAPIN-71)

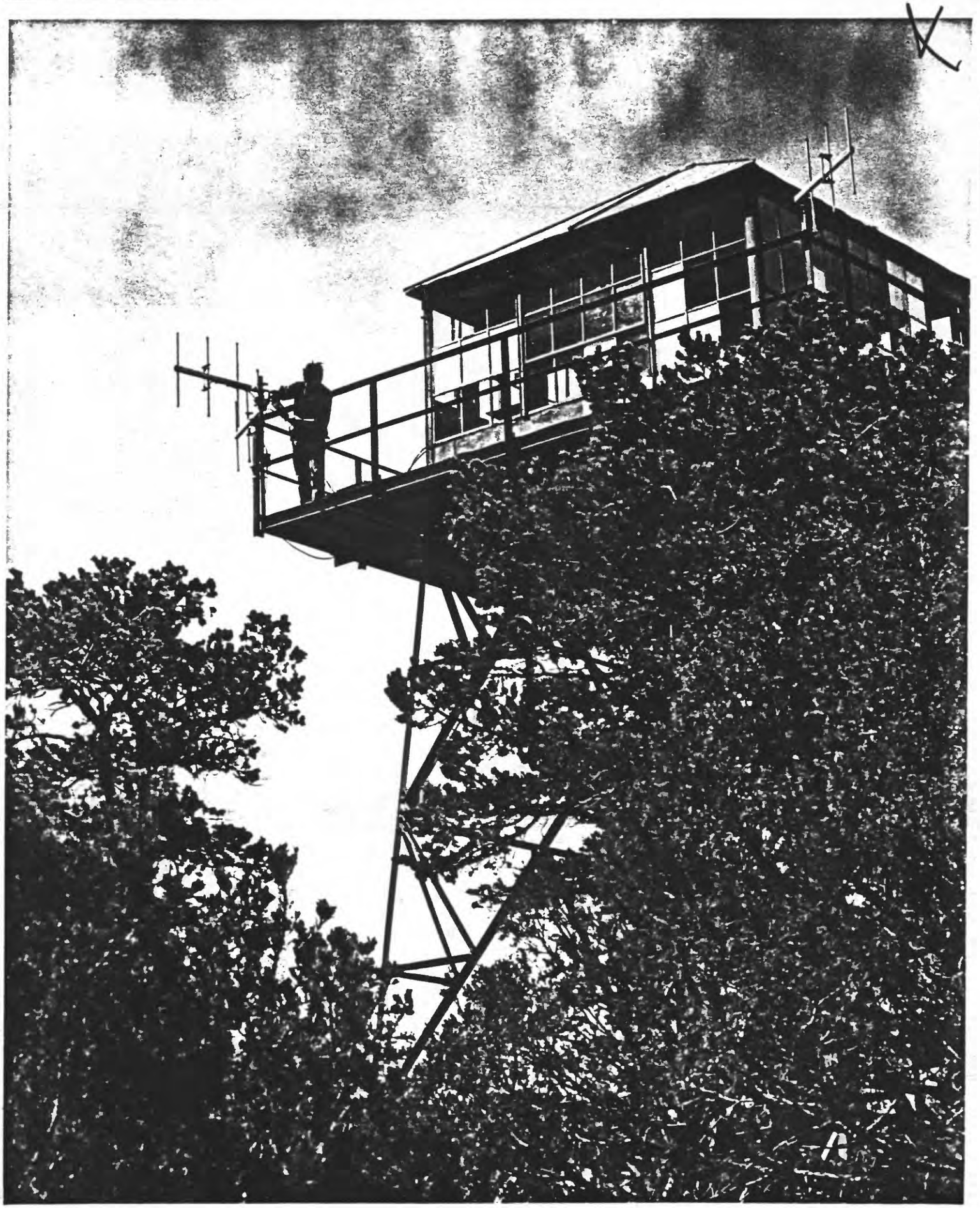


Figure 3. MANZANO LOOKOUT TOWER

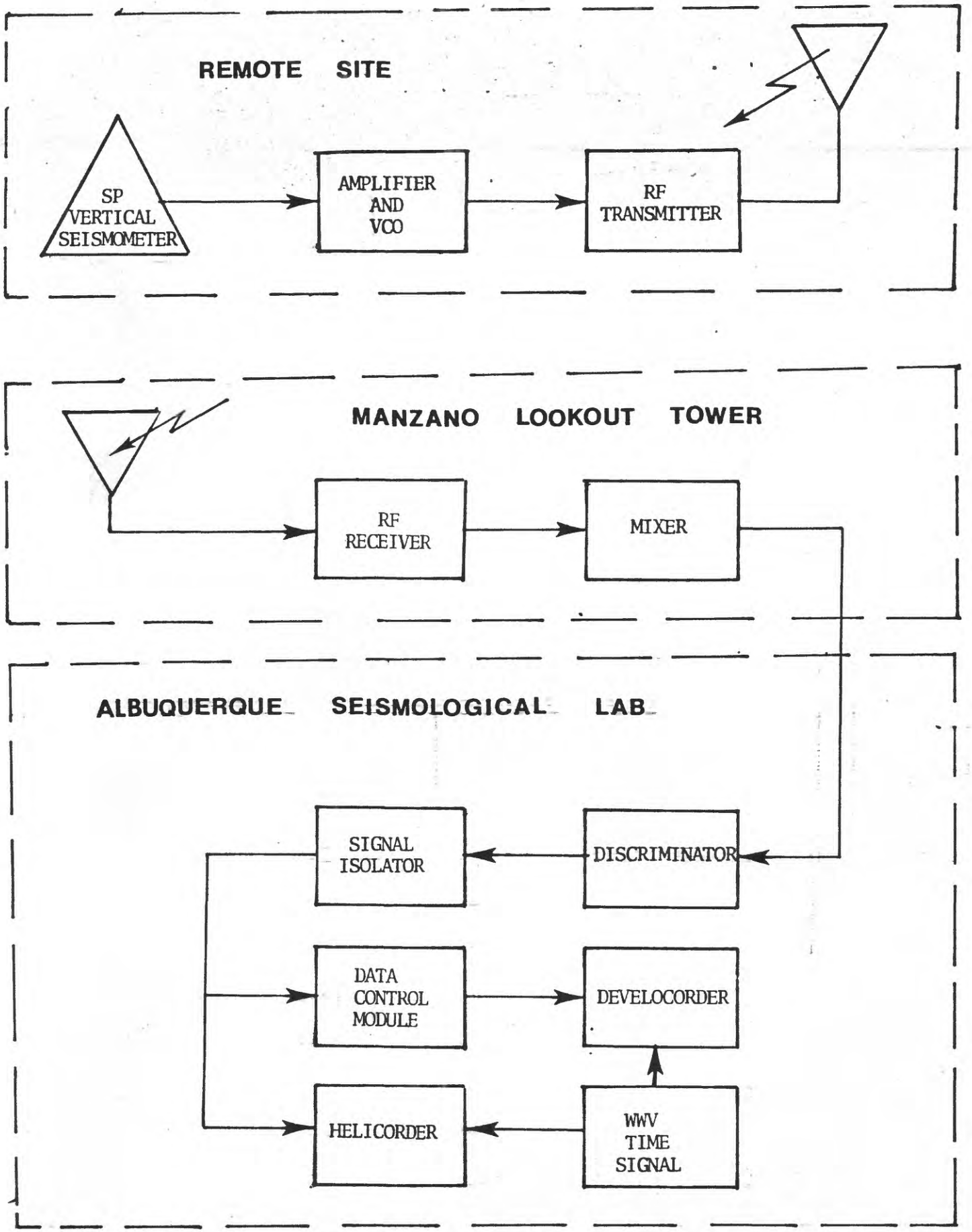


Figure 4. A TYPICAL REMOTE DATA CHANNEL

Figure 5. 16MM FILM RECORDER

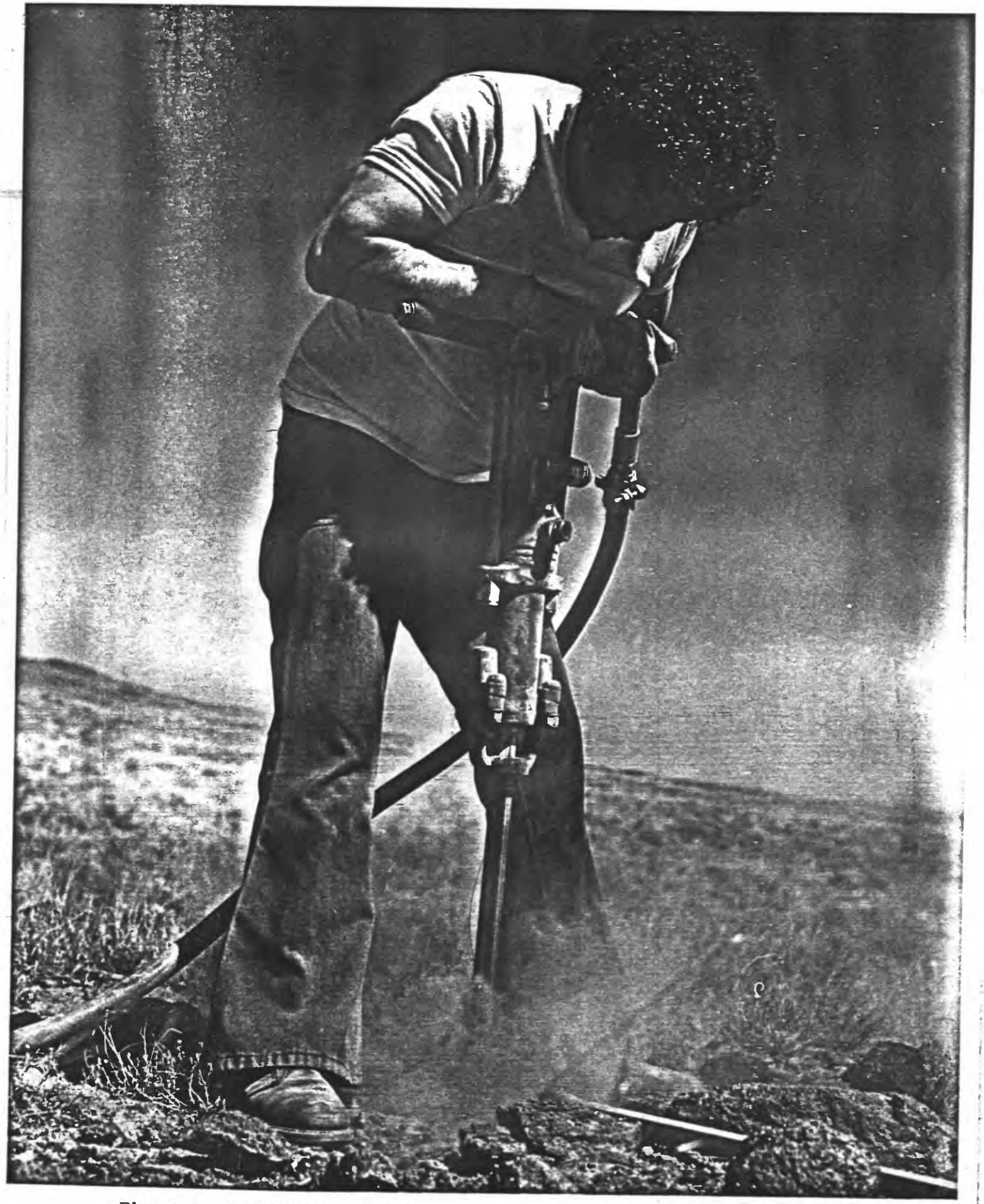


Figure 6. DRILLING INTO BEDROCK

Figure 8. SHOOTING THE SITE

Figure 7. PREPARATIONS FOR BLASTING

Figure 9. MUCKING OUT THE SITE

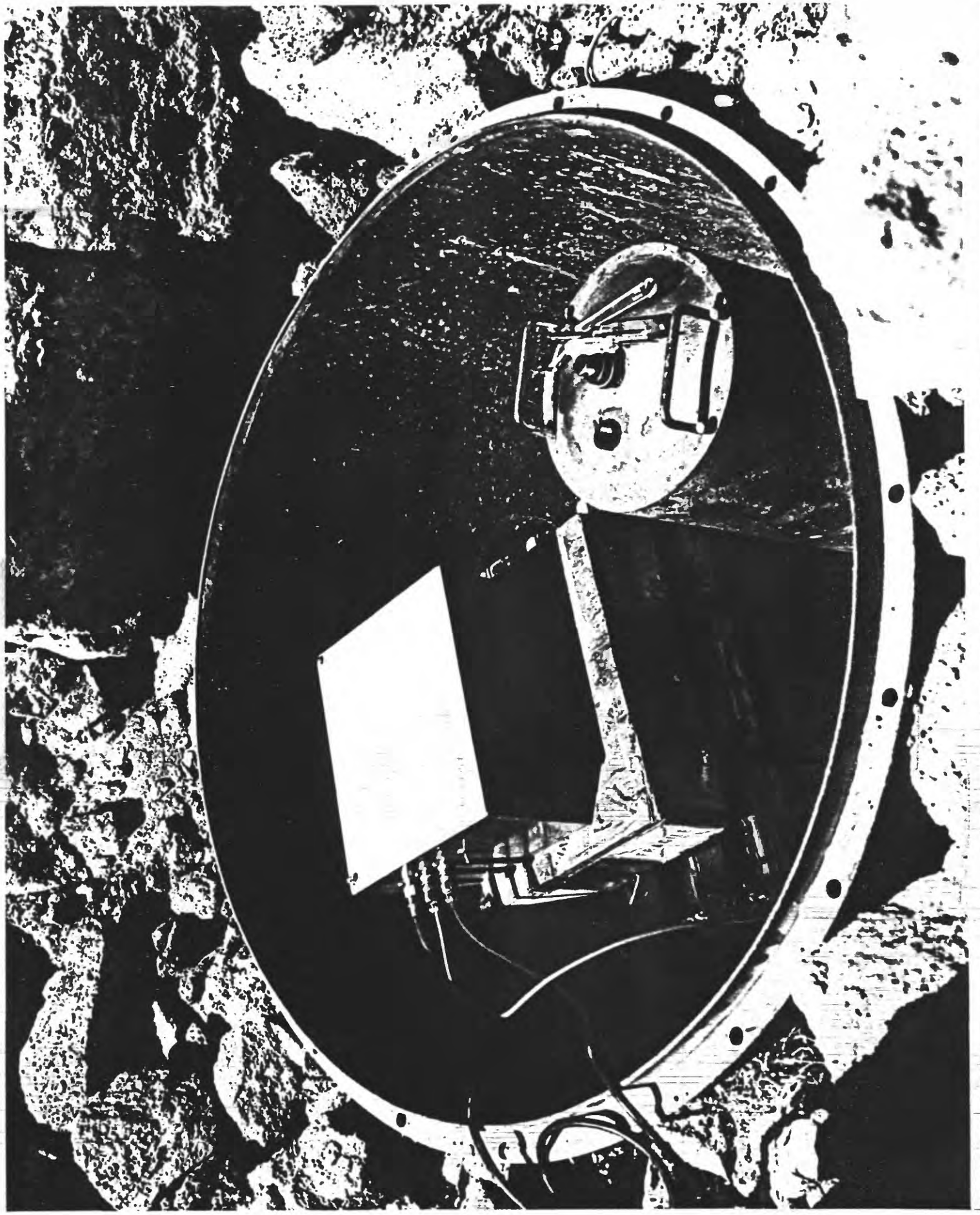


Figure 10. INSTALLATION OF UNDERGROUND INSTRUMENTS

Figure 11. SITE COMPLETE EXCEPT FOR BACKFILLING AND WIRE ON CATTLE FENCE

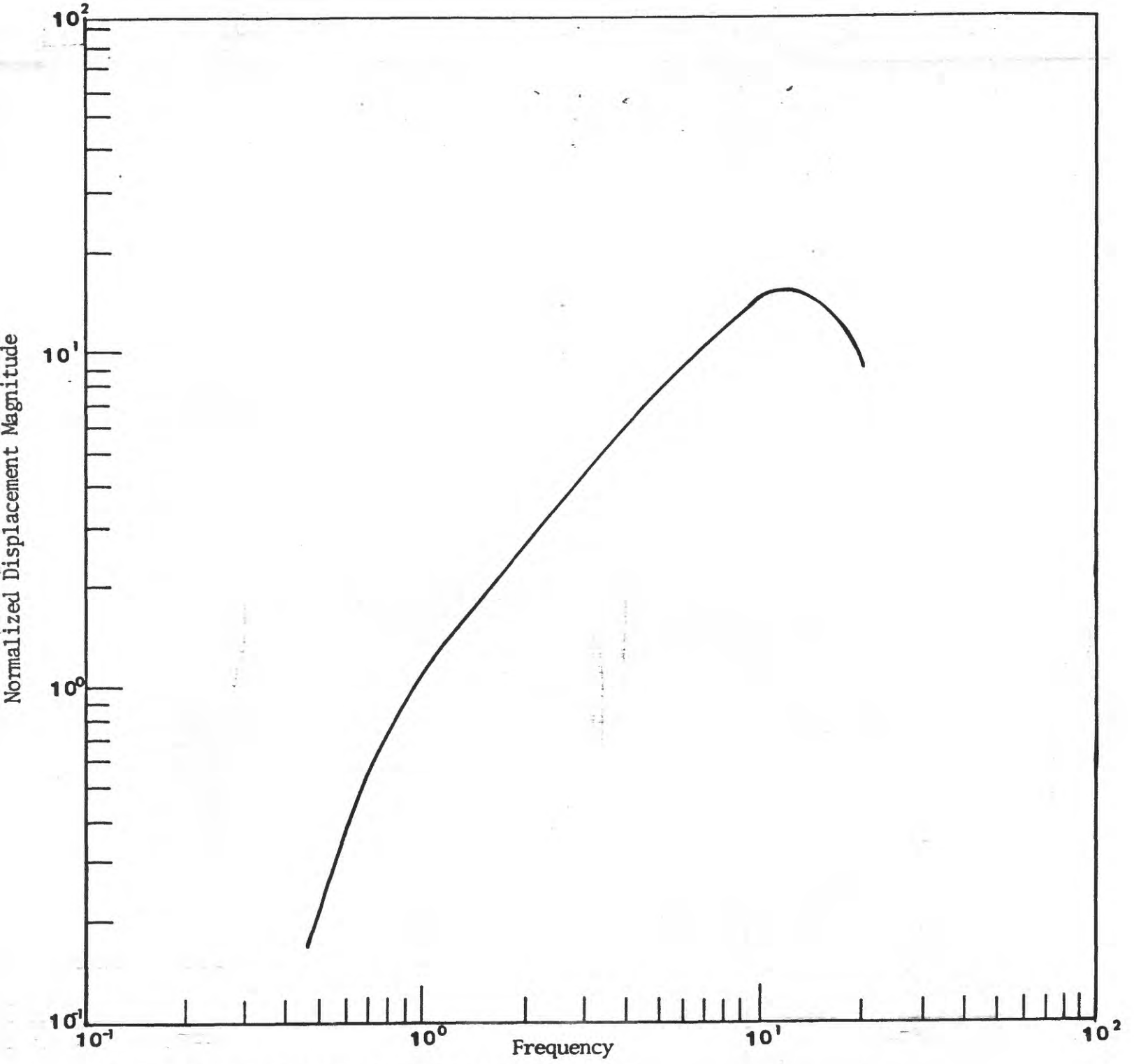


Figure 12. REMOTE SITE FREQUENCY RESPONSE CURVE

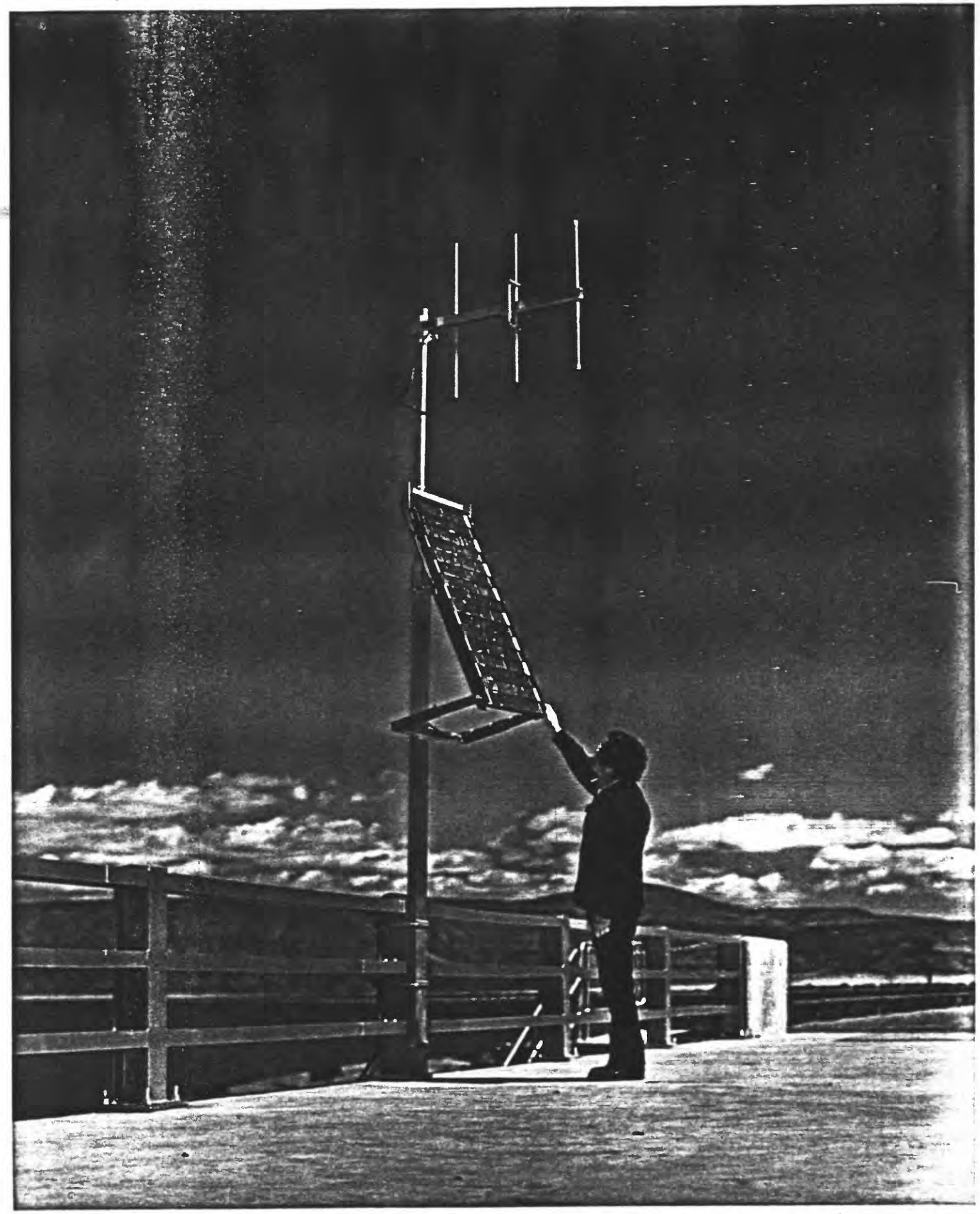


Figure 13. COCHITI DAM SEISMIC STATION

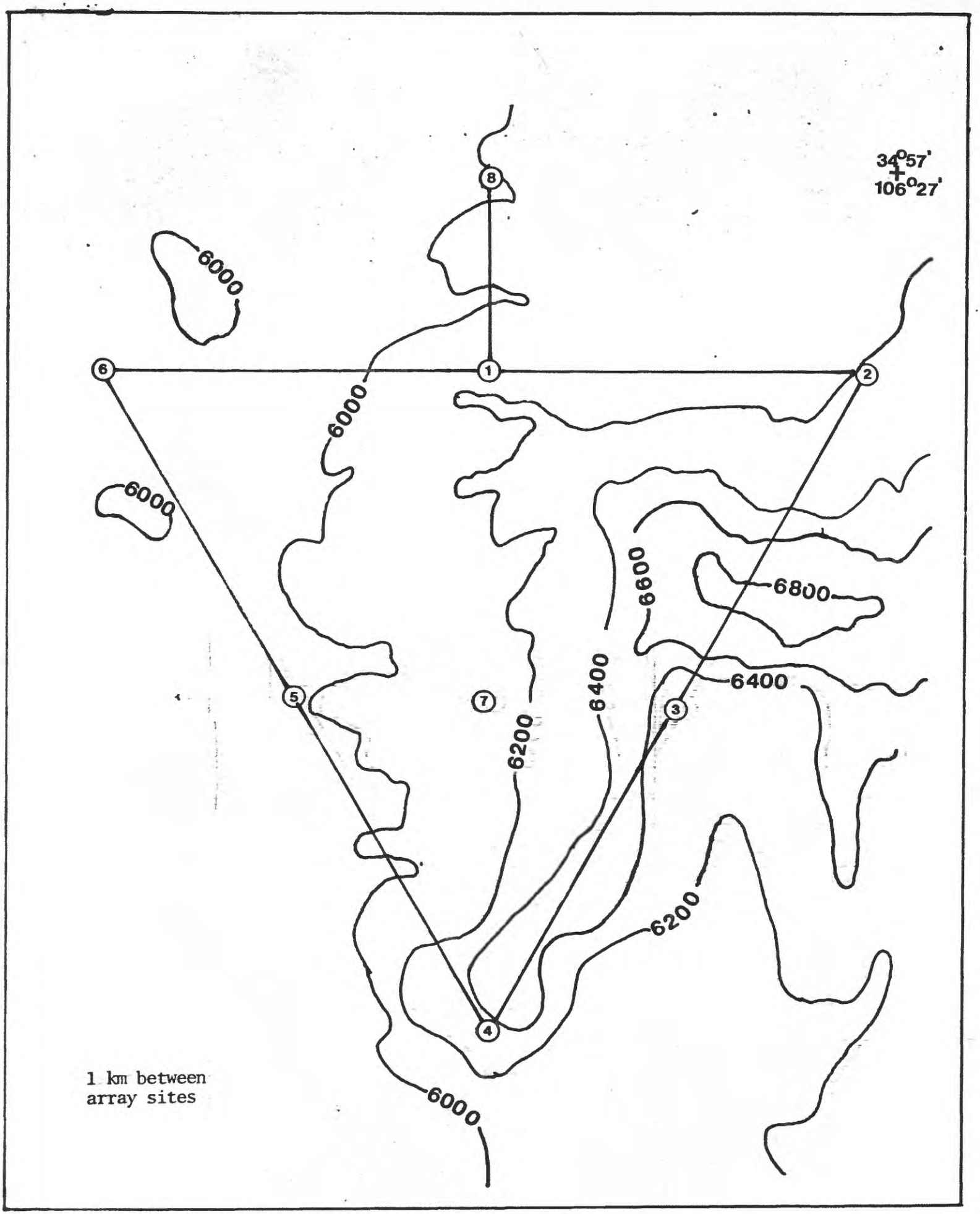


Figure 14. CONFIGURATION OF LOCAL ARRAY

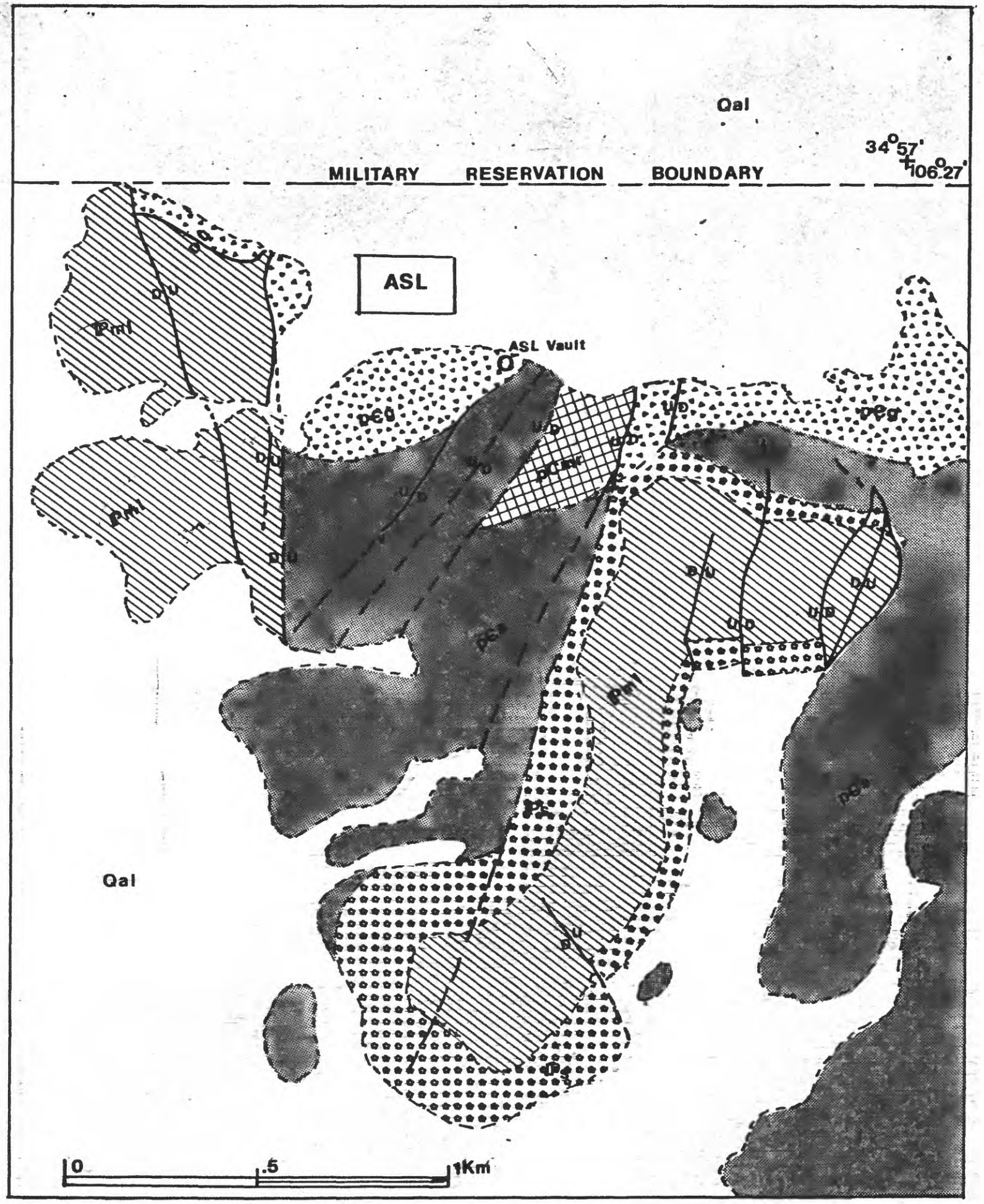
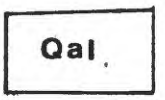


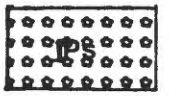
Figure 15. GEOLOGY OF LOCAL ARRAY AREA

Key to Preceding Map



Qal - Quaternary alluvium

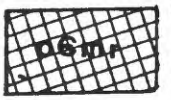
Pml - Middle Pennsylvanian Madera Limestone, lower part



Ps - Middle Pennsylvanian Sandia Formation

pCg - Precambrian granite and gneiss

pCs - 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

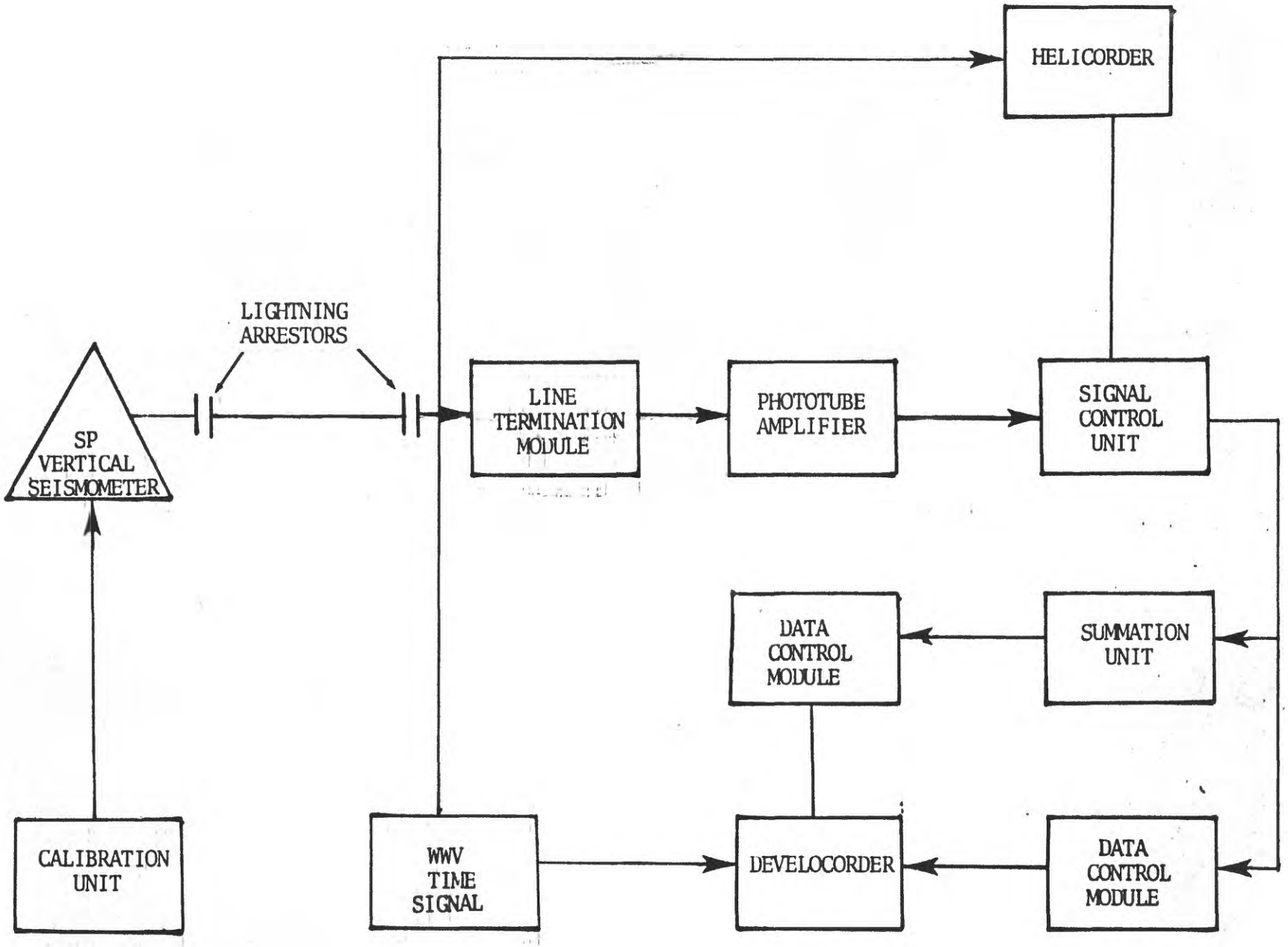


Figure 16. A TYPICAL ARRAY ELEMENT

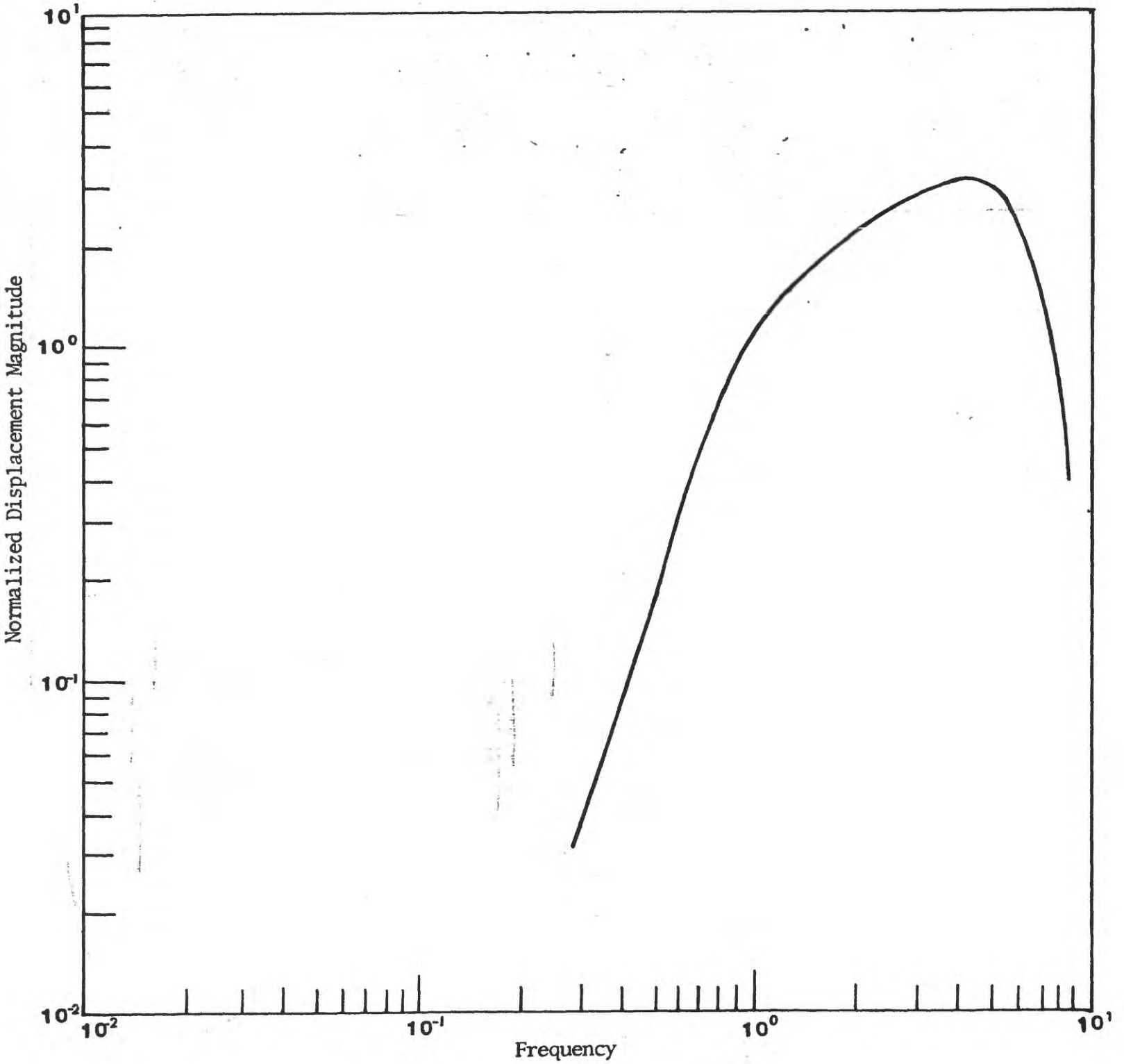


Figure 17. FREQUENCY RESPONSE CURVE FOR Z_1 OF LOCAL ARRAY

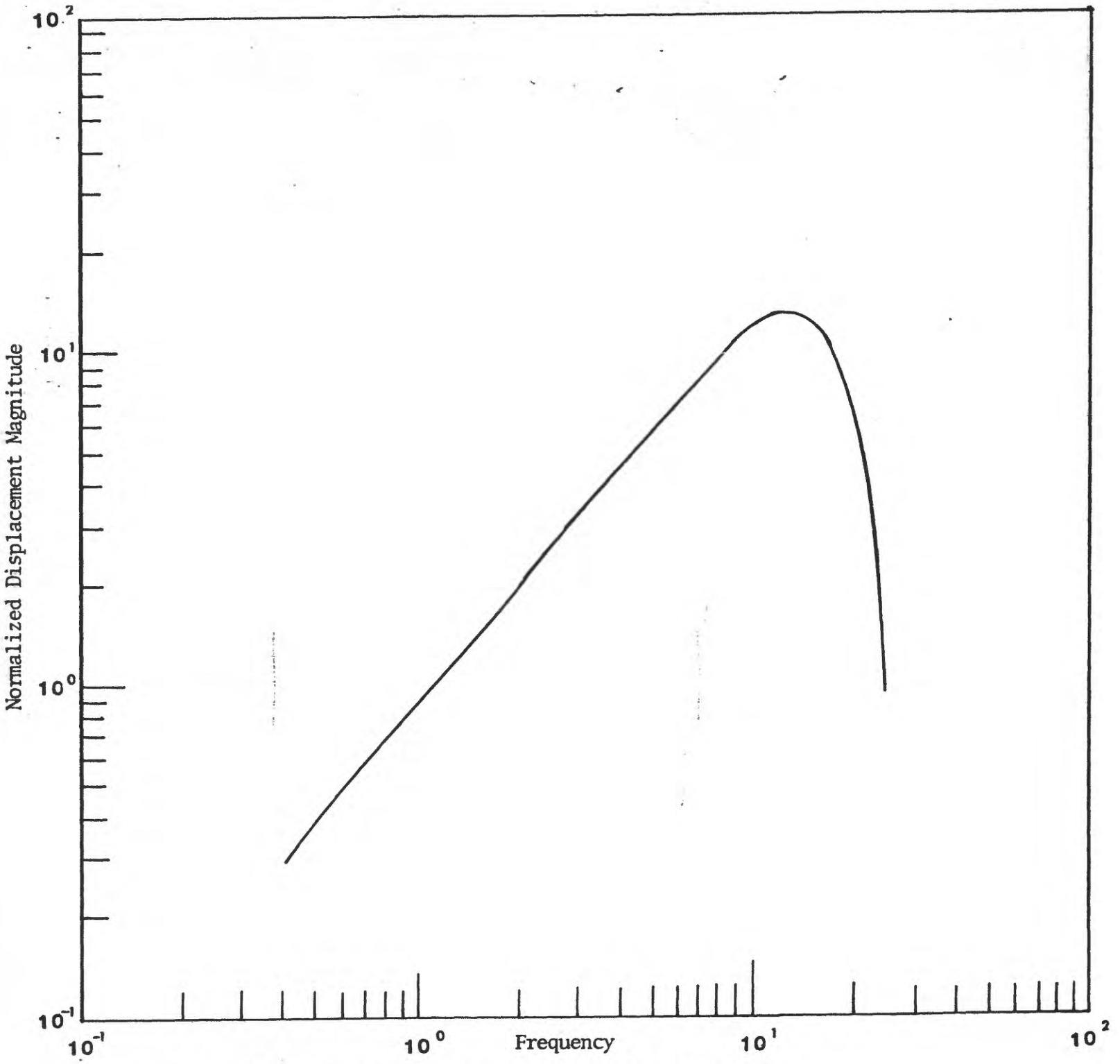


Figure 18. FREQUENCY RESPONSE CURVE FOR Z_2 OF LOCAL ARRAY