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AN EVALUATION OF THE SEISMICITY OF THE NEVADA TEST SITE AND VICINITY

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Abstract

Two USGS catalogs of earthquakes in the Southern Great Basin were edited to remove man-made seisms. Editing reduced 11,988 entries to 8,161. Known location of underground nuclear explosions provided an opportunity to assess location accuracy showing that accuracy differed according to the source of earthquake data. No evidence was found of explosions triggering earthquakes distant from the working points. Relationships are developed between earthquake magnitude and explosion yield for explosions at Pahute Mesa and Yucca Flat. Comparison of the number of underground nuclear explosions with the number of earthquakes of comparable magnitude shows the former exceeds the

This work was performed under WBS 1.2.3.2.8.3.3.

PREFACE

The Yucca Mountain Site Characterization Project (YMP), managed by the Office of Geologic Disposal of the Office of Civilian Radioactive Waste Management of the U. S. Department of Energy, is examining the feasibility of siting a potential repository for commercial high-level nuclear wastes at Yucca Mountain on and adjacent to the Nevada Test Site. This work, intended to extend our understanding of the ground motion at Yucca Mountain from both earthquakes and the testing of nuclear weapons on the NTS, was funded jointly by the YMP and the Military Applications Weapons Test Program.

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CONTENTS

TABLES

FIGURES

INTRODUCTION

Nevada has a history of significant earthquakes, and as a consequence, its historic earthquake catalogue has received considerable attention (Townley and Allen, 1939; Slemmons et al, 1965; Wood et al, 1966; Ryall et al, 1966; and Gumper and Scholz, 1971). With the advent of underground nuclear testing, the area on and around the Nevada Test Site (NTS) has been subjected to even greater scrutiny (Hamilton et al, 1969; King et al, 1971; Hamilton et al, 1971; Fischer et al, 1972; Rogers et al, 1976; Rogers et al, 1977a; and Rogers et al, 1977b). At the beginning of the Yucca Mountain Site Characterization Project (YMP), an extensive net (the Southern Nevada Seismograph Network - SNSN) was installed on and around the NTS (Rogers et al, 1981; Rogers et al, 1983).

These and other sources have been used by the U.S. Geological Survey (USGS) to compile two catalogs of earthquakes in the NTS vicinity. In August 1986, USGS provided a draft of an open file report (Meremonte and Rogers, 1987) on the Southern Great Basin Historical Catalog (SGBHC) to Sandia National Laboratories. In January 1987, USGS also provided a tape of the SGBHC earthquakes and those from the more recent SNSN measurements. This report is the result of examining both catalogs.

Meremonte and Rogers were careful to acknowledge that many items in the SGBHC were man-made seisms rather than natural earthquakes. These included underground nuclear explosions, their collapses and aftershocks, chemical explosive detonations, mine blasts, and seisms resulting from the filling and subsequent level changes of Lake Mead. In order that these catalogs could be complete, USGS chose to retain the man-made events but to flag them where they could be identified. To retain the man-made events in using the catalogs for estimating seismic hazard with respect to Yucca Mountain results in an exaggeration of the hazard. While man-made events cause ground motion as do earthquakes, there are significant differences. UNEs are totally predictable in time and location, and quite predictable in energy release. HE tests, mine blasts have similar predictability and are small energy releases. Lake Mead events more nearly resemble natural earthquakes, but because they result from reservoir filling, they represent an unnatural perturbation on natural regional seismicity.

In this report, we have identified and deleted man-made events, examined the accuracy of hypocenter location, and considered the matter of triggering earthquakes with underground nuclear explosions. A tape of the edited version of the catalogs is available for further hazard analysis.

Not all underground nuclear explosions are announced to the public. Thus, the date, time, and names of unannounced events are classified. To avoid publication of classified information, dates and times of unannounced events have been omitted.

THE DATA BASE

The 28 source codes used in the SGBHC of Meremonte and Rogers have been retained and are reproduced in Appendix A. Some of the older sources gave locations only to the nearest degree of latitude and longitude. ALX, ISC, and KKG ordinarily have readings to the nearest 0.01 degree, and the balance to the nearest 0.001 degree. A difference of 0.001 degree resolves into a difference of about 110 m in latitude and 90 m in longitude. A later section of this report treats the accuracy actually achieved by some of the sources. The various sources differed in a number of ways in the amount of data provided and the detail in which it was presented.

Most, but not all, of the earthquakes in the RYC are listed in Slemmons et al (1965). The latter source lists many more earthquakes not shown in RYC, presumably because of more distant geographic locations. Earthquakes from HSF came from Hamilton et al (1969 and 1971), and those from ROW from Rogers et al (1977b). As would be expected from the titles, most of the events are aftershocks following underground nuclear explosions (UNEs).

Those events listed under KKG are not just from King et al (1971), but rather Bayer et al (May 1972), Bayer (July 1972), Bayer (September 1972), Bayer and King (October 1972), Bayer and King (November 1972), Bayer (December 1972), Bayer (January 1973), Bayer (February 1973), and Bayer (May 1973).

Man-Made Events

Five types of non-earthquake events were found in the catalogs: seisms induced by impoundment of Lake Mead, mine blasting and chemical explosions, UNEs, cavity collapses, and aftershocks following underground nuclear explosions. The numbers of these events deleted are listed by source in Table 1.

Lake Mead Earthquakes--When Lake Mead reservoir began filling in 1936, an increase in seismic activity was observed. Over a span of about 40 years, several efforts to measure the seismicity of the vicinity were made, including one during 1972 and 1973 (Rogers and Lee, 1976). It is to be expected that some of these earthquakes would find their way into the SGBHC. It is the position taken here that reservoir-induced earthquakes are not indicative of regional seismicity as it relates to a proposed repository at Yucca Mountain (unless, of course, a comparable reservoir is contemplated near Yucca Mountain.) Lake Mead events had M5 or less and were 160 km or more from Yucca Mountain, hence they do not add to the hazard there.

Accordingly, earthquakes which fell within 0.2 degree of the lake perimeter, according to the criterion used by Meremonte and Rogers (1987), were deleted. These numbered 428 and were distributed among the sources as shown in Table 1.

Table 1. Summary of Events Deleted

Source	Total	Lake Mead	Blasts & HE Explosions	UNEs, Collapses, Aftershocks	Collapse*	Net
ALX	66	6		2	2	56
BRK	168			2	1	165
BRP	395	294	1	17	1	82
CVH	1	1				0
ERS	3	2				1
FPH	18					18
GDY	226	11	2	59	4	150
HSF	2288			2159		129
ISC	83			19	12	52
KKG	1340	19	7	111		1203
PAS	1049	24		16	2	1007
PDX	66	1	1	31	13	20
PHM	33					33
ROW	519			498		21
RYC	107	47		1		59
RYN	241**			17	2	222**
SHJ	9					9
USE	1	1				0
Total SGBHC	6613	406	11	2932	37	3227
SNSN	5375+	22	26	392	1	4934+
Grand Total	11988	428	37	3324	38	8161

*Located outside aftershock criteria

**Includes one outside map boundaries

+Includes two duplicates

High Explosive (HE) Test Explosions--Fourteen high explosive tests were

640206	16 17 49.54	Pre-Schooner A [Spruill and Paul (1965)]
640225	18 40 25.41	Pre-Schooner C [Spruill and Paul (1965)]
640227	18 17 54.60	Pre-Schooner D [Spruill and Paul (1965)]
710429	19 00 00.00	Mine Throw I [Carnes and Conway (1973)]
720510	12 00 00.00	Pre Mine Dust
720522	23 27 00.00	Post Mine Throw #1
720523	22 15 00.00	Post Mine Throw #2
720524	21 20 00.00	Post Mine Throw #3
720525	20 30 00.00	Post Mine Throw #4
720526	19 15 00.00	Post Mine Throw #5
800911	14 59 59.80	Nuclear Hardness & Survivability DH-1 [Swartz et al (June 1981)]
810213	18 00 00.70	Nuclear Hardness & Survivability D-1 [Noble et al (November 1981)]
810618	17 00 00.34	Nuclear Hardness & Survivability SH-1 [Noble et al (January 1982)]
820429	04 00 00.54	USGS Seismic Refraction [Hoffman and Mooney (1984)]

There were other man-made explosions associated with mining at Bare Mountain and construction and operation of an Air Force shock tube at Little Skull Mountain. These are difficult to identify positively because times of the explosions were not recorded. Some of these will be discussed in a later section.

Underground Nuclear Explosions--There were 85 nuclear explosions included in the catalogs that were identified by the same or nearly the same times as the recorded time of the explosions. Times for announced shots are in Table

Table 2. Location Accuracy (UNE and HE data)

Event	Date hr:min	True Event Time hr:min sec	Time from USGS Catalog hr:min sec	Time Differ min	Lat.	Long.	Equiv. NTS Coordinates N	Equiv. NTS Coordinates E	Hole Number	Actual Hole Coordinates N	Actual Hole Coordinates E	Dist. Differ. (km)	Azimuth Clock-wise from No. about GZ	Depth USGS (km)	Mag.	Remarks	Time Probability 1i	Space Probability 1i
Unannounced				-00:00.20								2.911	126.61				4.32+05	3.89+03
Unannounced				+00:02.00								10.807	45.15				4.32+04	2.83-02
Unannounced				-00:00.20								4.562	116.38			(a)	1.44+05	5.29+02
Unannounced				00:00.00								3.141	37.37			(a)	8.64+06	3.35+03
Unannounced				+00:00.30								3.996	114.07			(a)	7.20+04	5.17+02
Unannounced				+00:00.40								10.377	167.65			(a)	2.16+05	3.07+02
Unannounced				-00:00.10								2.135	101.13			(a)	8.64+05	7.24+03
Unannounced				+00:00.10								2.512	211.40			(a)	8.64+05	5.23+03
Unannounced				+00:00.20								3.013	116.12			(a)	2.16+05	1.82+03
Unannounced				+00:00.40								12.450	172.36			(a)	2.16+05	2.11+02
Unannounced				+00:00.20								3.465	193.54			(a)	2.16+05	1.17+03
Unannounced				00:00.00								1.064	255.84				8.64+06	2.92+04
Unannounced				+00:00.10								1.810	213.83				8.64+05	1.01+04
Unannounced				+00:01.70								19.695	290.76			(a)	1.69+04	2.84+01
Unannounced				00:00.00								1.687	34.88			(a)	8.64+06	1.16+04
Unannounced				+00:01.20								1.887	108.38			(a)	1.20+04	1.54+03
Pre-Schooner D(HE)	640227	18:18	18:17 54.60	-00:05.40	37.200	116.300	891985	606790	-	858092	592410	11.222	22.99	30.0	—	(a) (b) (c)	1.60+04	2.62+02
Unannounced				+00:02.60								1.792	196.05			(a)	3.69+03	1.14+03
Unannounced				+00:01.61								6.715	348.19				4.37+04	7.32+02
Unannounced				+00:01.48								4.712	235.07				5.48+04	1.49+03
Unannounced				+00:00.82								4.231	152.00			(a)	3.05+05	1.84+03
Unannounced				+00:01.21								3.232	212.56			(a)	7.14+04	3.16+03
Unannounced				+00:01.61								6.385	346.45				5.37+04	8.10+02
Unannounced				+00:01.41								2.531	197.54			(a)	1.23+04	1.03+03
Unannounced				+00:01.96								7.753	299.12				2.20+04	2.75+02
Unannounced				+00:01.18								7.913	78.64				9.15+03	6.59+01
Unannounced				+00:01.66								6.624	174.94			(a)	5.20+04	7.52+02
Unannounced				+00:02.00								3.195	160.14			(a)	4.32+04	3.23+03
Unannounced				-00:00.87								43.551	249.76				9.93+04	1.74+01
Unannounced				+00:01.38								3.428	235.74			(a)	6.26+04	2.81+03
Unannounced				+00:00.51								3.058	139.36			(a)	1.69+05	3.53+03
Unannounced				-00:00.09								21.392	216.65			(a)	9.60+05	7.22+01
Unannounced				+00:01.09								4.966	196.61			(a)	7.93+04	1.34+03
Unannounced				-00:01.72								4.644	220.97				5.02+04	1.51+03
Unannounced				+00:01.68								5.973	91.90				2.57+04	4.63+02
Unannounced				+00:01.69								3.837	140.17			(a)	3.65+03	6.99+02
Unannounced				+00:01.48								7.677	152.34			(a)	5.84+04	5.60+02
Unannounced				+00:02.01								6.993	182.82				4.26+04	6.74+02
Unannounced				+00:01.68								6.2[illegible]	148.38			(a)	1.74+04	2.79+02
Unannounced				+00:01.18								5.320	64.49				9.15+03	[illegible]
Unannounced				+00:01.58								4.063	240.15				7.73+04	1.00+03
Unannounced				+00:01.75								[illegible]	283.58				4.94+04	[illegible]
Unannounced				+00:01.34								[illegible]	235.49				6.45+03	4.78+[illegible]
Unannounced				+00:01.70								[illegible]	257.53				6.08+[illegible]	[illegible]
Unannounced				-00:00.56								[illegible]	249.75				3.49+05	[illegible]
Unannounced				+00:01.96								[illegible]	84.39				2.27+04	1.10+03
Unannounced				+00:01.50								2.8[illegible]	123.97				1.92+04	1.37+03
Unannounced				+00:02.60								10.448	124.54				3.32+04	3.02+02
Pre-Schooner A(HE)	640206	16:16	[illegible]	+01:49.54	37.303	116.257	929648	622059	—	855129	589739	21.732	23.49	8.0	—	(a) (c)	7.89+02	5.40+01
Pre-Schooner C(HE)	640225	16:43	[illegible]	-00:34.59	36.953	116.466	801917	598633	—	858132	594588	[illegible]	214.59	8.0		(c)	2.50+03	8.94+02
Unannounced				+00:01.70								[illegible]	301.61				3.37+04	2.89+03
"				+00:02.20								[illegible]	214.37				3.93+04	1.11+02
"				+00:00.30								[illegible]	85.32				8.64+05	[illegible]
"				-00:00.20								21.317	77.42				4.32+05	[illegible]
"				+00:01.40								7.119	165.11				3.09+04	3.26+02
Mine Throw 1 (HE)	[illegible]	20:[illegible]	[illegible]	-01:20.60	37.120	116.320	862837	601071	—	[illegible]	[illegible]	0.968	96.44	5.0	3.0	(c) (d)	5.60+02	1.17+03
Mine Dest [illegible] (HE)	720?10	12:00	12:00 00.00	00:00.00	37.010	116.200	822940	636254	—	823156	635871	0.140	123.80	0.0	—	(c)	4.32+06	8.42+05
Post Mine Throw #1 (HE)	720522	23:27	23:28 56.00	+1:56.00	37.120	116.330	862827	598156	--	863230	597940	0.144	148.60	0.0		(c) (d)	1.49+02	3.18+05
Post Mine Throw #2 (HE)	720523	22:15	22:15 38.00	+00:38.00	37.120	116.330	862827	598156	--	863230	597940	0.144	148.60	0.00		(c) (d)	5.68+02	3.98+05
Post Mine Throw #3 (HE)	720524	21:20	21:21 19.00	+01:19.00	37.120	116.330	862827	598156	--	863230	597940	0.144	148.60	0.00		(c) (d)	3.65+02	5.31+05
Post Mine Throw #4 (HE)	720525	20:30	20:30 59.00	+00:59.00	37.120	116.330	862827	598156	--	863230	597940	0.144	148.60	0.00		(c) (d)	1.63+02	1.77+05
Post Mine Throw #5 (HE)	720526	19:15	19:15 42.00	+00:42.00	37.120	116.330	862827		--	863230	597940	0.144	148.60	0.0		(c) (d)	1.20+03	5.31+05
Laguna	710623	15:30 00.00	15:29 00.09	-00:59.91	37.090	116.000	852413	694445	3[illegible]	827599	688000	7.814	34.56	-	4.8	(e) (f)	1.44+03	5.41+02
Unannounced				-00:01.08								21.420	93.19			(a) (e) (f)	4.00+04	3.60+01
Unannounced				-00:00.90								6.109	102.09			(a)	9.60+04	8.84+02
Unannounced				-00:00.10								1.549	342.73			(a)	4.32+05	6.88+03
Unannounced				-00:00.60								2.738	52.71			(a)	1.44+05	4.40+03
Mine Throw (HE)	710429	19:00 00.00	19:00 00.00	00:00.00	37.122	116.333	863552	597278	--	862830	597752	0.263	326.80	-	-	(a) (e)	8.64+06	4.77+05
[illegible]	721214	15:00 00.10	15:00 00.00	-00:00.10	37.033	115.956	831755	707414	2[illegible]	868948	667251	16.249	334.25	5.0	3.4	(a) (e)	4.32+05	6.25+01
Unannounced				+00:02.70								4.893	263.04				8.00+03	1.45+02
Unannounced				-00:00.90								10.672	127.73				2.40+04	7.24+01
Unannounced				+00:01.30								1.317	357.31				2.27+04	6.34+01
Unannounced				+00:02.40								15.494	54.11				1.80+04	6.87+01
Unannounced				-00:00.60								15.741	141.19			(a)	7.29+04	[illegible]
Unannounced				-00:00.80								14.608	135.62			(a)	7.40+04	7.73+01
Unannounced				-00:00.90								2.130	252.44			(a) (g)	9.60+04	[illegible]
Unannounced				-00:00.72								7.119	335.69				6.00+04	3.26+02
[illegible]	[illegible]	21:[illegible]	21:[illegible]	+00:00.14	37.107	116.114	858089	661159	[illegible]	861114	658554	1.149	[illegible]	0.12	2.90	(a) (e) (g)	6.15+05	2.50+03
[illegible]	[illegible]	16:40 [illegible]	16:40 [illegible]	+00:06.4[illegible]	36.987	116.057	814800	678066	[illegible]	819650	[illegible]	[illegible]	[illegible]	[illegible]	2.99	(a) (e) (g)	2.06+05	2.27+03
[illegible]	[illegible]	16:2[illegible]	16:2[illegible]	-00:00.0[illegible]	37.006	116.049	821735	680152	[illegible]	820400	682[illegible]	[illegible]	[illegible]	-0.16	0.15	(a) (e) (g)	5.76+05	2.45+04
[illegible]	[illegible]	15:0[illegible]	15:0[illegible]	-00:00.45	37.094	116.009	85[illegible]	691610	[illegible]	855400	689900	[illegible]	[illegible]	-0.56	0.15	(a) (e) (g)	3.27+03	[illegible]
[illegible]	[illegible]	15:[illegible]	14:[illegible]	-00:00.31	36.974	116.170	8[illegible]	654082	[illegible]	810864	642640	[illegible]	[illegible]	[illegible]	1.65	(a) (g)	9.60+04	3.45+03
[illegible]	[illegible]	18:0[illegible]	16:[illegible]	+00:00.25	36.971	116.194	80[illegible]	[illegible]	[illegible]	810479	641[illegible]	[illegible]	[illegible]	[illegible]	1.68	(a) (g)	3.49+05	[illegible]
[illegible]	[illegible]	04:[illegible]	04:[illegible]	+00:00.40	36.874	116.777	773114	46[illegible]	[illegible]	7786[illegible]	464315	[illegible]	[illegible]	[illegible]	1.49	(a) (g) (h)	2.16+05	[illegible]
[illegible]	[illegible]	17:00	17:[illegible]	+00:00.34	36.987	116.175	814604	64[illegible]	[illegible]	8110[illegible]	6410[illegible]	1.10[illegible]	[illegible]	[illegible]	2.83	(a) (g)	1.08+04	1.34+0[illegible]

Table 2. Location Accuracy (UNE and HE data - continued)

Remarks:

(a) Reported by National Earthquake Information Service (NEIS)

(b) NEIS gave location only to 0.1 degree

(c) Event time not precise

(d) Exact location not surveyed

(e) NEIS quoted event location

(f) NEIS location not used or substantially rounded

(g) Depth with respect to mean sea level

(h) Hoffman & Mooney, 1984

Thus, aftershocks are a result of the explosion rather than being triggered by it. The explosion alters the existing stress field, and adjustments are required to bring the field back into equilibrium. The 1.15 megaton test Benham (Hamilton, 1969) produced aftershocks until the Purse event 140 days later. (Using the criteria described below, aftershocks occurring more than four years later in precisely the locations Hamilton observed Benham aftershocks provides strong evidence that they are attributable to Benham.)

separated in time from the explosion signal and is viewed as a relatively rare event. Possible triggering is discussed in a later section of this report.

The criteria for defining and eliminating aftershocks used here differ from those of Meremonte and Rogers (1987). Hamilton observed Benham aftershocks to 14 km. If aftershocks are a return to equilibrium from stress changes caused by the shock wave, the distance to a critical stress should scale as the cube root of yield. Since the Benham yield was 1.15 Mt, the scaled distance to the critical stress would be $d = 1.336\ km/kt^{1/3}$.

The procedure for defining aftershocks was as follows:

a. The yield of the most recent UNE was used to determine a distance d.

b. A circle about ground zero with a radius d was determined.

c. All catalog listings subsequent to the time of the shot were scanned. If any had a location within the circle it was ascribed to that UNE and deleted from the catalog.

Attention was turned to the next earlier UNE and the procedure repeated until the earliest UNE was reached. This resulted in the determination and deletion of 3314 listings. A useful follow-on study would be to compare these results with results of other criteria and models for aftershock discrimination.

Since collapses occur below ground zero, they were also removed by this same procedure. However, there were 38 collapses (identified as such by temporal proximity to DOE determined collapse times) that fell beyond the circles as defined above (Table 1). These were the result of a location error in the catalogs which was large relative to the diameter of the circle for a given UNE yield.

There are three locations within the area of concern where natural earthquakes are known to occur: Thirsty Canyon, Massachusetts Mountain, and an area of about 3.6 km north of the common intersection of Areas 18, 19, and 20. Catalog listings falling within those areas were not deleted.

Location Accuracy

Slemmons et al (1965) divided their epicenters into two groups--pre-1932 and post-1932, "in order to distinguish between early historic events with poor epicentral locations, and modern events with better epicenters based on instrumental information." Entries in the SGBHC deserve the same division. There were 50 pre-1932 earthquakes listed in the SGBHC. Six are from the RYC source and are those of Slemmons et al. Thirty-four were attributed to BRP, but only 10 are among those published by BRP. The remainder are unpublished data. Twenty of the 50 had locations given only to the nearest degree, and 22 to the nearest 0.1 degree.

Location error estimates decrease as the number of stations is increases. These factors may affect latitude and longitude error estimates differently, depending on where the stations recording the signal are located with respect to the earthquake. There is some point at which the location error is so large that the data are of little value in assessing the seismicity of the

area as it relates to siting a waste repository. The selection of a cut-off is purely subjective. Opinions solicited from several people suggested that around 10 km would be a reasonable cut-off.

Only the data collected by the SNSN from August 1, 1978 to September 30, 1986 have calculated error estimates. There were 45 entries with error estimates from 10 to 20 km, 13 from 20 to 30 km, 5 from 30 to 50, 10 from 50 to 100, and 7 over 100 km.

Where the number of stations is 4 or fewer, the hypocentral solution is unique but not necessarily correct, and no error estimate is calcualted. There are 3,239 such entries in the SNSN catalog. The location errors for these entries could range from small to very large. If they were over 10 km in the same ratio to the SNSN total as the 80 entries above, the number with error estimates greater than 10 km would be increased to 85. While no attempt has been made to delete entries with large location errors, attention should be called to these location uncertainties.

A 10 km cut-off approximates a 0.1 degree uncertainty in location. In the earlier years of the SGBHC, numerous locations were given only to the nearest degree and even more given only to the nearest 0.1 degree. It was noted that many of the early earthquakes located to the nearest degree were at 38° latitude and 118° longitude, the region attributed to the Tonopah Junction earthquakes. Thus, although earlier sources rounded latitude and longitude, by pure coincidence a significant portion of later earthquakes in that area appear to be close to 38°, 118°. However, this does not diminish uncertainty in the location of early earthquakes. Most of these events are of little consequence in assessing seismicity relative to siting the proposed repository since they are about 185 km from Yucca Mountain.

The fact that a number of UNEs were included in the catalogs provides a unique opportunity to assess the location accuracy published from the various sources.

The earthquake catalogs contain information on events that can be identified as UNEs or HE explosions. Most of the UNEs so identified are unannounced events. Those identified as explosions are listed in Table 2. The names, dates, and time of unannounced UNEs is classified data and have been omitted from the table. This information is available from Sandia National Laboratories for those who have access to classified information.

Listings are identified as UNEs or HE explosions by the closeness in time to the known time of the explosions. HE shots were reported only to the nearest minute, apparently from the experimenter's watch resulting in some large time differences (see lines 49, 50, 56, 58, 60, 61, and 62). The largest time difference for a UNE (line 63) appears to have resulted from a one minute error in the time of the earthquake, since it was the only event that day and the largest reported by KKG (M 4.8) during the month of June 1971.

The probability of a natural earthquake falling within the time difference between a UNE and a listed seism is

$$p = 1/\frac{T}{n\Delta t} \qquad (1)$$

where Δt is the time difference in seconds and n is the number of events listed in time T in seconds. If T is taken as one day, then the probability based on time is shown in the table. All identified UNEs show that the probability that the listing is a UNE is better than 1:9000.

The location of each specified UNE in the listing can be compared with [redacted]

Table 3. Comparison of Location Accuracy by Source (UNE and HE Data)

	Number	Distance Difference (km)		
		Smallest	Log Avg.	Largest
ALX	2	2.91	5.61	10.81
BRK	1		4.56	
BRP	15	1.06	3.06	19.70
GDY	32	1.84	6.21	43.55
HSF	1		23.90	
ISC	4	7.12	23.89	109.29
KKG	8	0.14	0.30	7.81
PAS	1		21.42	
PDX	5	0.26	4.73	16.25
RYN	6	1.32	7.91	15.74
SNSN	10	0.56	1.53	7.12

Table 4. Location Accuracy (Collapse Data)

Table 4. Location Accuracy (Collapse Data)

Number	Source	Event	Date hrmin	True Event Time hrmin sec	Col Time min	Time from USGS Catalog hrmin sec	Time Differ min	Lat.	Long.	Equiv. WGS Coordinates N	E	Hole Number	Actual Hole Coordinates N	E	Dist. Differ. (km)	Azimuth Clockwise from No. about GZ	Depth USGS (km)	Mag.	Remarks	Time Probability 1:	Space Probability 1:
1	ALX	Pebe	620920	17:12 36.00	12.6	17:12 38.70	+00:02.70	37.430	115.650	977107	795201	3hb	839628	685989	53.516	38.46	0.0	3.5	(a,e,f,i)	3.20+04	1.15+01
2	ALX	Pleasant	630529	15:13 00.20	9.5	15:12 42.20	-00:18.00	37.050	116.120	837627	659528	9ah	866189	681969	11.071	218.16	0.0	2.6	(i)	4.80+03	2.69+02
3	BRK	Comico	700515	15:19 00.00	109.0	15:19 38.00	+00:38.00	36.100	116.000	492017	696945	10ap1	878520	682940	117.884	177.93	0.0	4.0	(a,e,f,i,l)	2.53+02	2.64-01
4	BRP	Unannounced			45.4		+00:03.50								1.792	196.04				2.74+03	1.14+03
5	BRP	Rickey	680615	22:30 00.00	510.0	22:30 05.00	+00:05.00	36.700	116.200	710085	636805	19c	915600	602435	63.511	170.51	33.0	-	(a,b,i)	1.73+04	8.18+00
6	GDY	Unannounced			23.8		+00:02.42								18.560	214.18			(i)	1.19+04	3.19+01
7	GDY	Unannounced			27.1		+00:17.43								0.328	187.59				5.51+02	3.41+04
8	GDY	Unannounced			14.4		+00:03.67								12.294	148.03			(i)	7.85+03	7.28+01
9	GDY	Merlin	650216	17:49 18.00	19.3	17:49 20.64	+00:02.64	37.048	116.142	836863	653112	3ct	838400	687599	10.522	267.45	8.0	-	(a,e,f,i)	3.27+04	2.98+02
10	GDY	Cup	650326	16:29 20.20	55.2	16:29 40.17	+00:19.97	36.715	116.064	715768	676640	9cb	873299	681797	48.041	181.87	8.0	-	(a,e,f,i,l)	2.16+03	7.15+00
11	GDY	Clarkemobile	680517	14:11 24.00	71.4	14:11 15.85	-00:08.15	36.109	115.952	859432	708393	2as	863238	677216	9.573	96.96	8.0	4.0	(a)	1.06+04	3.60+02
12	HSF	Jorum	690916	18:15 00.00	225.0	18:15 39.10	+00:39.10	37.317	116.455	934443	561551	20e	933401	559900	0.595	57.74	0.60	3.9	(a,e,f,j,m)	3.35+01	1.41+03
13	ISC	Unannounced			62.6		-00:12.20								83.629	270.73			(i)	3.54+03	2.36+00
14	ISC	Unannounced			32.0		-00:00.20								5.637	147.20				1.44+05	3.46+02
15	ISC	Unannounced			30.7		+00:05.00								17.546	168.24			(i)	5.76+03	3.57+01
16	ISC	Unannounced			4.2		+00:01.00								49.981	188.54			(i)	1.44+04	6.61+00
17	ISC	Unannounced			13.0		-00:00.20								5.819	142.50				1.44+05	3.25+02
18	ISC	Pipefish	640429	20:57 12.10	10.2	20:57 14.80	+00:02.70	37.040	116.030	834150	685817	3co	833999	686800	0.303	278.73	0.0	-	(a,e,k)	3.20+04	3.60+05
19	ISC	Fade	640625	14:08 36.10	38.6	14:08 38.00	+00:01.90	37.100	116.100	855865	665256	9ba	860050	686000	6.450	258.59	33.0	-	(a,e,f)	4.55+04	7.93+02
20	ISC	Wool	650114	16:24 00.10	24.0	16:24 02.00	+00:01.90	37.200	116.200	892113	635914	9bh	862930	687149	17.972	299.67	33.0	-	(a,e,f)	4.55+04	1.02+02
21	ISC	Kestrel	650405	22:03 18.00	63.3	22:03 19.00	+00:01.00	37.800	115.000	111523	981555	3dd	829000	687999	124.819	45.79	0.0	-	(a,e,f,i)	8.64+04	2.12+00
22	ISC	Scaup	650514	18:46 54.20	74.3	18:46 24.70	-00:29.50	37.060	116.010	841471	691604	3das	841049	691449	0.137	20.17	0.0	-	(a,e,k)	2.93+03	1.76+06
23	ISC	Purple	660318	20:03 36.00	63.6	20:03 40.00	+00:04.00	37.009	116.009	822906	692024	3ds	822999	691999	0.029	164.95	0.0	-	(a,e,k)	2.16+04	3.92+07
24	ISC	Grape A	691217	15:48 00.00	48.2	15:47 53.00	-00:07.00	37.000	116.000	819648	694674	7s	850000	694000	9.254	178.73	0.0	4.3	(a,e,f)	4.11+03	1.28+02
25	ISC	Ajo	700130	17:09 48.00	9.8	17:09 55.00	+00:07.00	36.900	116.000	783242	694929	3gd	830800	684449	14.844	167.57	0.0	-	(a,e,f,i)	6.17+03	7.49+01
26	ISC	Grape B	700204	18:07 12.00	67.2	18:07 20.00	+00:08.00	37.700	116.800	1073847	461425	7v	855300	686700	95.667	314.13	0.0	-	(a,e,f,i)	3.60+03	1.20+00
27	ISC	Yanigan	700226	17:43 00.00	133.0	17:43 04.90	+00:04.90	35.580	116.110	1030606	661310	2ay	862496	675000	51.410	355.34	0.0	-	(a,e,f,i)	1.76+04	1.25+01
28	ISC	Tijeras	701014	15:22 18.00	52.3	15:22 21.00	+00:03.00	36.900	115.700	783993	782650	7y	845360	692999	33.114	124.39	0.0	-	(a,e,f,i)	9.60+03	1.00+01
29	ISC	Abeytas	701105	16:01 42.00	61.7	16:01 00.00	-00:42.00	37.000	116.000	819648	694674	3gx	830350	691150	3.434	161.77	0.0	4.5	(a,e,f,i)	2.06+03	2.80+03
30	ISC	Carpetbag	701217	16:20 48.20	15.8	16:20 44.00	-00:04.20	36.500	116.300	637152	607768	2dg	866500	670150	72.445	195.22	0.0	-	(a,e,f,i)	5.14+03	1.57+00
31	ISC	Latir	740228	02:55 00.10	595.0	02:56 00.00	+00:59.90	37.100	116.050	855955	679838	4d	857500	679000	0.536	151.52	0.0	-	(a,e)	1.44+03	1.15+05
32	ISC	Escabosa	740710	21:09 42.10	309.7	21:09 45.30	+00:03.20	37.276	116.354	919598	590971	7ac	846900	685200	36.275	307.65	0.0	-	(a,e,f)	2.70+04	2.51+01
33	ISC	Fontina	760215	03:50 00.20	3665.0	03:52 58.30	+02:58.10	37.464	116.577	987906	526024	20f	917825	551857	22.766	339.77	-	-	(a,e,f,i)	4.85+02	6.37+01
34	ISC	Aslago	761221	21:03 00.20	354.0	21:04 54.90	+01:54.70	37.210	116.270	895660	615512	2ar	864628	674692	20.366	297.67	-	-	(a,e,f,i)	9.42+01	9.95+00
35	ISC	Reblochon	780224	00:09 00.20	429.0	00:09 05.10	+00:04.90	37.044	115.871	835956	723211	2en	864550	675750	19.290	116.86	41.0	-	(a,e,f,i)	8.82+03	4.43+01
36	PAS	Jal	700319	16:29 12.00	145.7	16:29 19.95	+00:07.95	36.838	116.254	760251	620758	3hh	820000	688000	27.418	228.38	8.0	3.5	(a,e,f,i)	3.62+03	1.46+01
37	PAS	Backbeach	780412	03:42 00.10	597.0	03:46 56.12	+04:56.02	37.174	116.285	882536	611196	19x	904108	586810	9.924	131.50	6.0	3.6	(a,e,f,i)	9.73+01	1.12+02
38	PDX	Pore	640116	18:08 00.10	128.0	18:08 40.20	+00:40.10	37.100	116.000	856054	694420	9ao	871350	679999	6.408	136.69	0.0		(a,b,e)	2.92+02	8.04+02
39	PDX	Oconto	640123	16:39 42.20	39.7	16:39 45.30	+00:03.10	37.000	116.000	819648	694675	9ay	865600	683771	14.395	116.65	0.0		(a,e,f)	2.79+04	1.59+02
40	PDX	Klickitat	640220	16:48 00.10	78.0	16:48 08.50	+00:08.40	37.200	116.000	892461	694164	10e	874508	682599	6.509	32.79	0.0		(a,e,f)	1.03+04	7.79+02
41	PDX	Backswing	640514	14:44 00.20	4.0	14:44 06.40	+00:06.20	37.000	116.100	819458	665473	9aw	862294	683020	14.109	202.28	0.0		(a,e,f,i,k)	1.39+04	1.66+02
42	PDX	Minnow	640515	16:25 30.10	10.5	16:25 39.30	+00:09.20	37.100	115.900	856274	723583	3cv	834799	691000	26.009	75.42	0.0		(a,e,f,i,k)	9.39+03	4.88+01
43	PDX	Bye	640716	14:18 00.20	63.0	14:18 06.40	+00:06.20	37.200	116.100	892271	665039	10i	885894	680999	5.239	291.78	0.0		(a,e,f,k)	1.39+04	1.20+03
44	PDX	Guanay	640904	18:34 54.10	19.9	18:35 04.30	+00:10.20	37.000	116.000	819648	694675	3di	826000	688001	2.808	133.58	0.0		(a,e,f,k)	8.47+03	4.19+03
45	PDX	Crepe	641205	23:20 00.10	125.0	23:19 28.50	-00:31.60	37.100	116.100	855865	665256	2q	861200	678800	4.437	248.50	0.0		(a,e,f,k)	1.37+03	8.38+02
46	PDX	Tweed	650521	13:50 58.10	42.1	13:51 51.60	+00:53.70	37.100	116.000	856054	694420	9bn	862750	686300	3.208	129.51	0.0		(a,e,f,k)	8.04+02	1.60+03
47	PDX	Bronze	650724	00:43 00.10	463.0	00:42 05.40	-00:54.70	37.100	116.000	856054	694420	7f	855199	684800	2.944	84.92	0.0		(a,e,f,k)	1.58+03	3.81+03
48	PDX	Buff	651216	21:43 30.40	148.5	21:42 55.00	-00:35.40	37.100	116.100	855648	694675	3dv	836000	690700	6.110	11.44	0.0		(a,e,f,k)	2.44+03	8.84+02
49	PDX	Dovekie	660121	19:03 18.00	35.3	19:03 19.30	+00:01.30	37.000	115.800	820118	753078	3cd	831199	690000	19.521	99.96	0.0	3.4	(a,e,f,i,k)	6.65+04	8.66+01
50	PDX	Dumont	660519	15:37 16.10	100.8	15:37 17.90	-00:01.80	37.000	116.100	819458	665473	2t	860000	677500	12.890	196.52	0.0	4.5	(a,e,f,i,k)	4.80+04	1.99+02
51	PDX	Discus Thrower	660527	20:52 36.00	52.6	20:52 32.90	-00:03.10	37.200	116.200	892113	635914	8a	884407	665739	9.389	284.49	0.0	3.9	(a,e,f,i,k)	2.79+04	3.74+02
52	PDX	Tan	660603	15:31 48.00	91.8	15:31 57.40	+00:09.40	37.100	116.000	856054	584420	7k	844500	684200	4.702	41.49	0.0	-	(a,e,f,i,k)	9.19+03	1.49+03
53	PDX	Oerise	661118	15:15 06.10	13.1	15:15 05.00	-00:01.10	37.000	116.000	819648	694675	3eu	835199	691550	4.835	168.64	0.0	-	(a,e,f,i,k)	7.85+04	1.41+03
54	PDX	Agile	670223	21:11 30.00	141.5	21:11 33.10	+00:03.10	37.127	116.066	865755	675110	2v	865700	675000	0.037	63.43	0.0	4.7	(a,e,i,k)	2.79+04	2.41+07
55	PDX	Estuary	760309	16:55 06.10	175.1	16:55 02.00	-00:04.10	37.310	116.364	931967	588022	19g	931918	587897	0.041	68.59	0.0	4.0-4.1	(a,e,i,k)	1.24+03	1.15+06
56	PDX	Colby	760314	15:25 00.20	175.0	15:24 28.80	-00:31.40	37.306	116.471	930428	556907	20aa	930426	556766	0.043	89.19	0.0	4.7-4.1	(a,e,i,k)	1.62+02	1.05+06
57	PDX	Rudder	761228	20:29 30.10	149.5	20:29 26.00	-00:04.10	37.100	116.036	855982	683921	7ajs	856161	683785	0.069	142.77	0.0	4.5-4.4	(a,e,i,k)	5.27+03	1.73+06
58	PDX	Marsilly	770405	16:57 00.20	117.0	16:57 06.30	+00:06.10	37.120	116.062	863214	676292	2el	863299	676210	0.036	116.03	0.0	4.4-4.6	(a,e,i,k)	1.42+04	2.55+07
59	PDX	Seamount	771117	20:39 24.10	69.4	20:39 24.70	+00:00.60	37.021	116.025	827243	687323	3kp	827098	687302	0.045	8.24	0.0	3.4-3.8	(a,e,i,k)	7.20+04	8.15+06
60	RYN	Unannounced			9.2		-00:11.10								18.534	358.82				7.78+2	9.61+00
61	RYN	Rod	700501	14:55 48.20	15.8	14:55 48.30	+00:00.10	37.606	116.023	1040233	686456	9i	869201	684401	52.134	0.69	0.0		(a,e,f,i)	8.64+04	1.21+00
62	SNSN	Backgammon	791129	16:37 06.10	97.1	16:37 04.46	-00:01.64	36.985	116.003	814180	693837	3jh	817400	687650	2.126	117.49	5.81	2.47		2.63+04	3.65+03
63	SNSN	Verdello	800731	19:26 12.10	67.2	19:26 15.68	+00:03.58	37.073	116.005	846214	693030	3kn	824350	688000	6.838	12.96	2.12	2.67	(a,e)	8.04+03	2.35+02
64	SNSN	Kappeli	840726	05:52 00.00	862.0	05:51 16.04	-00:43.96	37.271	116.378	917755	583994	20am	916550	574499	2.917	82.77	9.38	2.31		1.93+02	7.76+02
65	SNSN	Serena	850726	02:06 00.10	726.0	02:05 26.53	-00:33.57	37.358	116.667	949301	499903	20an	927263	566491	21.379	288.31	4.71	0.15		8.58+02	2.41+01

Table 4. Location Accuracy (Collapse Data - continued)

Remarks:

(a) Reported by National Earthquake Information Service (NEIS)
(b) NEIS gave location only to 0.1 degree
(c) Event time not precise
(d) Exact location not surveyed
(e) NEIS quoted event location
(f) NEIS location not used or substantially rounded
(g) Depth with respect to mean sealevel
(h) Hoffman & Mooney, 1984
(i) Outside aftershock criteria
(j) NEIS identified as an aftershock
(k) NEIS identified as a collapse
(l) Possible natural earthquake
(m) Possible aftershock

detonation time plus the time to collapse. Only five collapse times are suspect. Those for Fontina (line 33) and Backbeach (line 37) may be associated aftershocks. Those for Cornice (line 3), Cup (line 10), and Asiago (line 34) are possibly natural earthquakes. Relatively low probabilities support this interpretation.

Three ISC listings (lines 18, 22, and 23) have small miss distances because the item was identified as a collapse by National Earthquake Information Service (NEIS). PDS has 19 items which NEIS identified as collapses, but it appears that the given locations were used in only six cases (lines 54-59).

Table 5 compares location accuracy by source. Use of announced locations of collapses and the possible natural earthquakes have been omitted in determining the distances given in the table. Comparison of the log average values in Tables 3 and 5 shows that only for GDY is the location accuracy about the same.

Entries from the SNSN after mid-1978 show calculated error estimates for both latitude and longitude. Table 6 lists the last 10 explosions from Table 2 together with the estimated errors. These in turn are compared with the actual error using the distance between the calculated and actual latitude and longitude. The next two columns are the ratio of calculated error to actual error. Error ratios range from 0.08 to 2.33 and have log averages of 0.52 for latitude and 0.31 for longitude. There is poor correlation between the ratios and the Quality HYP071 Estimate [Lee, et al (1975)]. These ten events, while a small sample, suggest that the estimated errors present an optimistic view of the accuracy of location.

Triggering Earthquakes

An argument could be made that the shockwave propagating outward from an explosion might trigger an earthquake on a fault at considerable distance, and that this might account for some of the larger miss distances. For this to be true, the earthquake would have to follow the explosion by an interval of time consistent with a propagation velocity appropriate for the distance between the two. There were only 7 candidates as shown in Table 7. Those on lines 1, 2, 3, 4, 5, and 7 had velocities greater than would be expected from velocities observed from nuclear explosions on NTS at the distances shown. That on line 6 fits the velocity criterion, but it also was from GDY, and well within the range of miss distances for that source (see Table 3). That on line 5 followed the UNE (line 16, Table 2) by 17.8 seconds. Event yield was was small, and an approximation of strain at about 112 km is 1.9×10^{-8}--about that caused by earth tides. Since triggering is thus unlikely, (time probability is 1:809) the interpretation here is that the seism (M4.3, RYN) is a natural earthquake unrelated to the UNE.

The data suggest that it is unlikely that any of the reported events was an earthquake triggered by an explosion at a distance from the explosion.

Table 5. Comparison of Location Accuracy by Source (Collapse Data)

	Number	Distance Difference (km) Smallest	Log Avg.	Largest
ALX	2	11.07	24.34	53.52
BRP	2	1.79	10.67	63.51
GDY	5	0.33	5.96	18.56
HSF	1		0.595	
ISC	20	0.54	18.82	124.82
PAS	2	9.92	16.50	27.42
PDX	17	2.81	7.56	26.01
RYN	2	18.53	31.08	52.13
SNSN	4	2.126	5.49	21.379

Table 6. Accuracy of SNSN Data

Date	Time	Latitude	Longitude	Calculated Error (km) Latitude	Calculated Error (km) Longitude	Actual Error (km) Latitude	Actual Error (km) Longitude	Ratio Calc:Act Latitude	Ratio Calc:Act Longitude	Location Quality
800911	14:59:59.70	36.974	116.170	0.5	0.3	0.300	3.488	1.67	0.09	B
810213	18:00:00.25	36.971	116.194	0.5	0.3	0.527	1.561	0.95	0.19	B
810618	17:00:00.34	36.987	116.175	0.4	0.4	1.093	0.180	0.37	2.22	B
811216	21:05:00.24	37.107	116.114	0.3	0.4	0.831	0.794	0.36	0.50	C
820429	04:00:00.54	36.874	116.777	0.2	0.2	1.677	1.041	0.12	0.19	B
841110	16:40:00.52	36.987	116.057	2.3	2.5	1.477	3.517	1.56	0.71	C
850817	16:25:00.05	37.006	116.049	0.2	0.1	0.407	0.533	0.49	0.19	B
860605	15:03:59.66	37.084	116.009	0.2	0.1	0.472	0.582	0.42	0.17	C
Unannounced				1.5	0.8	0.643	2.031	2.33	0.39	D
Unannounced				0.5	0.7	6.632	2.588	0.08	0.27	B
Log Average								0.52	0.31	

Table 7. Analysis of Possible Triggered Earthquakes

Number	Event	Date	Event Time	Earthquake Time	Time Difference (s)	Distance (km)	Velocity (km/s)	Expected Velocity (km/s)	Time Probability 1:
1	Bordeaux	670818	10:12:30.00	20:12:40.20	10.2	67.274	6.47	5.3 - 6.1	4.24 + 03
2	Diagonal Line	711124	20:15:00.20	20:15:20.00	19.8	155.481	7.85	5.2 - 6.6	2.18 + 03
3	Unannounced	Line 51, Table 2			3.7	23.897	6.46	4.6 - 5.4	1.17 + 04
4	Unannounced	Line 52, Table 2			2.2	17.207	7.82	3.9 - 4.8	3.93 + 04
5	Unannounced				17.8	111.944	6.29	5.0 - 6.1	8.09 + 02
6	Unannounced	Line 25, Table 2			1.96	7.753	3.96	3.2 - 4.2	2.20 + 04
7	Unannounced				3.6	26.152	7.26	4.7 - 5.5	1.20 + 04

Bare Mountain and Bare Mountain Fault

Bare Mountain fault has received considerable attention as a fault close to Yucca Mountain that conceivably could be active. Table 8 lists 45 entries from the SNSN catalog that fall within the boundaries of the Bare Mountain quadrangle (Map GQ-157, Cornwall and Kleinhamp[1], 1961). Of these, 16 fell within the vicinity of the Bare Mountain fault. Thirteen of these occurred on weekdays between 8 a.m. and 6:30 p.m. local time and were near the Sterling (Panama) mine. All occurred after 1980 when the mine resumed operations. The 14 we label as mine blasts (B) are shown in the next-to-last column of the table and can be compared with the last column which is the USGS notation. One at 9:29 p.m. could be either a blast or an earthquake. Nine have calculated depths above sea level. None of the 14 has a magnitude larger than 1.31. The remaining two, which are interpreted as natural earthquakes on or near Bare Mountain fault (labeled F in Table 8) have magnitudes of only 0.77 and 1.50. The SGBHC lists an additional M 3 event that occurred in August 1948 about 2 km from the Bare Mountain fault and the Sterling mine.

Deleting these mine blasts leaves evidence that the seismicity of Bare Mountain and the Bare Mountain fault is little different from the region around it.

Three listings in Table 8 in November 1985 are located at the north end of Bare Mountain. The three items have been retained, because they appear unrelated to the Bare Mountain fault and because mining activities there have not been confirmed.

Yucca Mountain Seismicity

Yucca Mountain is within the Tonopah Spring SW quadrangle (Map GQ-439, Lipman and McKay, 1965). There is only one M 3.6 earthquake in the SGBHC. This entry is from PAS and has an accuracy as indicated in Table 5; thus, it easily could have fallen outside the boundaries of the quadrangle.

The SNSN catalog has eight entries that fall within the Tonopah Spring SW quadrangle, five of which are identified as blasts, probably associated with construction activities. The remaining three had magnitudes of 0.63, 0.09, and 0.01. Thus, the Yucca Mountain area appears to be relatively quiescent.

Mountain Quadrangle

Azim. Gap	Mi	Qual.	Depth km	Depth Error km	No. ML Readings	ML Est.	Qual.	Comments
24	0.7	B	1.03	4.5	0	0.0	B	default
97	0.6	B	4.19	3.3	0	0.0	B	Md recomputed
106	0.7	C	8.25	3.0	0	0.0	D	F Md recomputed
92	1.1	A	8.92	1.2	0	0.0	B	Md recomputed
211	0.8	C	7.81	6.7	0	0.0	D	Md recomputed
119	1.1	A	7.94	1.2	0	0.0	C	Md recomputed
129	1.0	A	-1.19	0.4	0	0.0	B	B Md recomputed
92	1.1	A	-0.31	0.5	0	0.0	B	B Probable blast
48	0.4	C	-0.38	23.5	1	0.7	C	SGB defined ma
135	0.7	B	1.06	4.5	3	0.7	B	B Prob. blast
46	0.0	A	5.02	1.5	12	0.9	C	SGB defined ma
79	0.0	B	-0.48	0.7	7	1.0	A	B Probable blast
10	1.0	A	-1.19	0.5	6	0.9	B	B Prob. Bare Mtn
93	0.0	D	1.87	6.2	3	0.8	D	F SGB defined ma
244	0.0	A	-0.54		3	0.7	D	B SGB defined ma
14	1.0	A	0.66	0.4	2	0.4	B	B Prob blast
215	0.0	A	-0.94	0.5	4	1.2	D	B Prob blast
16	1.2	A	-0.55	0.6	8	0.9	B	B Prob blast
282	1.0	A	-0.44		1	0.9	D	B SGB defined ma
104	0.0	A	0.47	0.3	12	1.3	C	SGB defined ma
93	0.0	A	-0.72	0.3	9	1.0	B	B Probable blast
143	0.0	A	0.98		2	0.5	D	SGB defined ma
13	1.1	A	4.72	0.8	7	1.1	B	SGB defined ma
248	0.0	B	4.01	3.1	4	0.3	D	B SGB defined ma
237	0.0	B	34.47		2	1.6	D	SGB defined ma
27	0.0	B	0.90	0.8	7	0.7	B	B 1134
117	0.0	D	0.44	15.2	4	0.9	D	1134
133	0.0	D	0.04	23.4	3	1.0	D	1134
253	0.5	A	5.54	0.9	4	0.8	D	1134
58	1.1	A	0.58	0.2	26	1.3	B	1134
81	1.2	A	4.89	0.6	23	1.3	B	1134
240	1.0	A	2.07	0.7	3	0.6	D	Feb 85 digital
215	1.8	B	0.87	1.0	3	0.8	D	B Feb 85 digital
34	1.5	A	0.87	0.3	6	1.0	C	Feb 85 digital
178	1.5	B	8.08	2.9	8	0.9	D	Feb 85 digital
142	0.0	D	0.82	415.7	1	1.3	D	March 85 digita
95	1.5	A	2.57	0.7	11	1.0	C	uses Mca estim
96	1.3	A	1.71	0.9	5	1.1	C	1134 digital e
67	1.3	B	6.67	2.3	3	0.9	C	Prob Bare Mtn B
265	1.3	A	0.63	0.6	2	1.1	D	Prob Bare Mtn B
228	0.0	B	5.03	4.9	3	0.6	D	Prob Bare Mtn B
95	1.7	A	2.46	1.1	1	1.7	C	1134 digital eq
241	0.0	A	1.65	0.9	6	0.8	D	1134 eq
67	0.1	A	0.32	0.2	3	0.3	C	1134 data
29	0.0	A	7.22	1.1	13	0.5	C	1134 data

EARTHQUAKE LOCATIONS

To better portray earthquake locations, maps were prepared with locations plotted. The maps are separated between original listing (all data) and after deletions (modified). There is a map with limits 35.6 to 38.5° latitude and 114.5 to 118.0° longitude and a close-up of NTS with limits 36.5 to 37.5° and 115.7 to 116.7°. There are separate maps for magnitude increments: 0 (no magnitude determined), 0 to 1 (read >0 to ≤1), etc. Maps for each source are in separate appendices as follows:

Source	Appendix
ALX	B
BRK	C
BRP	D
CVH	E
ERS	F
FPH	G
GDY	H
HSF	I
ISC	J
KKG	K
PAS	L
PDX	M
PHM	N
ROW	O
RYC	P
RYN	Q
SHJ	R
USE	S
Total SGBHC	T
SNSN	U

Table 9 summarizes the distribution by magnitude and source of the original (unmodified) listing of earthquakes as shown on the maps. Table 10 does the same for the modified listing after removal of man-made seismic events.

Page T-2 shows the locations of earthquakes for which no magnitude was determined. It also shows where UNE-related and Lake Mead seisms were deleted. Table 9 shows that most of the events with no magnitude came from KKG, and that contribution can be seen in Page K-2. Magnitudes were not determined for so many KKG events because instruments were set to a high sensitivity such that peaks were clipped and magnitude could not be determined from amplitude. Page K-2 shows that natural earthquakes on the NTS in the vicinity of Massachusetts Mountain, Frenchman Flat, and Ranger Mountain have been retained.

Figures T-4 and T-5 show that many small (0.01 to 1.0) magnitude events were concentrated on Pahute Mesa and were removed having been identified as UNE aftershocks. The same pattern follows for magnitudes 1.01 to 2.00 (Figures T-6 and T-7). The remaining figures in Appendix T exhibit a similar effect. Note in Table 9 that the majority of the earthquakes came with defined magnitudes came from PAS, HSF, and ROW. Note in Appendix L that most

Table 9. Distribution of Original Data by Magnitude

Source \ Magnitude	0	0.01-1.00	1.01-2.00	2.01-3.00	3.01-4.00	4.01-5.00	5.01-6.00	6.01-7.00	Outside Map Boundaries	Total
ALX			9	53	4					66
BRK	23			12	109	24				168
BRP	35		17	167	147	22	5	2		395
CVH					1					1
ERS					3					3
FPH			9	7	2					18
GDY	51		3	37	86	41	8			226
HSF	50	448	875	837	74	4				2288
ISC	75				2	6				83
KKG	1224	1	10	47	54	4				1340
PAS	31	1	93	580	318	26				1049
PDX	23		2	3	18	19	1			66
PHM	12	16	4	1						33
ROW	4			242	264	9				519
RYC	44		1	10	35	16	1			107
RYH	22	1	53	97	61	6			1	241
SHJ		6	3							9
USE					1					1
Total SGBHC	1594	473	1079	2093	1179	177	15	2	1	6613
SNSN	28	1664	3209	346	8					5255
SNSN Outside map	9	60	45	6						120
Grand Total	1631	2197	4333	2445	1187	177	15	2	1	11988

Table 10. Distribution of Modified Data by Magnitude

Source \ Magnitude	0	0.01-1.00	1.01-2.00	2.01-3.00	3.01-4.00	4.01-5.00	5.01-6.00	6.01-7.00	Outside Map Boundaries	Total
ALX			9	45	2					56
BRK	23			12	108	22				165
BRP	24			20	19	12	5	2		82
CVH										0
ERS					1					1
FPH			9	7	2					18
GDY	33		3	33	53	21	7			150
HSF	2	32	67	28						129
ISC	49				2	1				52
KKG	1100	1	10	40	49	3				1203
PAS	31	1	93	576	282	24				1007
PDX	5		2	3	8	1	1			20
PHM	12	16	4	1						33
ROW				12	7	2				21
RYC	12		1	6	25	14	1			59
RYH	20	1	52	94	50	4			1	222
SHJ		6	3							9
USE										0
Total SGBHC	1311	57	253	877	608	104	14	2	1	3227
SNSN	27	1513	2965	307	6					4818
SNSN Outside map	9	60	43	4						116
Grand Total	1347	1630	3261	1188	614	104	14	2	1	8161

of the PAS earthquakes are in the Owens Valley vicinity (about 150 km from Yucca Mountain), with only an occasional UNE-related event included.

The seismic network employed for HSF was concentrated in Area 20 of Pahute Mesa with a few stations scattered out to about 30 km. Thus, as would be expected, the maps of Appendix L show few events away from the locations of the network.

ROW had 10 stations on NTS and 7 off-site--at Leeds, Utah, Darwin, California, and West Las Vegas, Angel Peak, Tonopah, Alamo, and Nelson, Nevada. The effort concentrated on UNE aftershocks on Pahute Mesa as shown on the maps of Appendix O; hence, most were deleted as UNE aftershocks. There were a few off-site earthquakes observed, most notably in the vicinity of the Rock Valley fault.

Most of the Lake Mead seisms removed came from BRP (Appendix D). Others came from RYC (Appendix P), PAS (Appendix L), KKG (Appendix K), and GDY (Appendix H).

Because the historical catalog contained data from sources which concentrated on Pahute Mesa UNE aftershocks, less than half the entries remain after editing out man-made events, as can be seen by comparing Tables 9 and 10. This is in contrast to the SNSN data where only about 8 percent of the entries were deleted. The effect of these deletions is shown on the maps in Appendix U.

Table 9 illustrates the effect of the sensitivity of the various seismic nets. The number of events observed by the SNSN has its peak for magnitudes 1.01 to 2.00 because of the sensitivity of the net. No event with a magnitude larger than 3.82 was observed, and that was 152 km from Yucca Mountain (shaft). For the historical catalog the largest number was observed for magnitudes from 2.01 to 3.00. Several of the individual sources peak at higher magnitudes. Only FPH, HSF, and PHM peaked lower.

The two largest earthquakes were magnitude 6.3. One, on September 4, 1868, is the earliest entry in the historical catalog. The location, given only to the nearest degree of both latitude and longitude, would be just east of Owens Valley, and about 140 km from Yucca Mountain shaft. The second, on November 21, 1910, also had location given only to the nearest degree, and was about 187 km from Yucca Mountain. (See Page D-14.) It was one of a series of Tonopah Junction earthquakes during that month, and warrants closer scrutiny.

Tonopah Junction Earthquakes

The M 6.30 and two M 5.7 earthquakes were located at latitude 38° and longitude 118°. There was one M 5.50 at 37.5° and 117°. Slemmons, et al (1965) list an additional nine in the same month at that location, which are included in the SGBHC. They cite the location as Tonopah Junction. That was a junction on the Tonopah & Goldfield and Carson and Colorado Railroads. The latitude and longitude are N38°16', W118°7', respectively. Slemmons et al (1965) cite the source of information as Townley and Allen (1939). Both show an intensity for each earthquake, rather than a magnitude, so a conversion has been made for entry into the SGBHC.

1910 November 7 — 9:20 a.m. VII? This shock was felt from Goldfield, Esmeralda Co., to Rhyolite, Nye Co., a distance of about sixty miles. A few windows and dishes were broken at Goldfield.--Reid's Scrapbook, 3, 105.

1910 November 18 — 6:25 p.m. VIII? Tonopah Junction, Esmeralda Co. Reid assigns an intensity of VIII. The only other statements are that the duration was fifteen seconds and that the shock was accompanied by a loud rumbling noise. This information and that for the following shocks felt at Tonopah Junction was obtained from a letter from H. B. Vandersaal written November 29, 1910.--Reid's Card Catalog.

1910 November 19 — 9:57 a.m. III-IV. Tonopah Junction. Duration five seconds; rumbling sound.--Reid's Card Catalog.

1910 November 21 — Tonopah Junction. The following shocks were reported by H. B. Vandersaal:

Time	Duration	Intensity
3:20 p.m.	5 sec.	---
3:23 p.m.		2 min. VIII
4:30 p.m.		15 sec. VI
10:00 p.m.		10 sec. ---
10:05 p.m.		25 sec. VII

The second shock broke window glass and threw the watchman's car from the track. There was a succession of shocks during the two minutes and loud rumbling noise. Rumbling sounds also accompanied the third and fourth shocks.--Reid's Card Catalog.

1910 November 23 — 10:50 p.m. III-IV. Tonopah Junction. Duration five seconds.--Reid's Card Catalog.

1910 November 24 — 8:30 p.m. III to IV? Tonopah Junction. Duration five seconds each. The vibrations of all the eleven shocks felt at Tonopah Junction, November 18 to 24 seemed to be north-south, according to Mr.Vandersaal.--Reid's Card Catalog.

About the source of the information, Townley and Allen say:

> "Professor H. F. Reid of Johns Hopkins University very kindly loaned us his card catalog of earthquakes of the Pacific Coast and three scrapbooks of newspaper clippings. In using the information from these sources, we have sometimes given credit to the original source and sometimes to the card catalog and scrapbooks. In many cases there is no indication of the newspapers from which clippings were taken. Some of Reid's information came from the Lick Observatory and is marked 'L. O. Reports.' In such cases we have given Reid's Catalog rather than Lick Observatory as the reference."

For these earthquakes Slemmons et al, use the intensities given by Townley and Allen, thus they were subsequently converted to magnitude.

Earthquakes as large as M 6.3 would be expected to attract considerable attention locally. The DOE/NVO librarian was requested to search for information in local newspapers during the period of the major earthquake activity at Tonopah Junction. The result of the search (personal communication, Cynthia Ortiz, DOE/NVO) was that no references to the events were found in the Tonopah Daily Miner, the Tonopah Daily Bonanza, the

the early entries. The closest M 5.7 event was 87 km and the next closest 107 km from Yucca Mountain shaft. Others were more distant.

GDY lists eight earthquakes with 5-plus magnitudes. One was UNE related and was deleted. The remainder (see Page H-12) were quite distant.

PDX shows one M 5.1 event (see Page M-13). It occurred 14 minutes 52 seconds after the Boxcar event in Area 20 of Pahute Mesa. Although not deleted, it is judged to be a Boxcar aftershock mislocated so as not to have

Figure 1. Magnitude vs. distance for unmodified (left) and modified (right) historical data - Line represents 0.01 g acceleration.

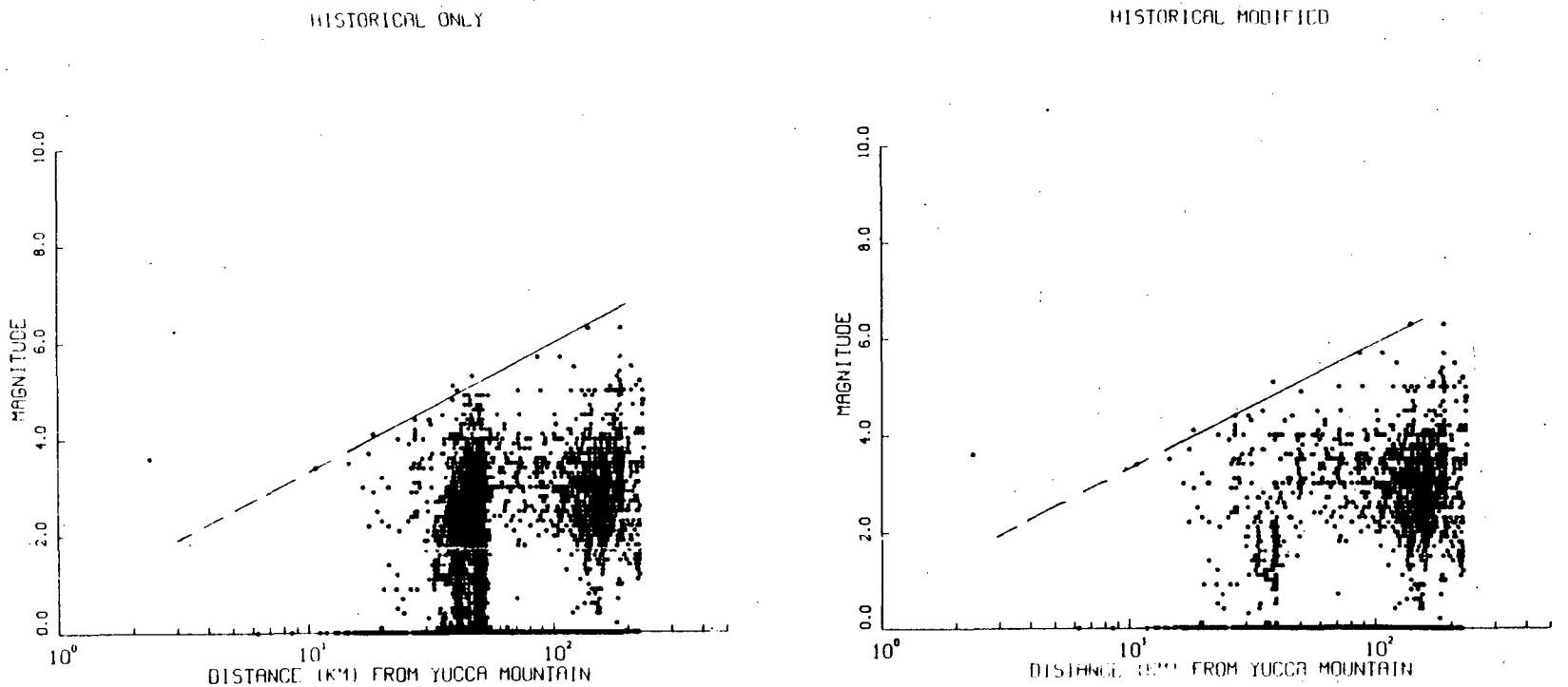
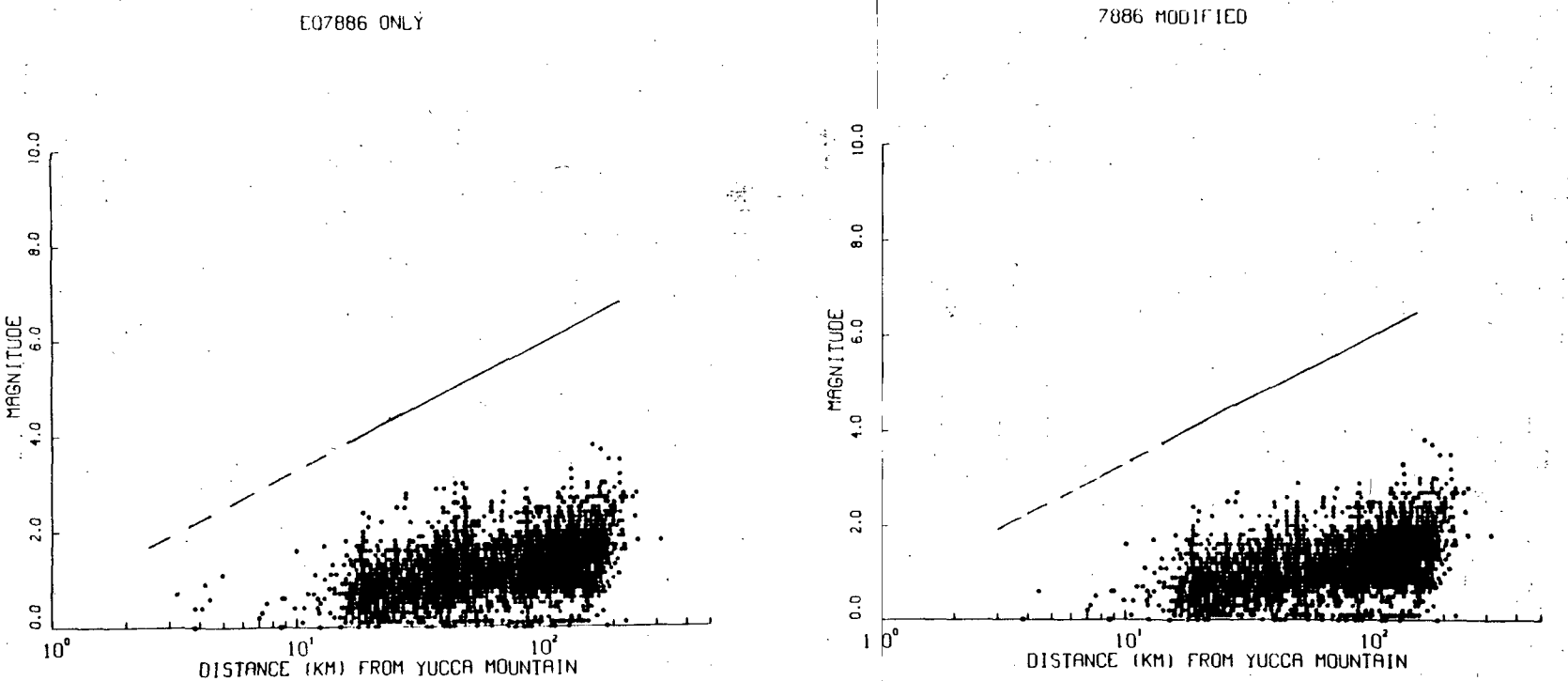


Figure 2. Magnitude vs. distance for unmodified (left) and modified (right) SNSN data - Line represents 0.01 g acceleration.



from the Modif

orical Catalog

Depth		Source	Distance km
18.00*	0.0	PAS	2.33103
15.00*	0.0	KKG	6.25789
20.00*	0.0	KKG	8.54619
16.00*	0.0	PAS	10.70284
15.70	0.0	KKG	11.78075
20.00*	0.0	KKG	12.76865
0.00*	0.0	KKG	13.09725
20.00*	0.0	KKG	13.13035
15.00*	0.0	KKG	13.90153
0.00*	0.0	KKG	13.95383
0.00*	0.0	ISC	14.26472
4.60	0.0	KKG	14.43106
8.00*	0.0	GDY	14.58336
0.00*	0.0	KKG	15.22161
0.70	0.0	KKG	15.44843
0.00*	0.0	KKG	15.44843
0.00*	0.0	KKG	15.44843
5.00*	0.0	KKG	15.99242
5.00*	0.0	KKG	15.99242
7.60	0.0	KKG	16.11971
0.00*	0.0	KKG	16.35729
4.30	0.0	KKG	16.54608
11.10	0.0	PAS	16.66339
33.00*	0.0	BRP	16.78937
0.00*	0.0	ISC	16.78937
7.30	0.0	KKG	16.79650
0.00	0.0	KKG	17.07081
8.20	0.0	KKG	17.08914
0.00	0.0	KKG	17.29586
8.00*	0.0	PAS	17.68951
3.76	0.0	ROW	17.80663
0.00	0.0	KKG	17.85032
0.00*	0.0	KKG	17.88924
0.00*	0.0	PDX	18.32182
5.92	0.0	PAS	18.38978
5.40	0.0	KKG	18.45491
25.00*	0.0	KKG	18.75307
5.00*	0.0	KKG	18.97289
10.10	0.0	KKG	18.98637
0.00*	0.0	RYN	19.06276
5.00*	0.0	KKG	19.19770
3.00*	0.0	HSF	19.61415
9.90	0.0	KKG	19.70622
0.00*	0.0	ALX	19.87022
10.60	0.0	RYN	19.89964
15.00*	0.0	KKG	19.95274
3.00*	0.0	HSF	20.14099
7.40	0.0	KKG	20.57109
10.00*	0.0	KKG	20.65487
6.80	0.0	KKG	20.70535
33.00*	0.0	BRP	21.03711
9.80	1.7	HSF	21.11459
0.00*	0.0	KKG	21.19942
10.00*	0.0	KKG	21.19942
3.00*	0.0	HSF	21.20602
18.00*	0.0	PAS	21.21612
33.00*	0.0	BRP	21.67803
0.00*	0.0	KKG	22.03221
0.00	0.0	KKG	22.21615

[redacted]

in from the Modified SNSN Data

Depth km	Depth Error km	No. Rdgs	Mc	Mc Est.	Qual.	Comments	Distance km
1.01	0.4	3	0.0	C		1134 eq	3.80596
5.30	0.4	5	-0.2	B		Y.M.reloc Mo	3.82617
1.39	0.5	0	0.0	A		Md recomputed	4.40809
3.68	1.5	1	0.3	C		1134 event	7.00617
5.81	0.7	9	0.4	B		SGB defined m	7.23192
7.00		0	0.0	D		SGB defined m	7.56363
9.04	0.6	4	0.1	D		1134;YucMtn e	8.57115
7.78	0.6	4	0.1	D		1134 data	8.71908
9.31		0	0.0	D		SGB defined m	8.75947
9.87	3.0	0	0.0	D		Md recomputed	8.94268
1.02		0	0.0	D		default	9.83796
1.47		2	1.6	D		SGB defined m	9.99695
7.00		0	0.2	D		Md recomputed	10.58774
1.71	1.2	2	0.5	D		uses Mca esti	10.77154
3.88	1.4	0	0.0	D		Md recomputed	11.12492
7.00		0	0.0	D		Md recomputed	11.76950
7.00		3	0.8	D		SGB defined m	11.77831
3.59	0.6	6	1.0	B		1134 digital	11.96636
4.19	0.4	4	0.4	A		1134 eq	12.22421
2.26	0.5	4	0.6	C		1134	12.27072
1.98	2.1	7	0.4	C		SGB defined m	12.41843
3.89		0	0.0	D		Md recomputed	12.50633
2.03	14.5	3	0.6	D		1134	12.61245
3.95	0.4	6	1.7	A		1134 digital	12.96302
3.74	0.3	2	0.8	A		1134 eq	13.09393
3.35	1.0	1	1.0	D		1134 digital	13.09491
1.63	1.5	3	0.8	D		1134 event	13.65925
1.73	1.1	1	0.3	D		1134 prelim	13.78582
9.51	0.6	7	0.9	D		Feb 85 digital	13.88340
3.34	3.4	0	0.0	B		Md recomputed	14.07090
1.07	0.7	6	0.7	D		1134	14.32367
3.16	0.6	5	0.2	D		1134 eq	14.33650
9.22	3.0	4	0.7	D		Feb 85 digital	14.37532
3.86	0.4	9	1.1	B		SGB defined m	14.64219
7.03	0.4	11	0.7	D		SGB defined m	15.06323
3.42	1.3	5	0.8	D		SGB defined m	15.09544
3.74	0.4	2	0.3	C		April 85 digi	15.16886
1.98		0	0.0	D		Md recomputed	15.22535
3.00	-99.9	0	0.0	C		Md recomputed	15.40700
9.74	0.5	9	0.7	C		1134 event	15.46192
1.20	1.0	1	0.9	C		1134	15.46351
5.77	0.8	6	0.8	B		SGB defined m	15.66232
9.98	1.3	3	0.5	C		SGB defined m	15.67647
3.82	415.7	1	1.3	D		March 85 digit	15.69693
5.30	1.2	2	0.2	D		1134 eq	15.86274
7.33	0.3	7	0.9	A		SGB defined m	15.88306
9.04	0.5	4	0.2	D		uses Mca esti	15.90889
7.84	0.5	18	1.9	A		SGB defined m	15.94810
2.32	0.5	0	0.2	C		Md recomputed	15.96396
2.25	1.3	7	1.0	B		SGB defined m	15.98619
1.87	8.2	3	0.8	D		SGB defined m	16.02688
9.68	0.4	4	1.4	A		uses Mca esti	16.12434
9.63	0.5	8	0.8	D		SGB defined m	16.20586
7.95	0.5	6	0.4	D		SGB defined m	16.21668
3.43	0.4	5	0.3	D		SGB defined m	16.29170
3.84	2.6	5	0.8	C		SGB defined m	16.37440
4.85	0.5	6	0.4	B		SGB defined m	16.48426
[illegible]	[illegible]	0	0.0	D		Md recomputed	16.61173
[illegible]	[illegible]	2	0.4	[illegible]		SGB defined m	16.62634

Table 11 lists the modified earthquakes from the historical catalog closest to the Yucca Mountain, with distance from the shaft in the far right column. The entry at 2.33 km from PAS could have a considerable location error (estimated at 16.5 to 21.4 km in Tables 3 and 5), which would move it to the right toward the other data in Figure 1.

Algermissen and Perkins (1976) determined the maximum acceleration versus distance and magnitude for stations on rock in the western region of the United States. The 0.01 g intercept from their Figure 3 is shown in Figures 1 and 2 by the solid line between magnitudes 4 and 6.6. A dashed line shows the extrapolation to smaller magnitudes. Thus, an acceleration of 0.01 g would be seen at Yucca Mountain for magnitude-distance falling along the line. With few exceptions the historical data fall below the 0.01 g line. The SNSN data fall more than one magnitude unit below the line. Considering the time span covered by the SNSN data (Figure 2), the probability of obtaining data from larger earthquakes between now and final siting decision must be especially small.

In Figure 1 (left) the plethora of nuclear test-related entries in the historical catalog is obvious. These have been deleted in the right side of Figure 1 as a result of editing. The deletions from SNSN data in Figure 2 are not as obvious.

Temporal Aspects of SGB Earthquakes

The earthquakes listed in the historical and SNSN catalogs reveal their episodic nature as well as manifesting the effectiveness of measuring programs. Table 13 shows the number of earthquakes in the modified catalogs by year and by month for each year. The SNSN started in August 1978 and measured an increasing number of events as more stations were added. The number of events for 1979 and subsequent years reflects that system's ability to measure a larger number of smaller earthquakes. Table 14 shows the same information for the modified catalogs. Comparison of the two tables indicates the number of deletions in each month and year. The deletions from the SNSN data were predominantly those related to nuclear tests. Note the large number of events in August 1979. Two swarms with large numbers of events were involved, one near Alamo and another in the Thirsty Canyon area.

An earlier version of the SNSN with 10 stations on the NTS and seven off-site was operated from October 1975 through June 1976 (Rogers et al, 1977b). The number in those years reflects a larger number of small earthquakes detected as a result of lowering the detection threshold, and is shown in Table 13. Most of the events were Pahute Mesa aftershocks which were deleted as shown in Table 14. The 18 remaining in June 1976 are the Rock Valley swarm.

A still earlier network was operated from March 1971 through June 1973. Again, the number of small earthquakes increased. Many were aftershocks following nuclear tests (KKG). Table 14 shows a number of months with larger activity. Those in August 1971 included the Massachusetts Mountain earthquake and its aftershocks. Forty-nine remaining in December 1972 included 19 in a swarm near China Lake, California, at a distance of 150 to 160 km.

Peaks in Table 13 in February 1964, December 1966, May 1967, May and December 1968, and January 1969 contained significant numbers of weapons test-related events as indicated by the reduced numbers for those months in Table 14. Deleted at Lake Mead were swarms in September 1936, May 1939, May 1944, May 1948, July 1949, July 1950, February 1952, October 1952, and November 1952. The reduced numbers in Table 14 reflect the deletions.

Table 13. Temporal Aspects of Earthquakes from the Unmodified Historical and SNSN Data

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1858	0	0	0	0	0	0	0	0	1	0	0	0	1
1871	0	0	1	0	0	0	4	0	0	0	0	0	5
1872	0	0	1	3	0	0	0	0	1	0	0	0	5
1882	0	0	0	0	0	0	0	1	0	0	0	0	1
1885	0	0	0	1	0	0	0	0	0	0	0	0	1
1888	0	0	0	1	0	0	0	0	0	0	0	0	1
1887	0	0	0	0	0	0	0	0	0	1	0	0	1
1892	0	0	0	0	0	0	0	1	0	0	0	0	1
1894	0	1	0	0	0	0	0	0	0	0	0	0	1
1904	0	0	0	0	0	0	0	0	0	1	0	0	1
1905	0	0	0	0	0	1	0	0	0	0	0	0	1
1908	0	0	0	0	0	0	0	0	0	0	1	0	1
1910	0	0	0	0	0	0	0	0	0	0	12	1	13
1914	0	0	0	1	0	0	0	0	0	0	0	0	1
1916	0	0	0	0	0	0	0	0	0	1	3	0	4
1917	0	1	0	0	0	0	0	0	1	0	0	0	2
1918	0	0	0	0	0	0	2	0	0	0	0	0	2
1921	0	0	0	0	0	0	0	0	0	0	1	0	1
1928	0	0	1	0	0	0	0	0	0	0	0	1	2
1930	0	0	1	0	0	0	1	0	0	0	0	0	2
1931	1	0	0	1	0	1	0	0	0	0	0	0	3
1932	1	2	3	3	6	0	2	4	0	1	1	2	25
1933	5	6	3	1	3	1	5	0	0	2	1	0	27
1934	2	0	11	6	0	3	2	7	2	1	1	3	38
1935	3	8	2	5	2	1	0	0	0	0	0	0	21
1936	3	0	1	8	2	1	2	1	14	5	3	2	42
1937	1	7	0	4	1	4	1	5	7	2	3	4	39
1938	1	0	1	0	0	1	11	0	4	4	1	3	26
1939	11	3	3	3	14	9	2	2	4	1	3	4	59
1940	1	0	4	1	2	0	1	0	2	2	0	0	13
1941	0	1	2	2	0	2	1	1	5	2	0	1	17
1942	3	0	0	0	0	4	4	1	1	3	0	0	16
1943	2	4	8	7	4	4	2	5	11	2	0	0	49
1944	1	1	2	0	9	5	2	8	5	5	5	3	46
1945	4	5	0	1	1	1	3	1	1	1	3	2	23
1946	2	3	16	23	25	16	12	2	6	8	3	8	124
1947	4	4	4	0	3	4	5	3	7	3	1	2	40
1948	3	7	1	2	12	4	5	2	2	4	8	1	51
1949	5	4	0	2	6	2	10	9	0	3	1	9	51
1950	8	6	4	4	1	1	9	1	4	9	8	6	61
1951	4	7	1	1	0	17	7	6	2	3	2	1	51
1952	4	22	4	1	7	8	2	5	2	13	7	1	76
1953	1	4	9	2	8	0	6	1	3	3	5	5	47
1954	2	1	2	6	6	1	5	2	1	0	4	0	30
1955	3	0	1	0	1	0	0	2	1	0	1	0	9
1956	1	0	0	1	2	0	2	1	1	1	1	0	10
1957	0	0	1	3	0	0	0	1	0	1	1	0	7
1958	0	0	0	1	1	0	1	5	0	1	0	0	9
1959	9	2	2	2	0	3	2	1	6	8	4	1	40
1960	4	0	1	0	1	0	0	1	0	1	1	0	9
1961	2	0	2	3	2	0	2	1	1	11	2	3	29
1962	2	0	4	6	3	3	1	1	3	2	3	1	29
1963	4	1	2	10	12	2	9	4	2	4	11	1	62
1964	4	15	7	4	6	8	4	3	7	14	11	13	96
1965	7	5	6	4	8	4	4	1	1	0	2	15	57
1966	6	1	1	2	3	3	3	4	5	6	1	14	49
1967	5	5	7	3	11	6	2	6	3	3	5	3	59
1968	5	8	11	10	10	6	1	1	2	2	0	827	683
1969	280	110	33	12	68	22	36	89	200	62	32	39	983

Table 13 Temporal Aspects of Earthquakes from the Unmodified Historical and SNSN Data (continued)

1970	42	35	175	233	105	43	52	36	35	34	35	39	864
1971	12	10	22	17	20	10	18	84	20	18	17	53	301
1972	25	26	72	50	60	32	43	59	70	84	92	57	670
1973	57	209	78	65	54	49	5	7	4	5	2	8	543
1974	1	4	3	4	22	6	13	7	6	3	3	5	77
1975	8	7	6	4	4	12	12	7	8	83	62	18	231
1976	133	120	157	23	12	28	4	10	25	23	11	31	577
1977	4	6	16	6	0	4	10	24	1	7	9	11	98
1978	17	10	33	10	5	10	14	17	8	3	6	31	164
1979	10	9	25	25	15	24	33	166	26	33	45	29	440
1980	37	24	24	43	12	16	66	44	27	47	48	40	428
1981	21	9	8	31	29	39	27	18	22	82	75	51	412
1982	65	73	90	70	73	58	100	76	43	47	50	91	836
1983	57	112	29	51	55	44	56	72	41	63	55	52	687
1984	35	38	55	37	47	31	89	51	115	35	52	83	646
1985	104	60	44	84	147	83	120	220	65	46	53	44	1070
1986	88	98	82	2	65	138	103	98	115	0	0	0	789
TOTALS	1120	1094	1082	905	965	775	918	1185	949	809	767	1419	11988

Table 14. Temporal Aspects of Earthquakes from the Modified Historical and SNSN Data

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	1	0	0	0	4	0	0	0	0	0	5
0	0	1	3	0	0	0	0	1	0	0	0	5
0	0	0	0	0	0	0	1	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	1	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0	1
0	1	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	1	0	0	1
0	0	0	0	0	1	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	0	0	0	12	1	13
0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	1	3	0	4
0	1	0	0	0	0	0	0	1	0	0	0	2
0	0	0	0	0	0	2	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	1	0	1
0	0	1	0	0	0	0	0	0	0	0	1	2
0	0	1	0	0	0	1	0	0	0	0	0	2
1	0	0	1	0	1	0	0	0	0	0	0	3
1	2	3	3	6	0	2	4	0	1	1	2	26
5	6	3	1	3	1	5	0	0	2	1	0	27
2	0	11	6	0	3	2	7	2	1	1	3	38
3	8	2	5	2	1	0	0	0	0	0	0	21
3	0	1	8	2	1	2	1	5	5	2	0	30
1	6	0	1	1	3	1	5	3	1	0	2	24
1	0	1	0	0	0	9	0	4	0	0	2	17
10	3	3	2	8	8	2	2	4	1	3	4	50
1	0	4	1	2	0	1	0	2	2	0	0	13
0	1	1	2	0	2	1	1	3	2	0	0	13
3	0	0	0	0	3	4	1	0	2	0	0	13
0	3	7	6	2	2	2	2	9	2	0	0	35
0	0	1	0	0	0	0	5	1	1	2	3	13
2	1	0	1	1	1	1	1	1	0	0	0	9
0	0	9	23	25	15	9	2	8	4	1	7	101
4	4	4	0	1	0	0	1	1	2	1	2	20
2	3	0	1	1	3	2	2	0	2	1	0	17
1	2	0	0	2	2	1	3	0	1	1	8	21
7	5	3	4	0	0	0	0	4	6	8	4	41
4	1	1	1	0	13	7	1	0	0	2	1	31
3	6	1	0	0	1	1	3	0	2	0	0	17
1	1	5	1	1	0	5	1	1	0	5	5	26
2	1	1	6	6	0	4	2	1	0	4	0	27
3	0	1	0	1	0	0	2	1	0	0	0	8
1	0	0	1	0	0	2	1	1	1	1	0	8
0	0	1	3	0	0	0	1	0	1	1	0	7
0	0	0	0	1	0	1	1	0	0	0	0	3
9	2	2	2	0	2	2	1	6	8	4	1	39
4	0	1	0	1	0	0	1	0	1	1	0	9
2	0	2	3	2	0	2	1	1	11	2	2	28
2	0	3	6	3	3	1	1	2	1	3	1	26
4	1	0	6	9	1	9	4	2	4	11	1	52
1	6	6	1	4	5	3	3	1	14	10	10	64
4	4	4	2	4	4	2	1	1	0	2	14	42
5	1	0	2	1	2	1	4	5	6	0	8	35
2	1	7	3	8	4	2	4	3	3	5	3	45
5	8	9	5	3	3	1	1	1	1	0	9	46

Table 14. Temporal Aspects of Earthquakes from the Modified Historical and SNSN Data (continued)

1969	9	3	2	2	9	1	24	57	5	4	7	7	130
1970	6	8	27	9	6	6	10	10	14	11	17	10	134
1971	12	9	15	11	19	9	14	84	16	16	16	50	271
1972	22	24	37	45	48	30	40	53	66	79	92	49	585
1973	52	204	76	63	52	29	4	7	4	4	2	5	502
1974	1	3	3	3	21	5	11	7	4	3	3	4	68
1975	8	5	6	4	3	7	10	6	8	13	1	13	84
1976	13	15	17	14	2	25	4	10	25	21	10	27	183
1977	4	5	15	4	0	4	8	21	1	7	8	10	87
1978	17	9	32	8	5	8	13	11	5	3	4	24	139
1979	9	7	24	24	15	16	33	152	21	24	42	28	395
1980	35	23	24	34	11	16	57	30	22	30	40	36	358
1981	20	7	8	29	29	37	24	17	20	77	68	43	379
1982	59	64	87	63	69	57	99	67	41	45	47	85	783
1983	53	107	26	49	54	43	52	72	41	59	52	48	656
1984	31	35	51	36	45	29	65	49	99	32	46	71	589
1985	92	55	43	79	144	72	114	215	50	42	38	40	984
1986	75	91	76	0	60	134	97	93	113	0	0	0	739
TOTALS	617	752	670	590	692	613	773	1033	629	561	583	644	8157

Other swarms can be identified with Tonopah Junction, China Lake, Owens Valley, and Scotty's Junction. These remain in the edited catalog. Peaks in May 1974 were a swarm in the vicinity of China Lake. The large number in March through July 1946 can be attributed to a swarm in the vicinity of Owens

A NOTE ON EARTHQUAKE MAGNITUDE AND EXPLOSION YIELD

There are nine Pahute Mesa tests for which yields have been announced (DOE/NVO 1985). These events and their yields are listed in Table 15. The table also shows the magnitude of each event as published by Rodean (1971). From the table, the yield-magnitude can be plotted as in Figure 3. Regression analysis gives the relationship

$$M = 3.603 + 0.3774 \ln W \qquad r^2 = 0.97,$$

where M is Richter magnitude and W is yield in kilotons. The coefficient of determination, r^2, is quite good. (Using classified yields changes the equation very little, although r^2 is smaller.) Perret (1972) shows that for the 1300 kt Boxcar event 2.86 percent, or 37.18 kt, of its energy was the

energy and magnitude:

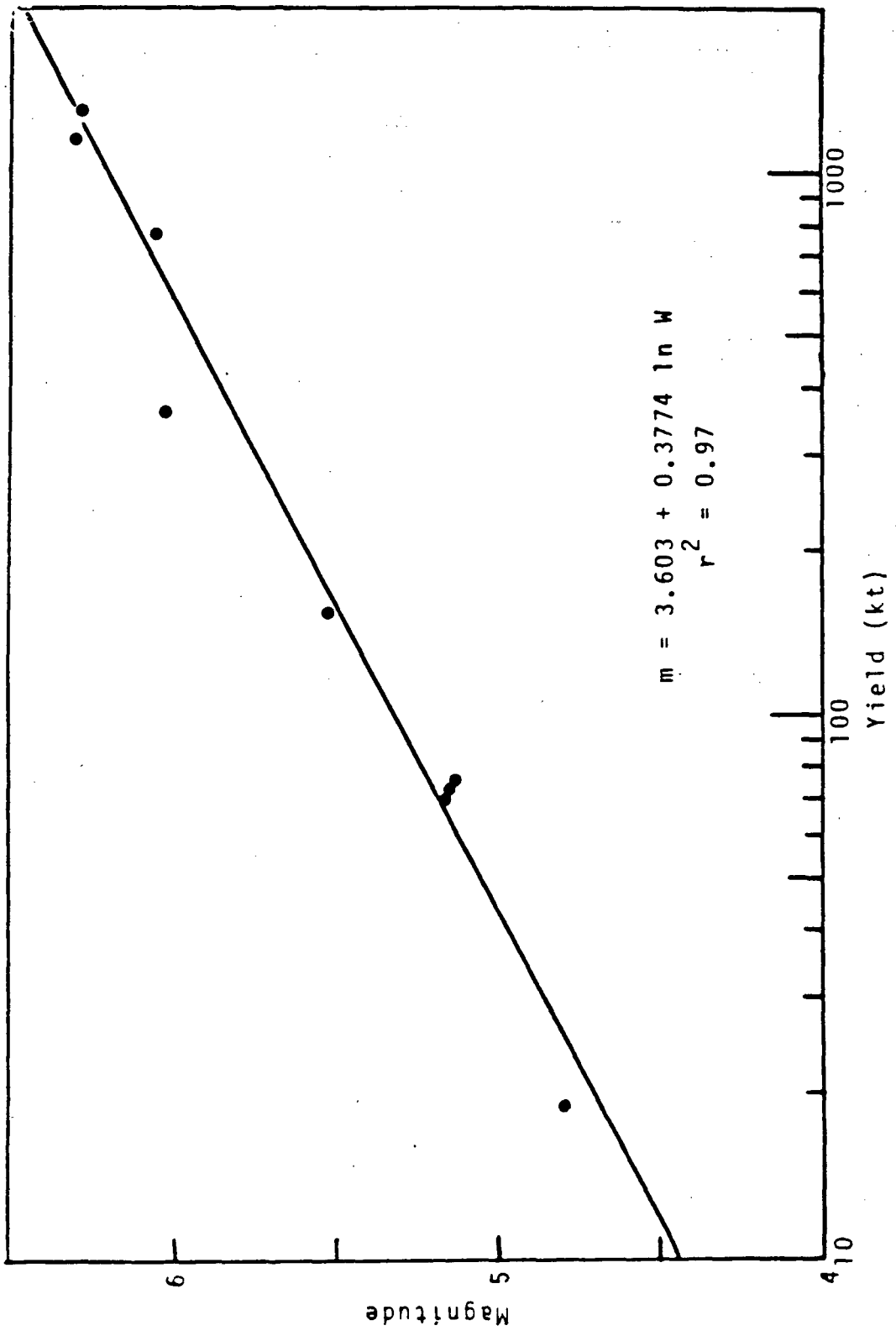


Figure 3. Magnitude vs. yield of Pahute Mesa underground nuclear explosions

Table 15. Nuclear Explosion Yields and Magnitudes

Event	Date	Yield (kt)	Magnitude
Scotch	67/05/23	155 (a)	5.51 (b,d)
Halfbeak	66/06/30	365 (a)	6.04 (b,d)
Chartreuse	66/05/06	73 (a)	5.15 (b,d)
Duryea	66/04/14	70 (a)	5.17 (b)
Benham	68/12/19	1150 (a)	6.3 (c)
Knickerbocker	67/05/26	76 (a)	5.14 (b,d)
Greely	66/12/20	870 (a)	6.05 (b,d)
Rex	66/02/24	19 (a)	4.80 (b)
Boxcar	68/04/26	1300 (a)	6.29 (b,d)

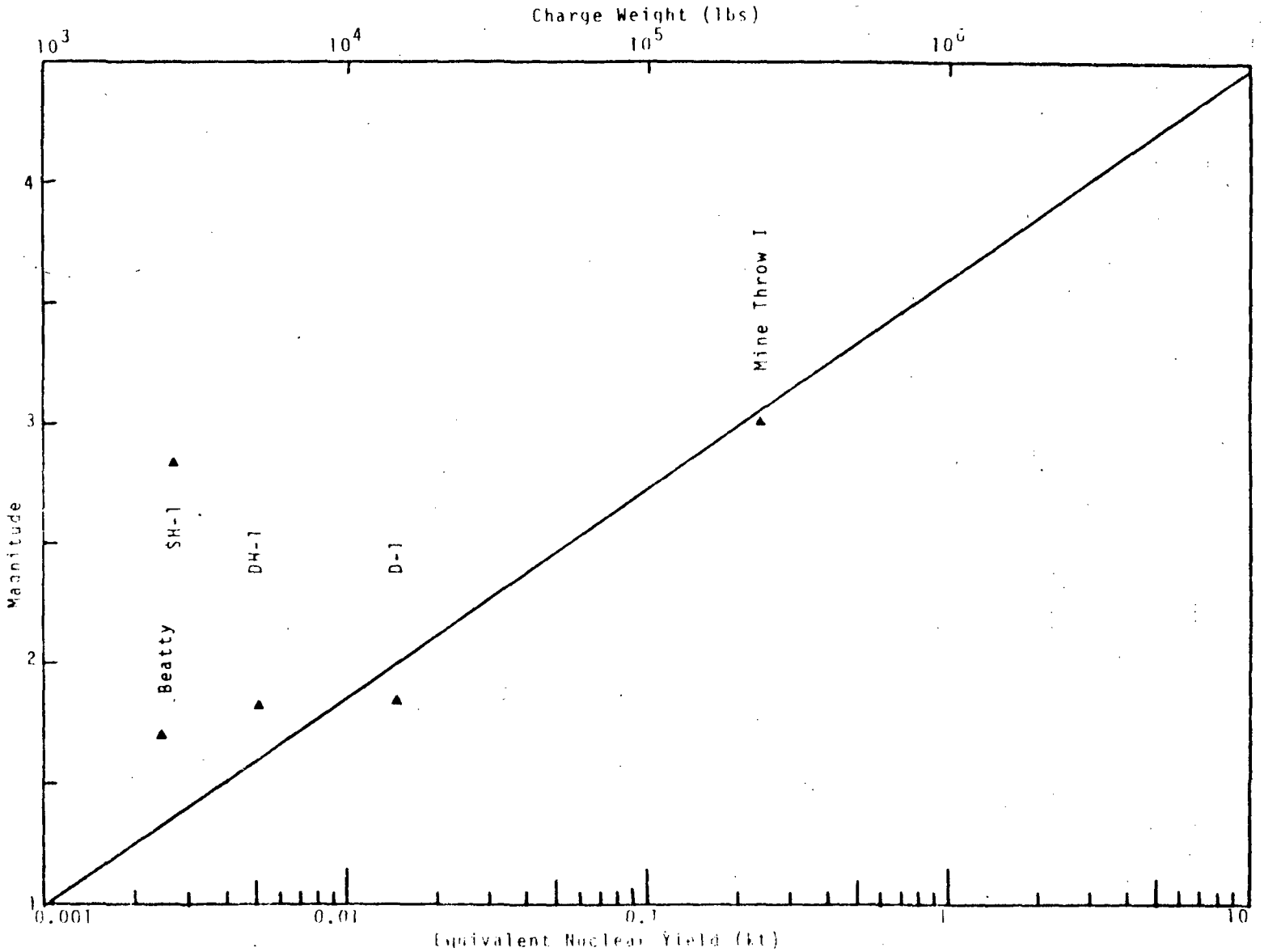
(a) DOE/NVO (1985)

(b) Rodean (1971)

(c) C&GS (1969)

(d) Basham (1969)

Figure 4. Magnitude vs. charge weight and yield for five HE shots



Tuff

BRK	$M_L = 3.623 + 0.3748 \ln W$	$r^2 = 0.86$
GS	$m_b = 3.618 + 0.4093 \ln W$	$r^2 = 0.73$

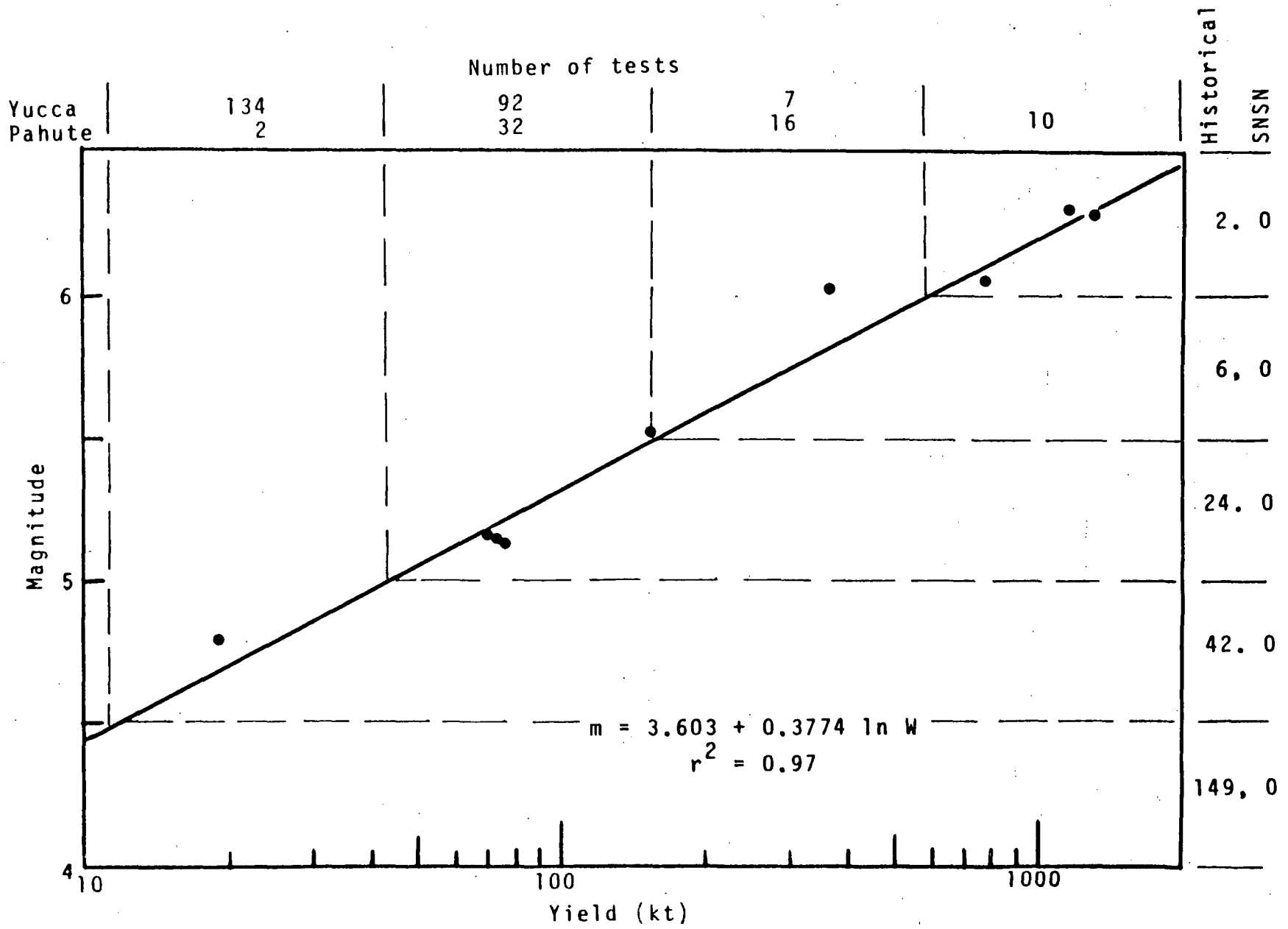
The Berkeley equation for tuff is almost identical to the Pahute Mesa equation. The Geological Survey equation for alluvium parallels (has similar slope to the Pahute Mesa one) and is lower by about 0.06 magnitude units. Nearly all of the data fall within 0.5 magnitude units of the above equations.

Having established relationships between yield and magnitude it is in order to compare the number of underground nuclear tests and the number of earthquakes as a function of yield and magnitude. This comparison is made in Figure 5, where the number of tests is shown separately for Yucca Flat and Pahute Mesa and the number of earthquakes separately for the historical and the SNSN catalogs.

There are five times as many tests magnitude 6 and above as there are earthquakes. The factor is 3.8 for magnitudes 5.5 to 6. For magnitudes 5.0 to 5.5, the multiplier is 5.2; only for 4.5 to 5.0 is the number of earthquakes slightly greater than the number of tests. Note that there are no earthquakes in this magnitude range from the SNSN catalog. Consider further that all nuclear tests are within 50 km of Yucca Mountain, whereas earthquakes in the catalogs extend to 230 km. If earthquakes were uniformly distributed and only considered to 50 km, the number of earthquakes in Figure 10 would be 1/21 the number shown. Consider still further that underground nuclear testing began in 1957, but the earthquake catalog extends back to 1868 in the case of the historical and 1978 to 1986 in the case of the SNSN. Consider even further that no weapon tests with yields greater than M 5.5 have been conducted since March 30, 1976. As would be expected, only the largest earthquakes were observed in the early years when sparse population and dependence on sensory perception ruled out smaller quakes.

Figure 5 emphasizes that UNEs have, in historical times, subjected the area to more large magnitude disturbances than have natural earthquakes. If these large magnitude UNEs had been plotted in Figure 1 in the range from 40 to 55 km, they would be shown to have produced the largest motion closest to Yucca Mountain.

Figure 5. Comparison of number of underground nuclear tests and number of earthquakes



CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Entries in the USGS SNSN and SGBHC have been scrutinized carefully. There was a combined total of 11,988 items listed making seismicity within about 200 km of Yucca Mountain appear to be a definite concern in the siting of a proposed waste repository. Table 1 summarizes the number of original entries, those which were selected for deletion for the reasons shown, and the balance remaining. The 8,161 entries remaining (68 percent of total) make it clear that the unedited catalogs tend to greatly exaggerate the seismicity of the region.

If one chooses not to use those events for which no magnitude was determined and those in the SNSN with large error estimates for purposes of hazard analysis, then the remaining number would be reduced by an additional 1,432, leaving 56 percent of the original number.

[redacted]

magnitudes, in spite of the facts that the earthquake history is longer and the area sampled is larger than for weapons test explosions.

It would appear that the probability of large earthquakes between now and siting a repository is exceedingly small.

Recommendations

For assessing the regional seismicity for purposes of hazard analysis relative to siting a waste facility at NTS, the edited version of the USGS catalogs should be used.

Seismicity maps (such as Figure 3-9 of the Draft Environmental Assessment, DOE/RW-0012, 1984) should be redone using the edited (modified) versions of the maps contained in these Appendices. Since the SNSN catalog includes events as small or smaller than M 0.1, seismologists should agree on a magnitude threshold below which seisms have little or no significance in assessing seismicity as it relates to siting a waste repository, and discard those from the data base.

Cumulative and interval frequency of occurrence and estimates of return

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APPENDIX A

The data sources used in this study were those given in the reference listed below. The codes given below and used in this report are identical to those in that reference.

Codes for Data Sources Used in this Report

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CGS
CVH
DMG
ERS
FPH
GDY
GPS
HSF
ISC
KKG
LLL
PAS
PDX
PHM
ROG
ROW
RWL
RYC
RYN
SPK
SHJ
USE
UTH
ZAK

REFERENCE

Meremonte, M. E., and A. M. Rogers, 1987. Historical Catalog of Southern Great Basin Earthquakes 1868-1978, USGS-OFR-87-80, Open File Report, U.S. Geological Survey, Denver, CO. (HQS.880517.1343)

APPENDIX B

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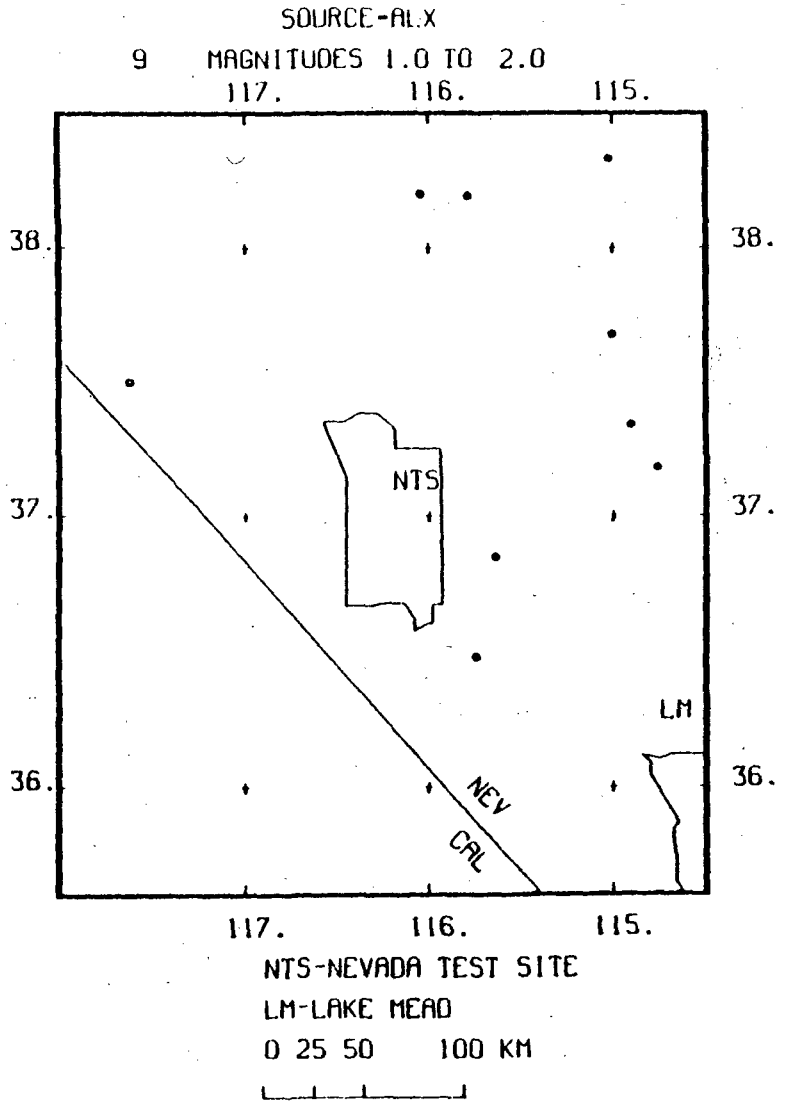
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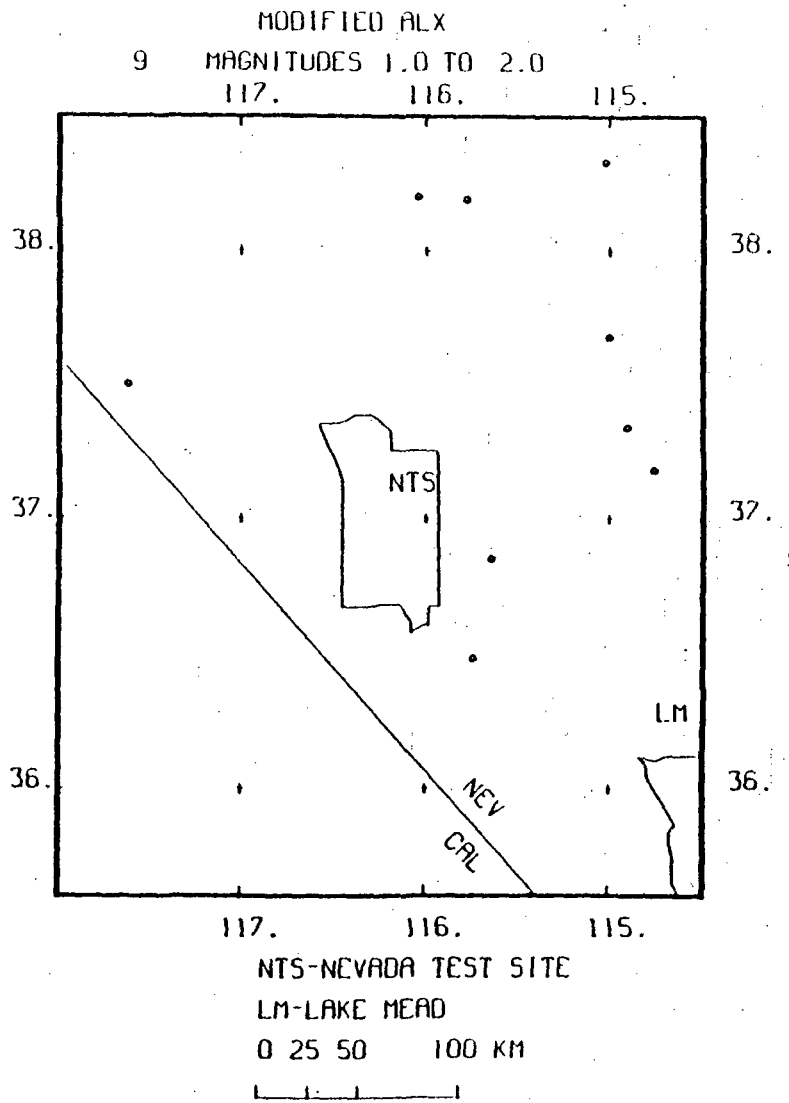
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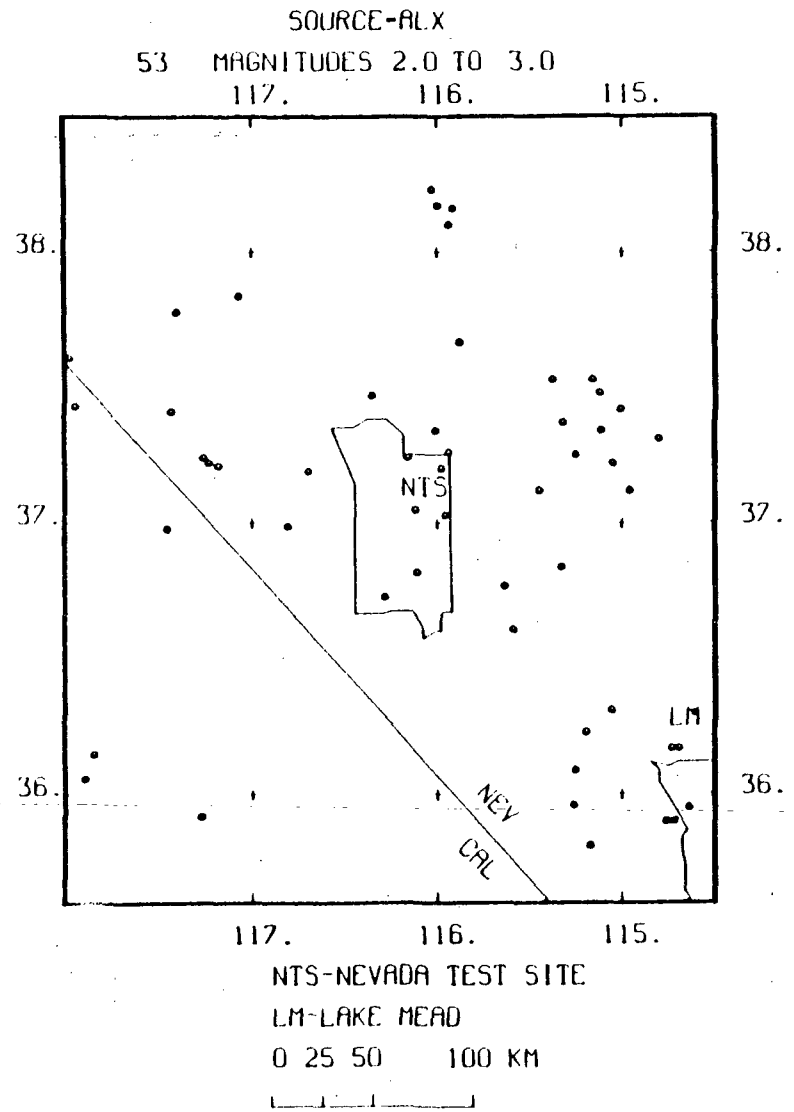
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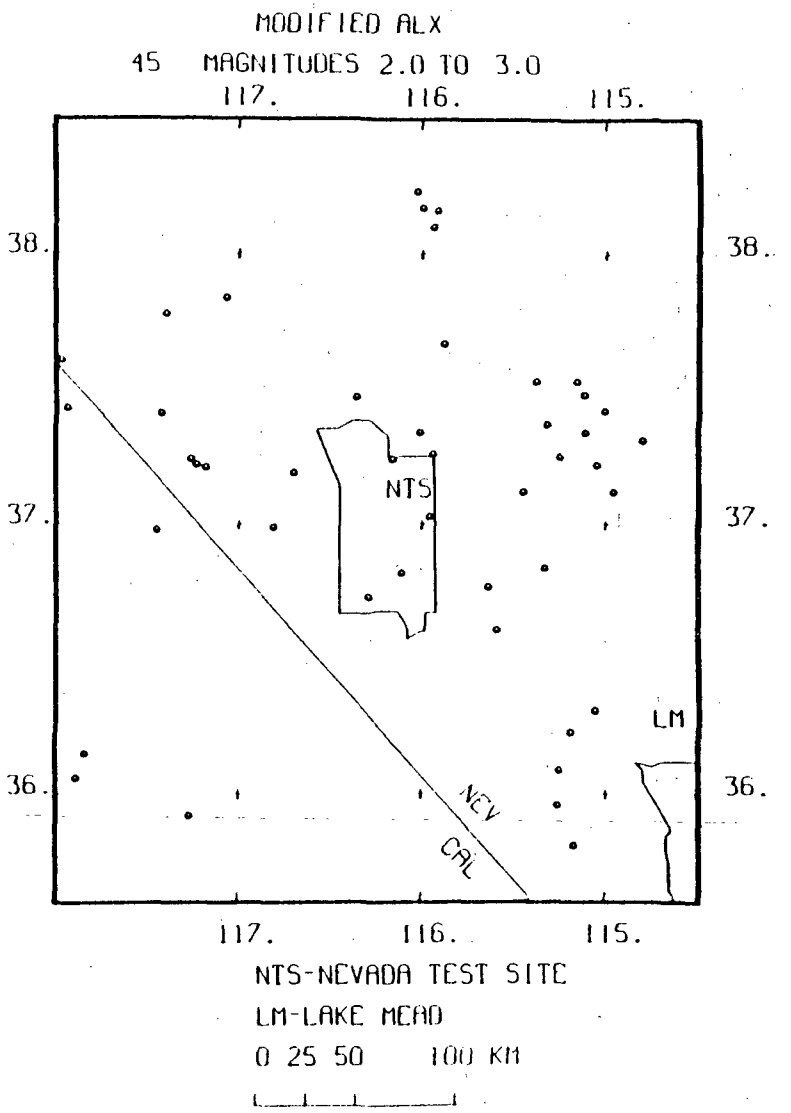
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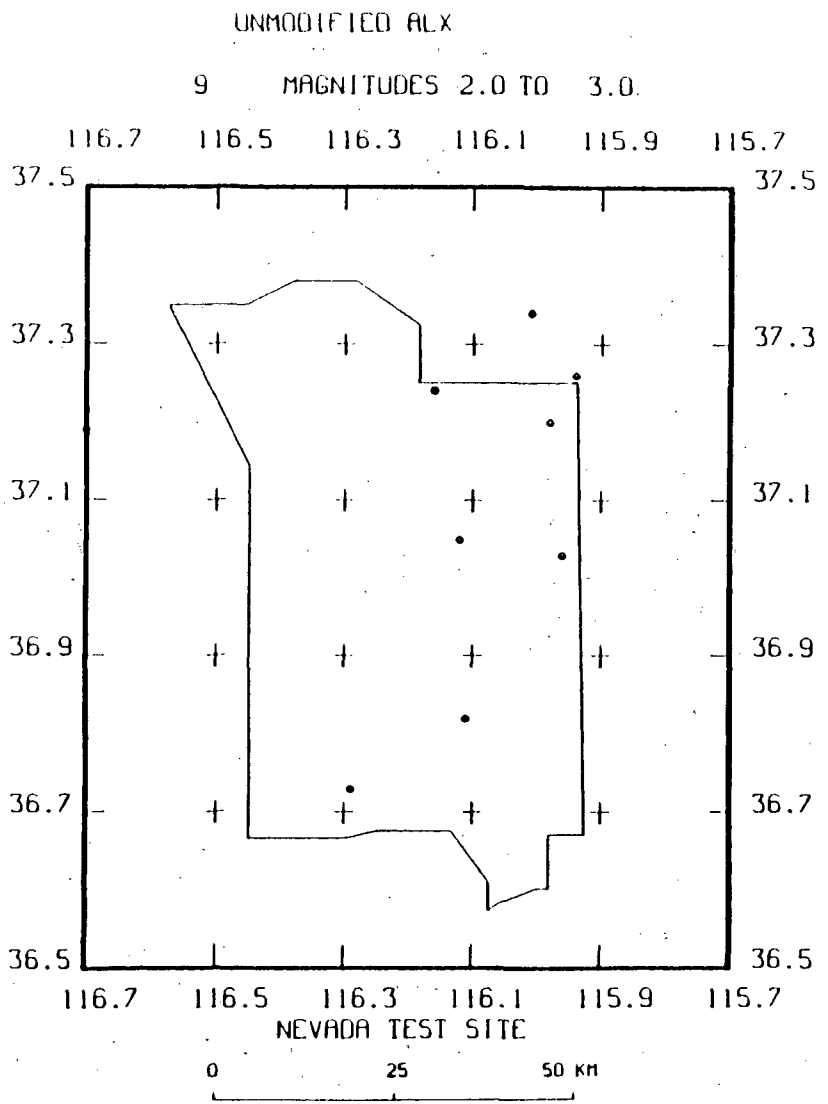
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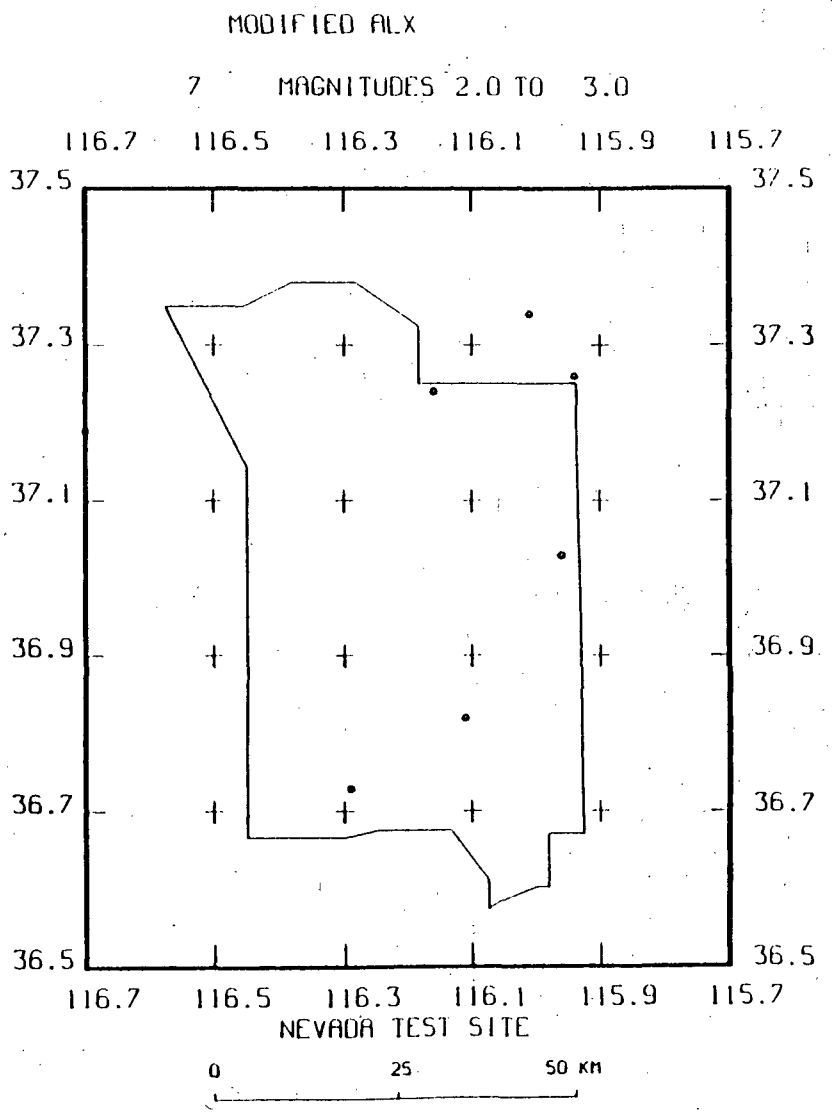
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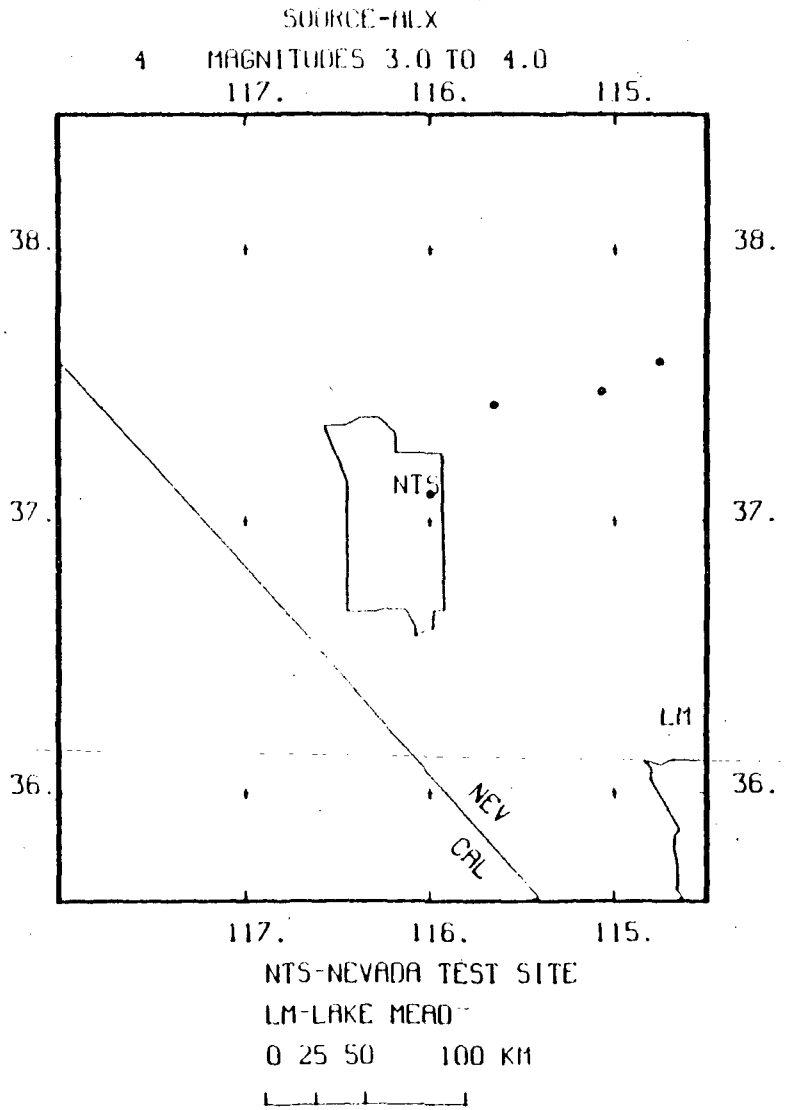
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CAL
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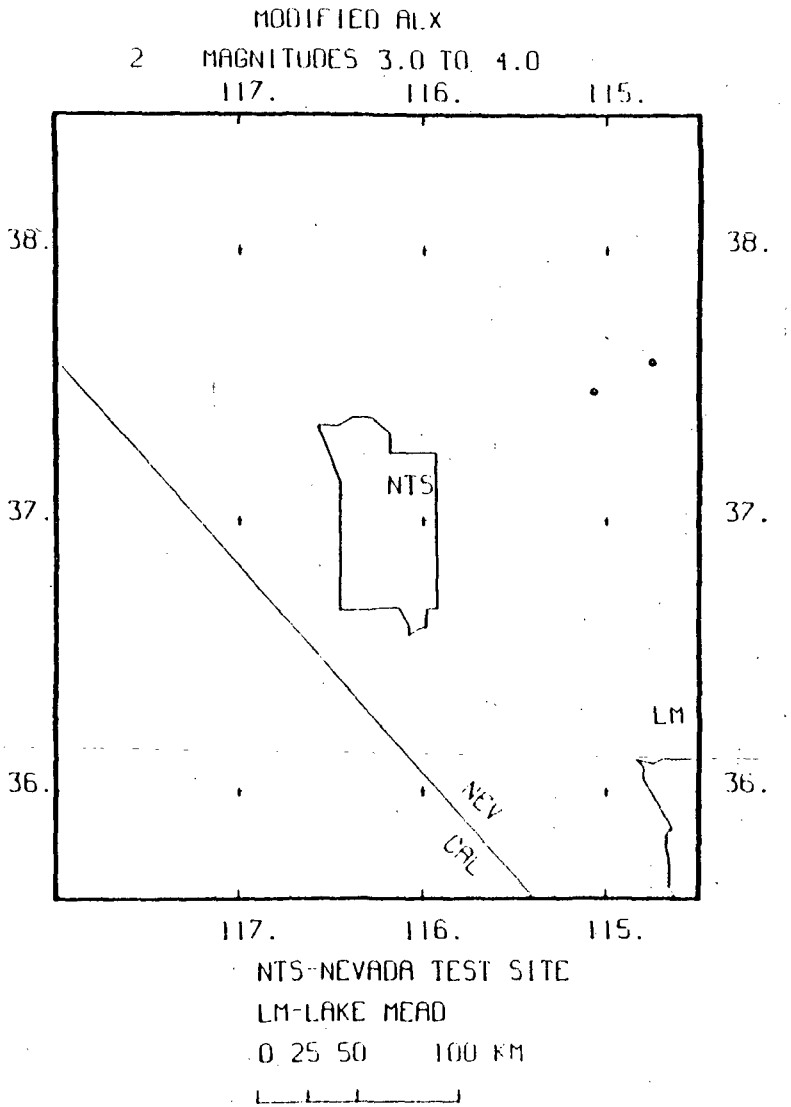
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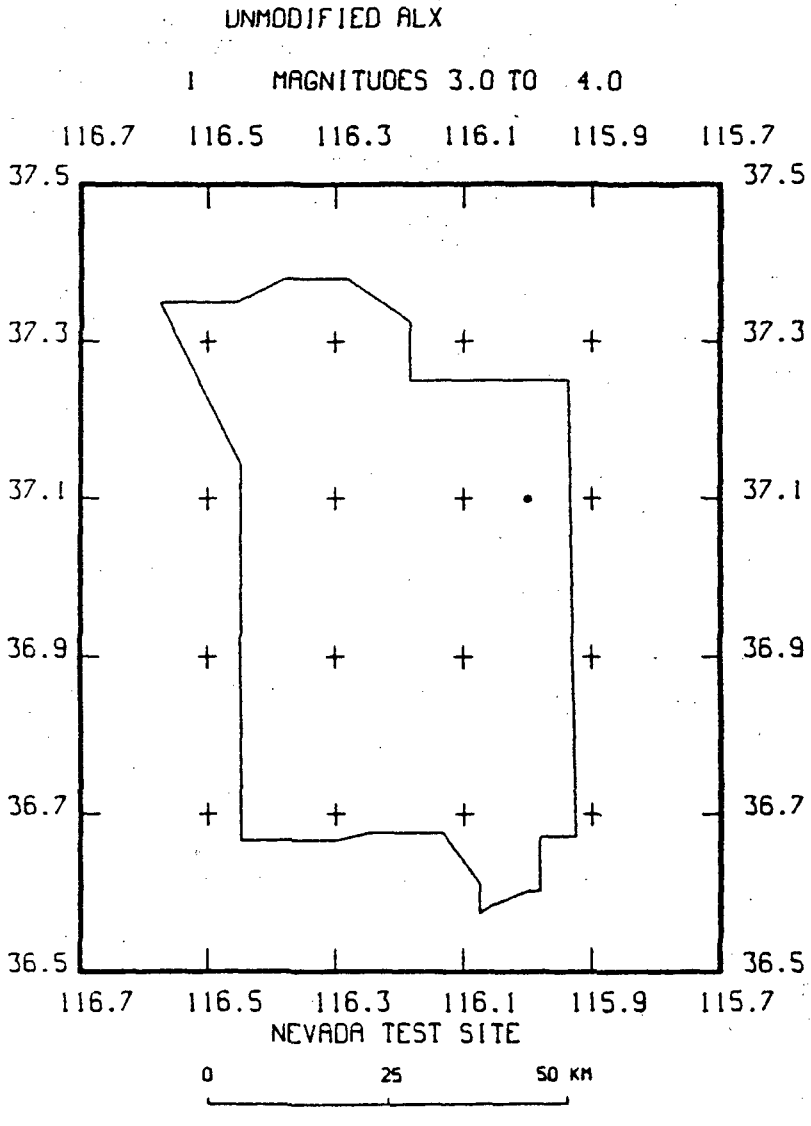
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APPENDIX C

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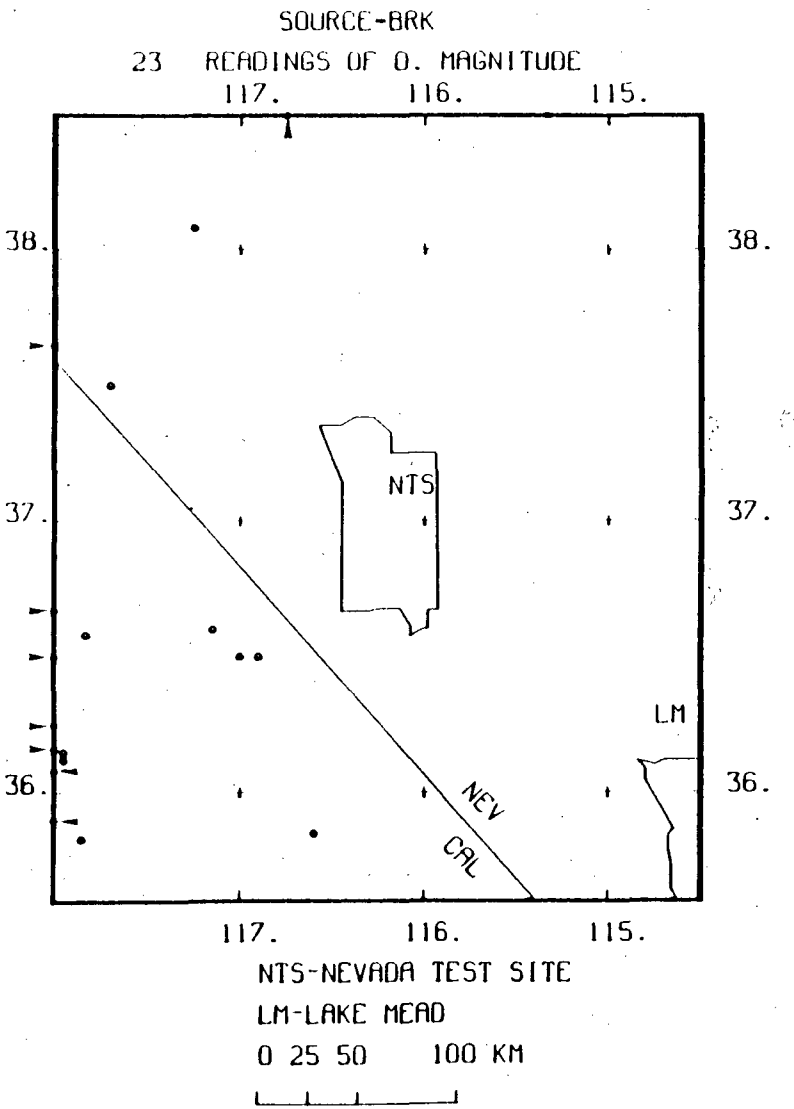
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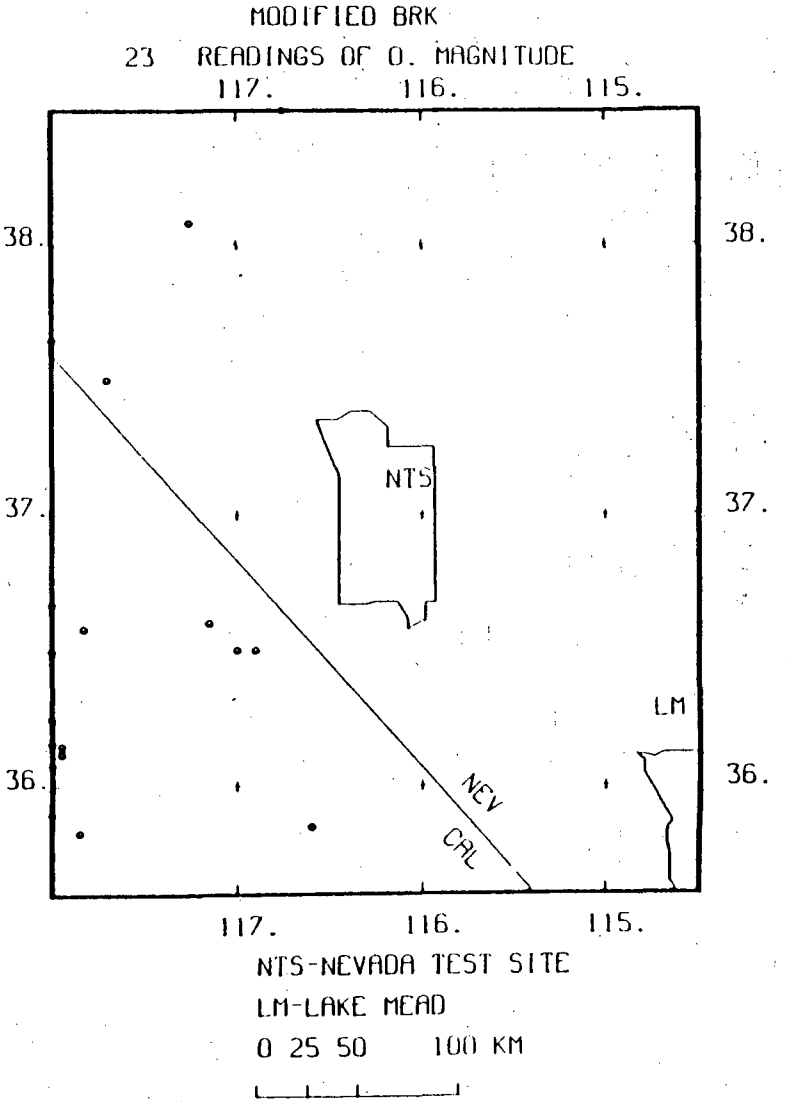
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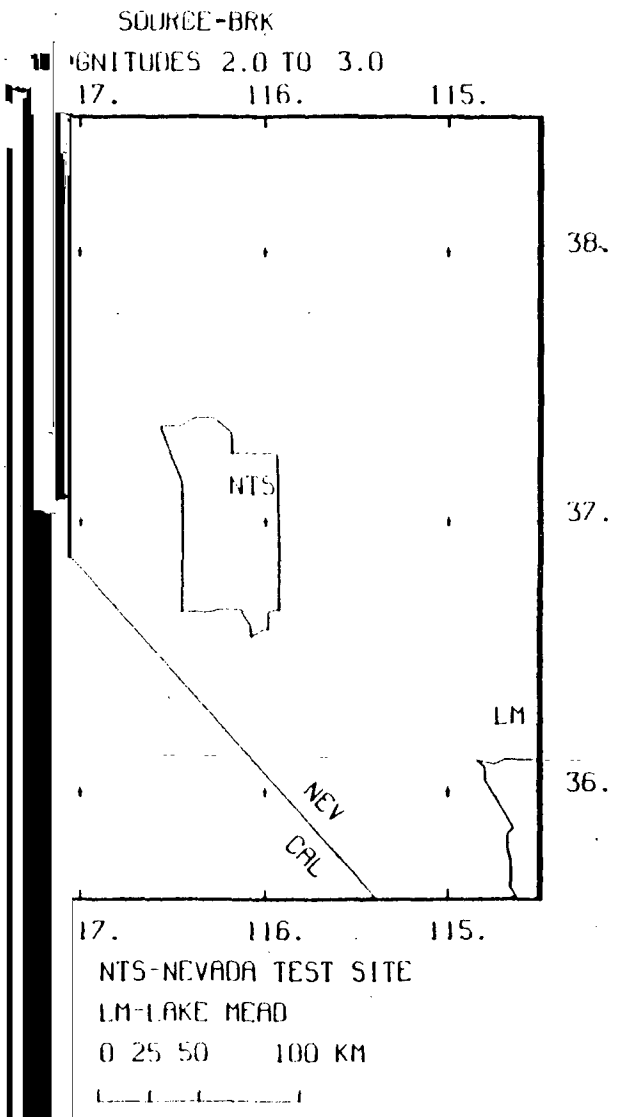
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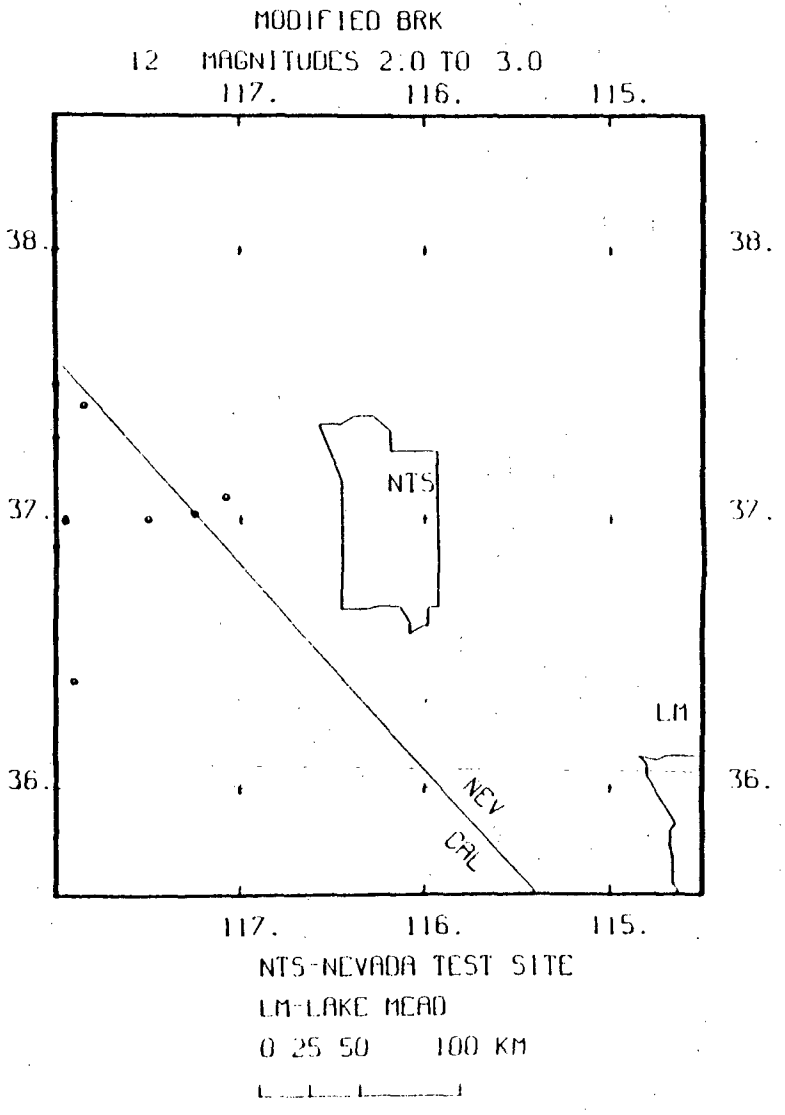
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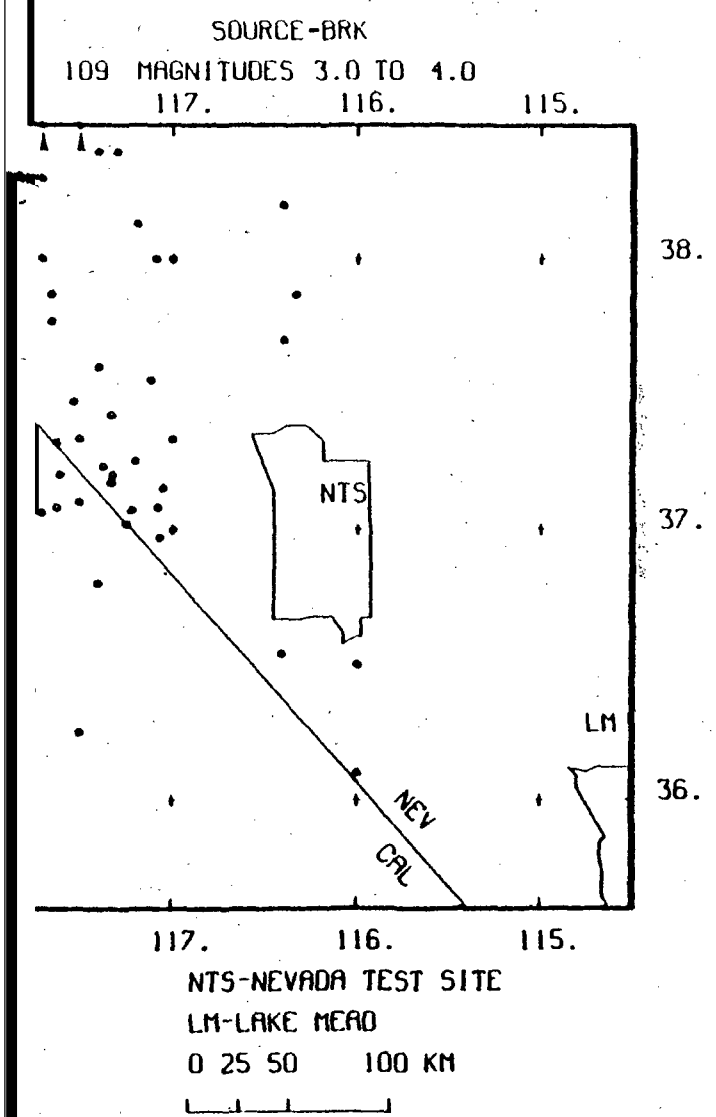
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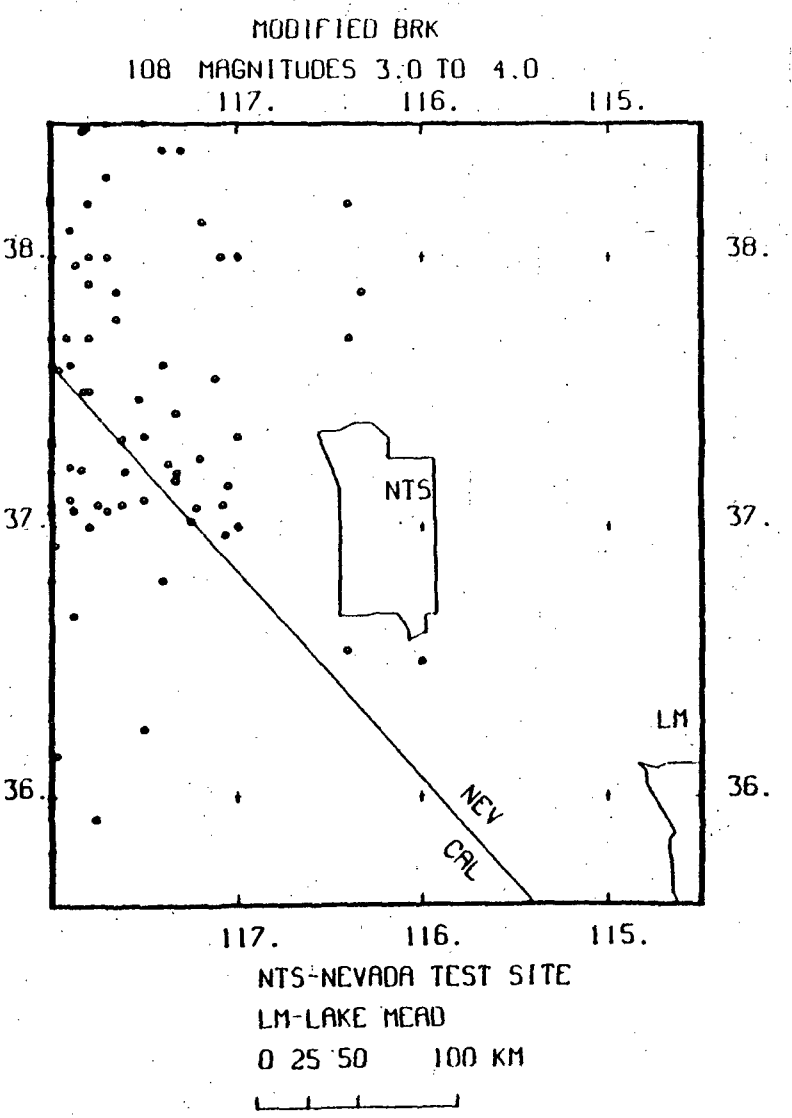
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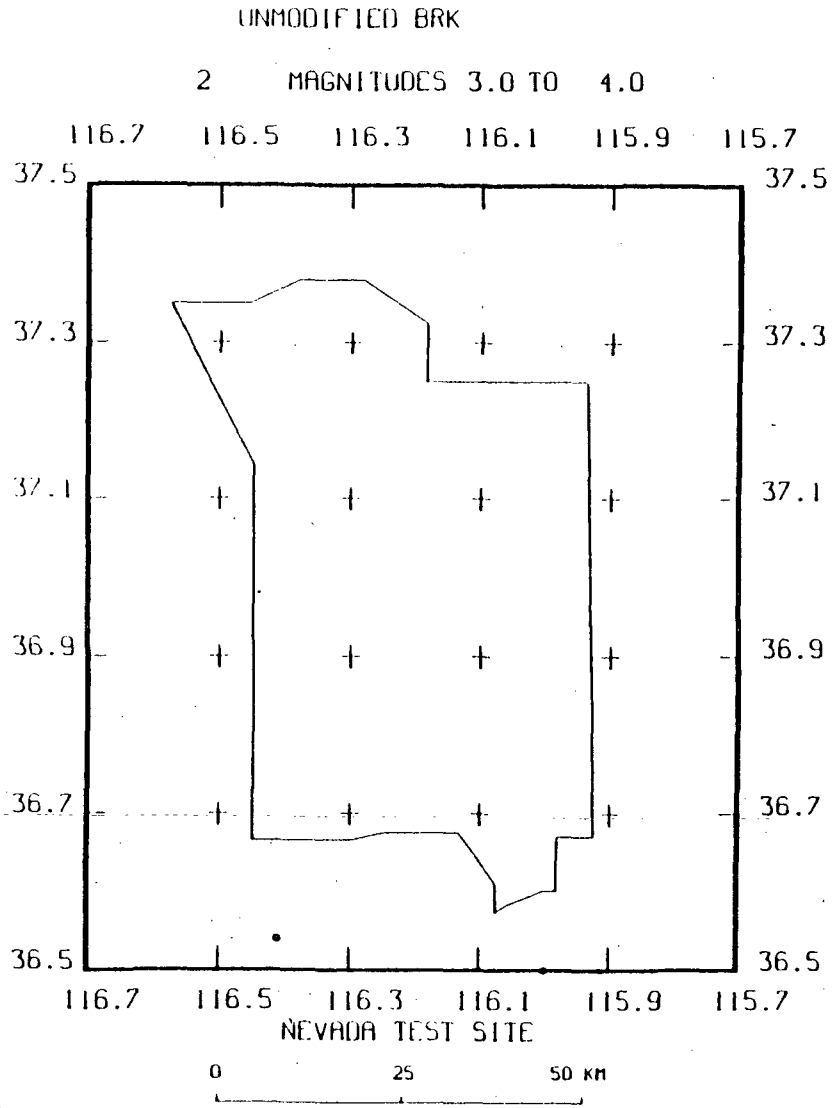
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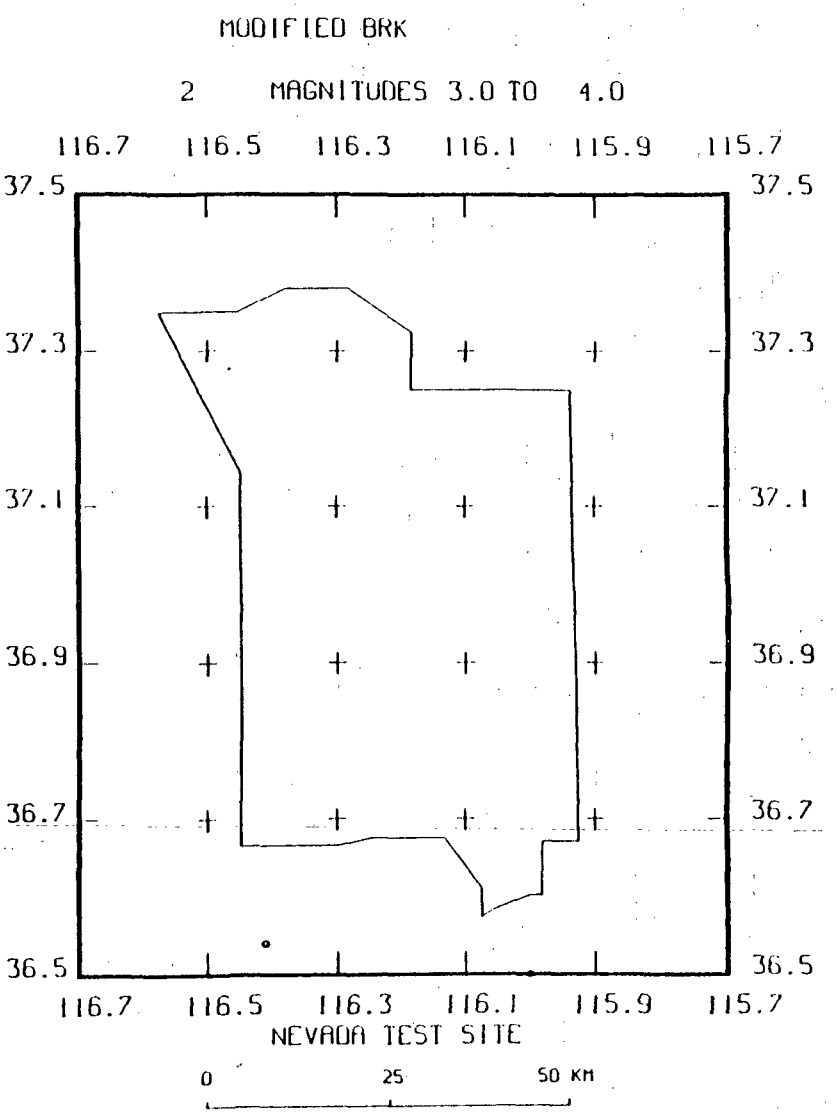
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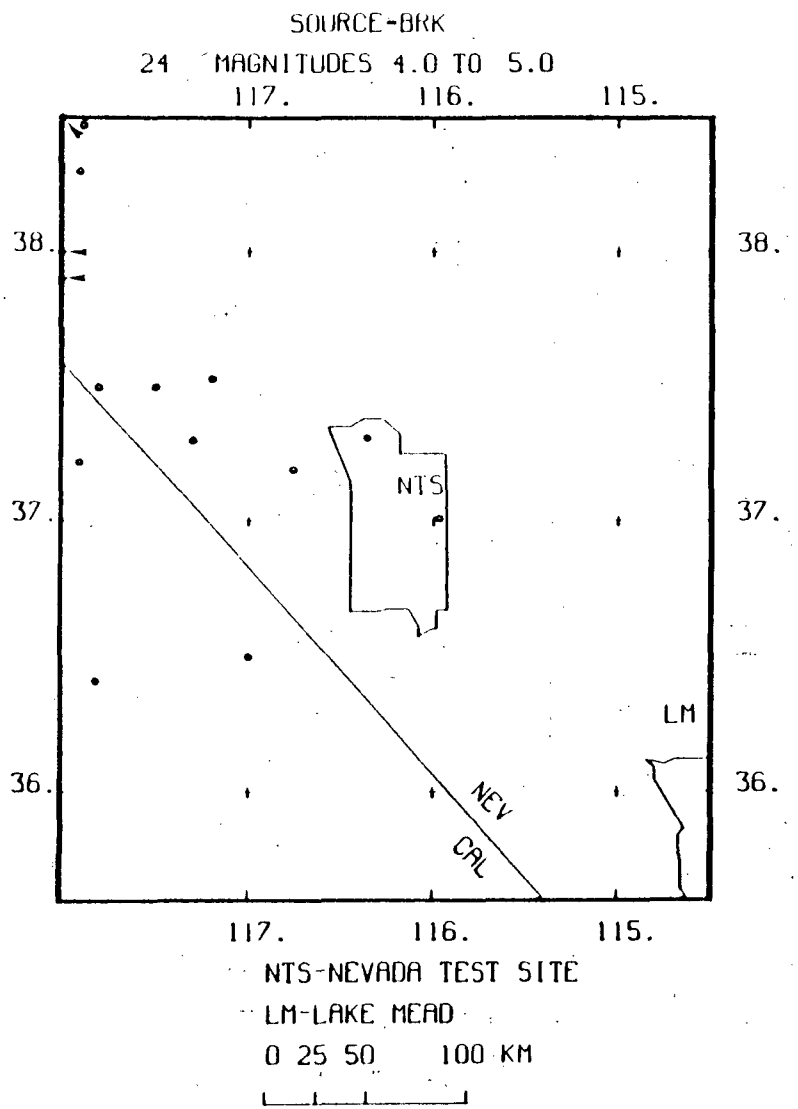
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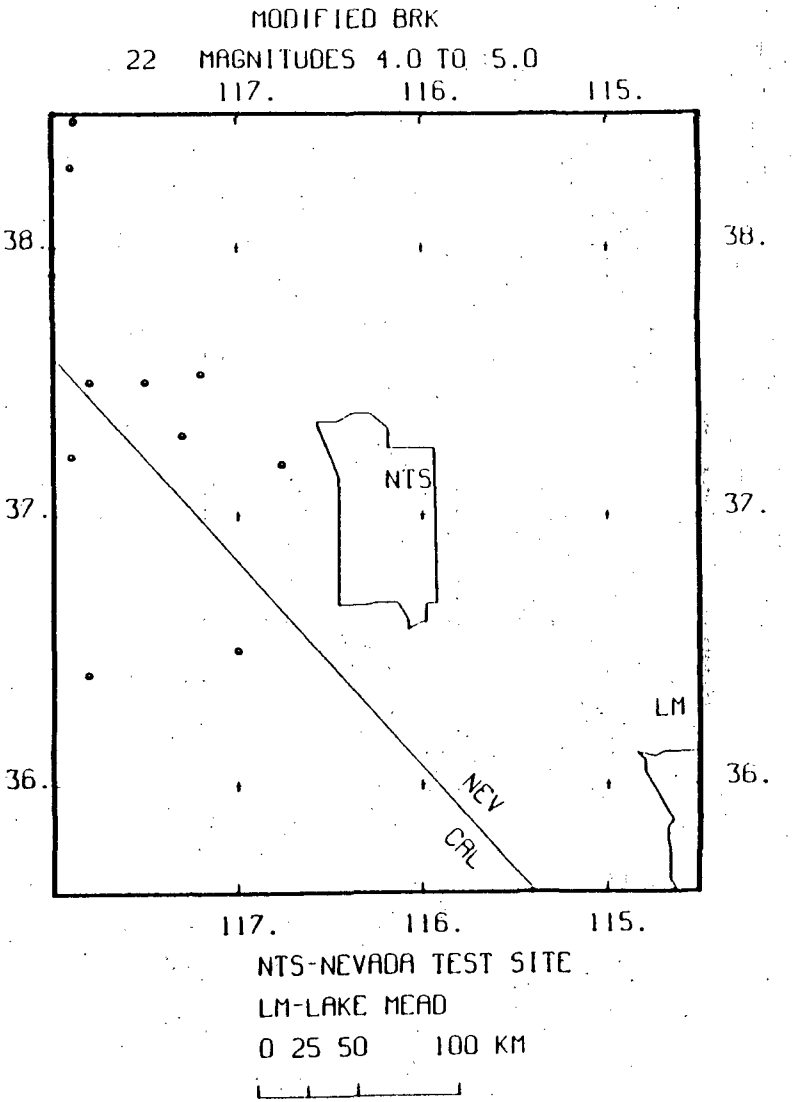
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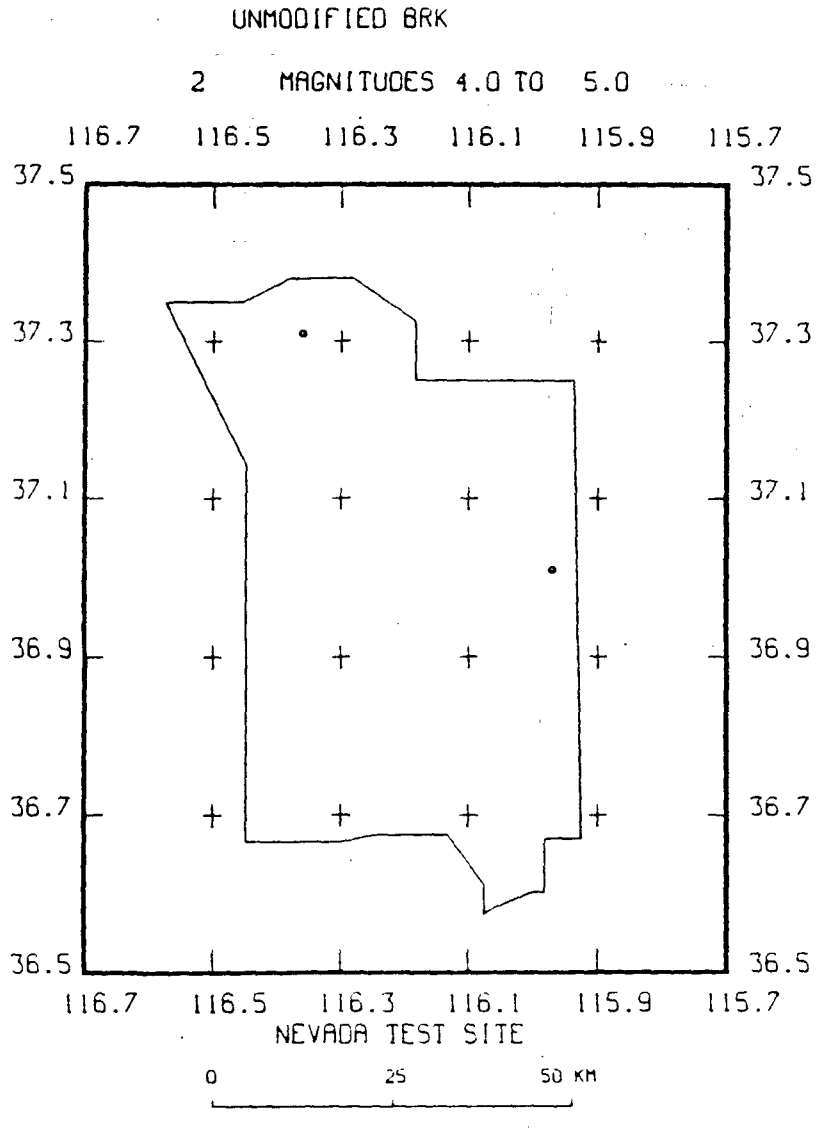
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50 KM

APPENDIX D

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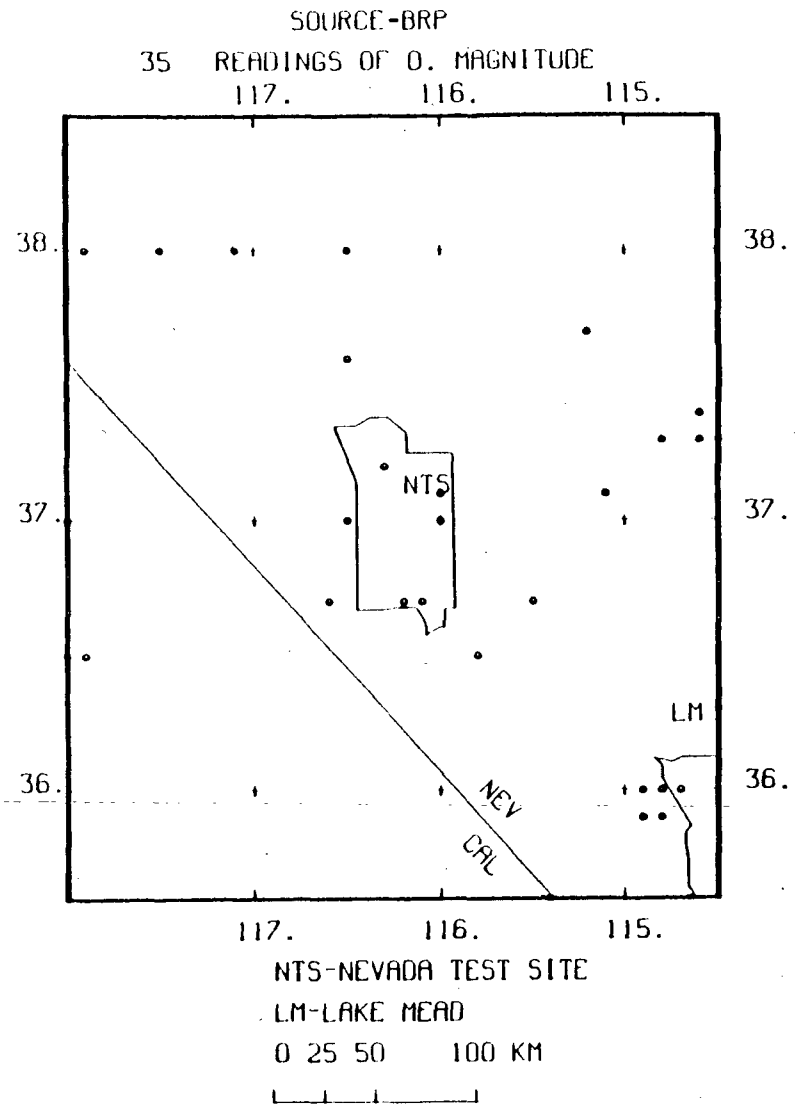
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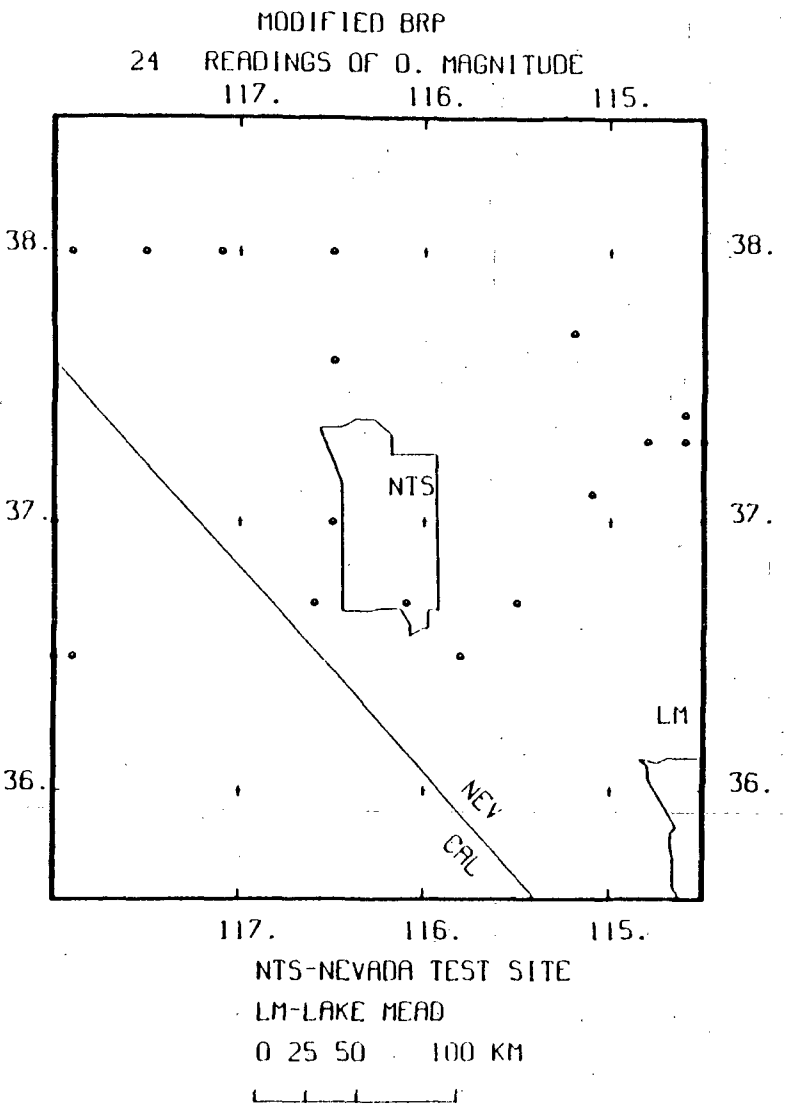
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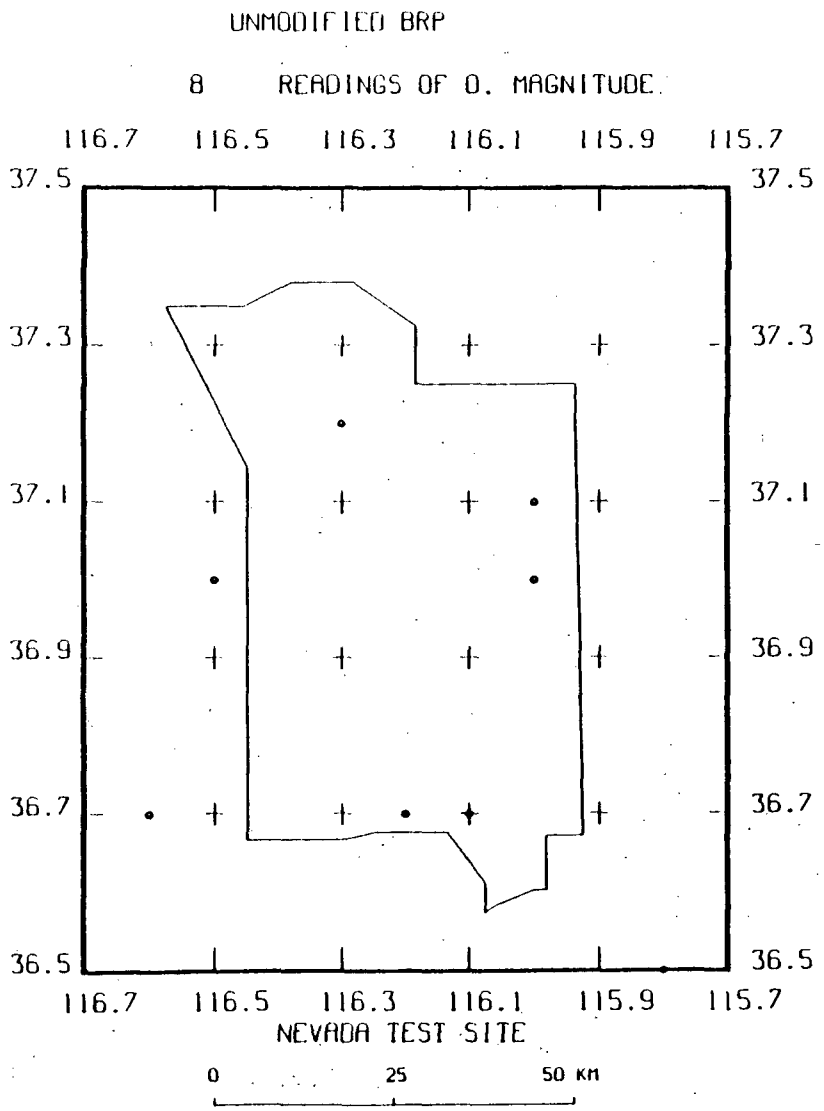
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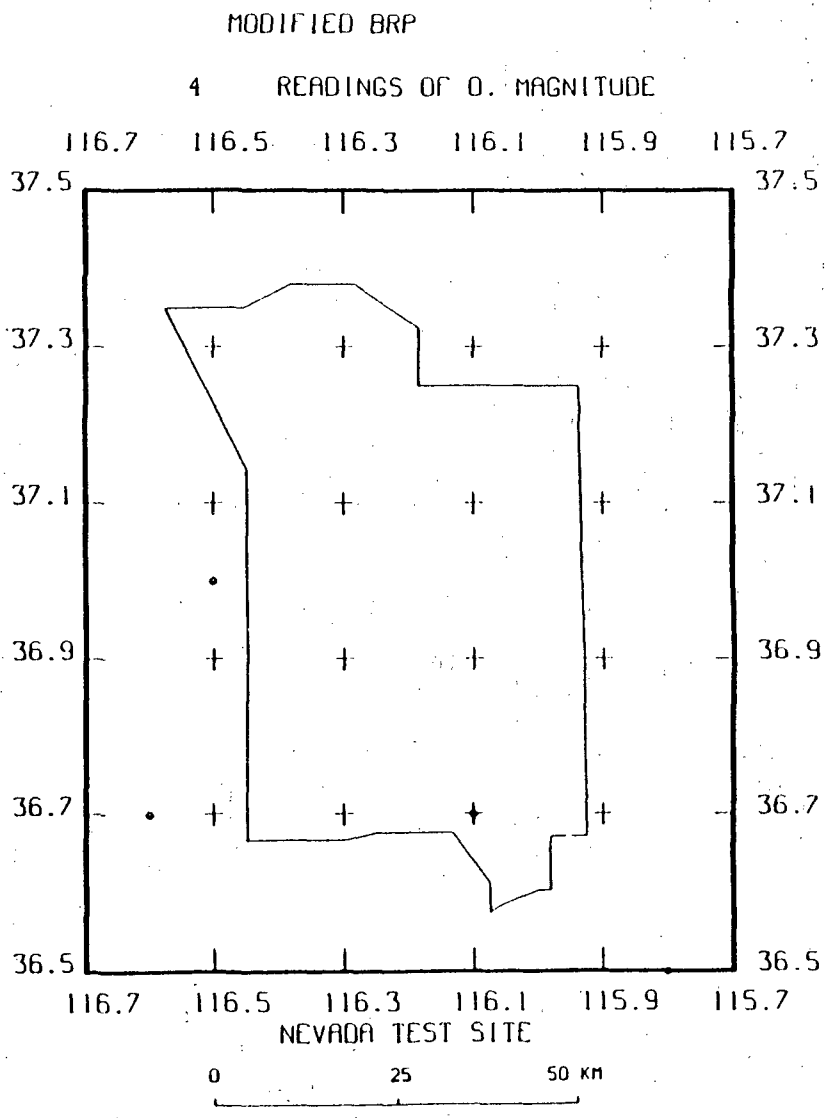
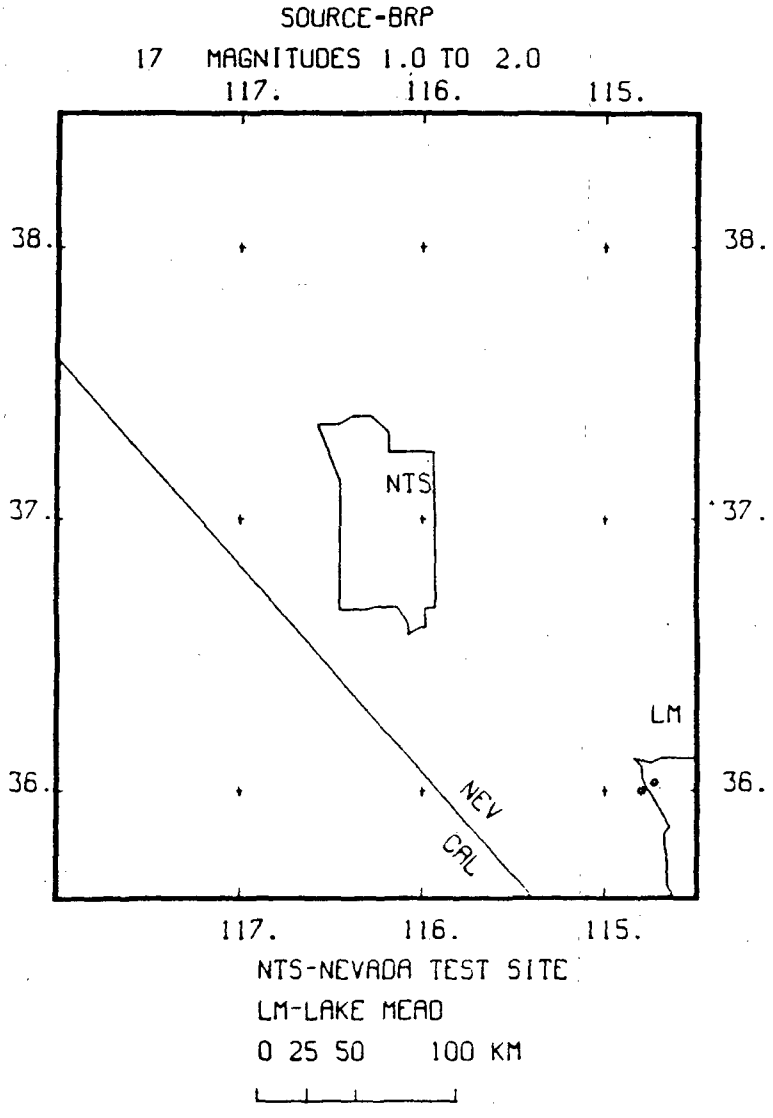
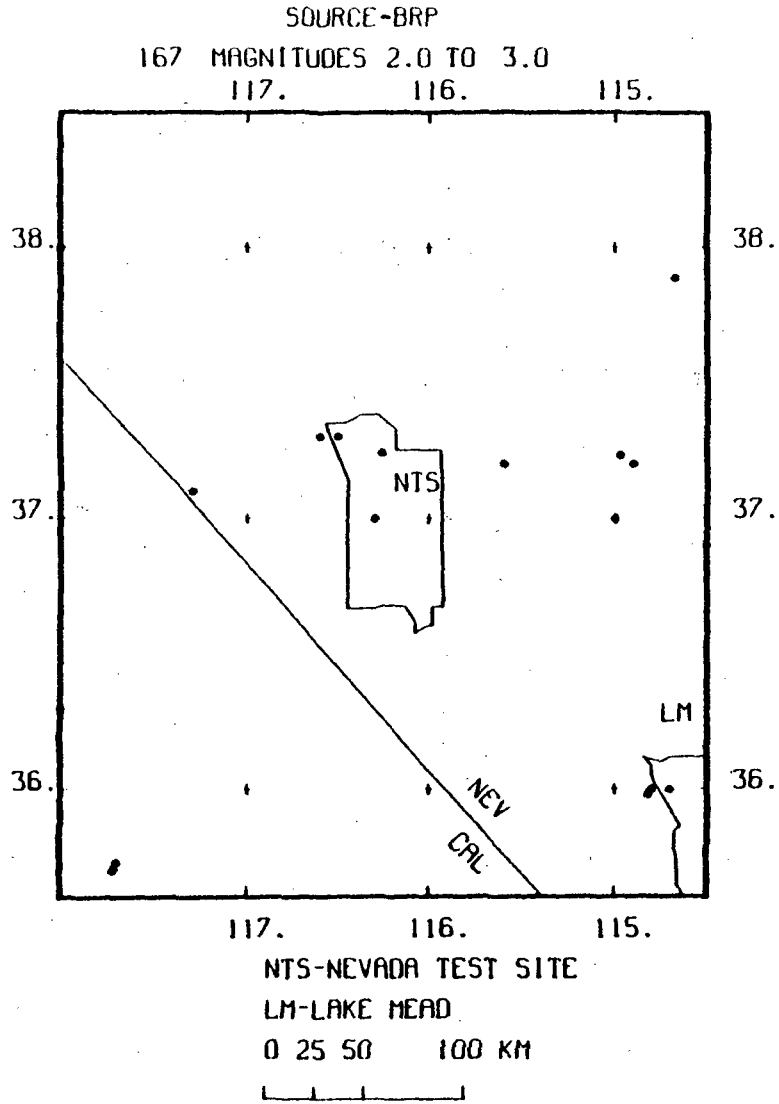
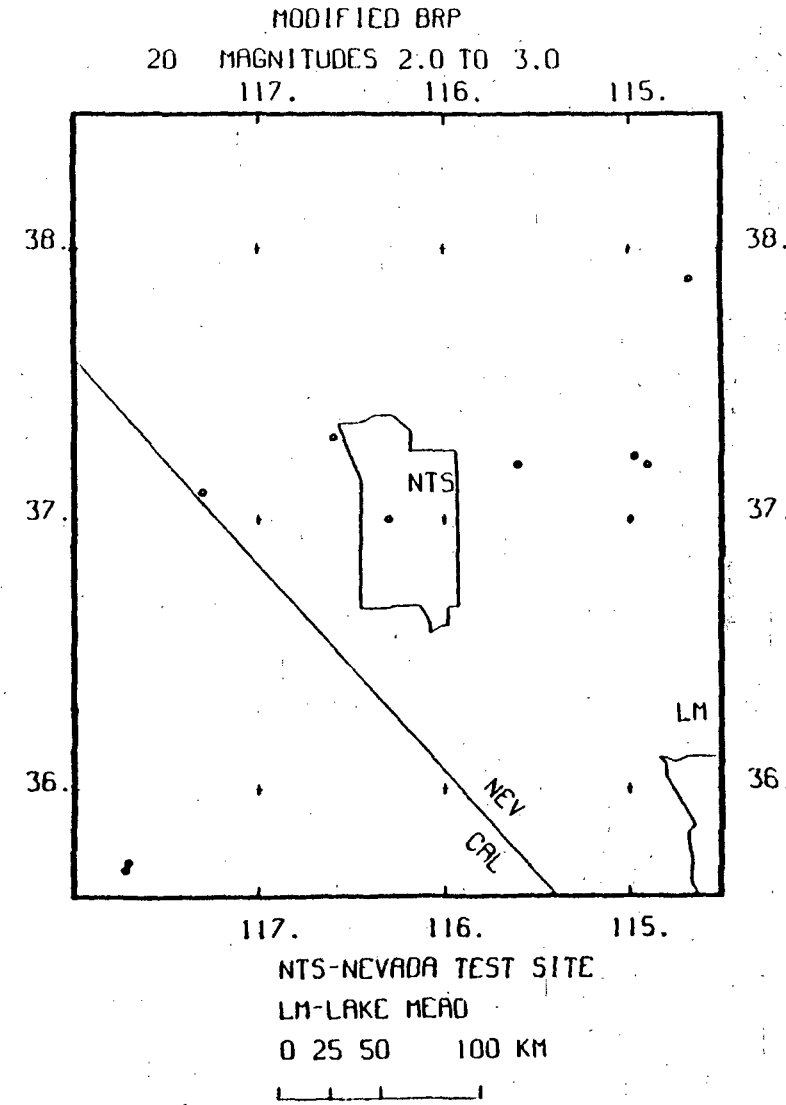
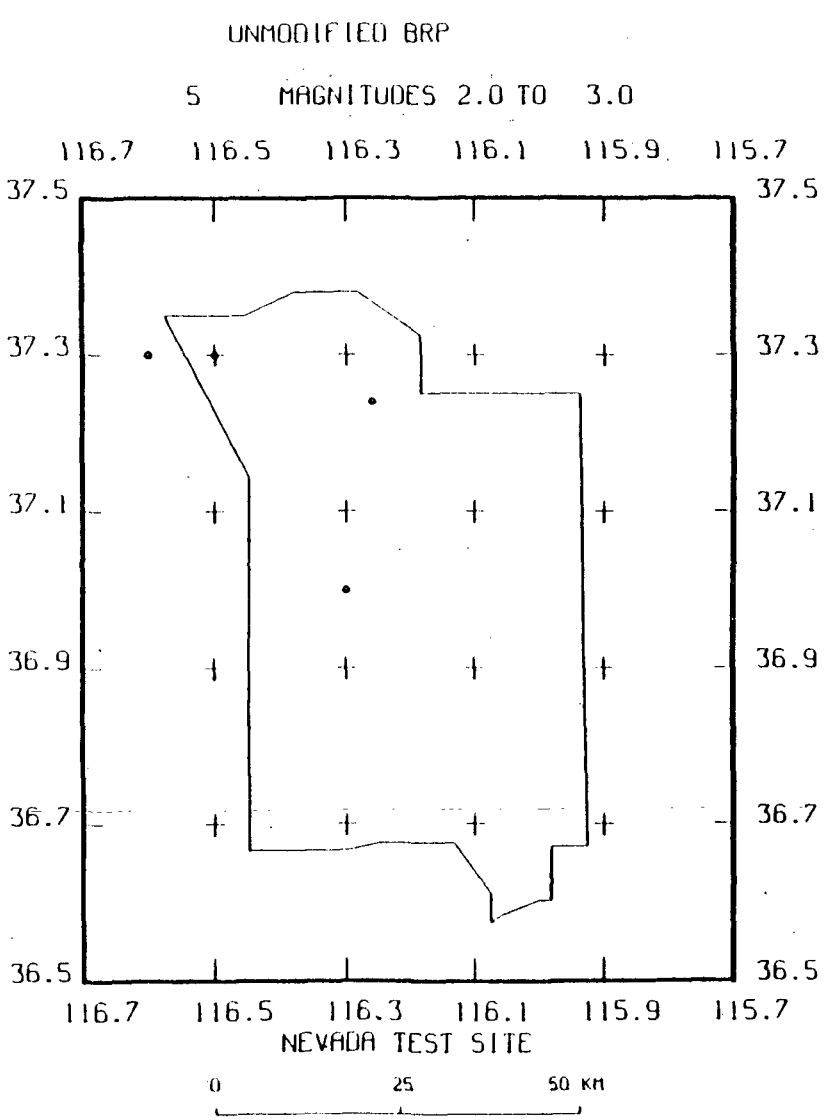
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

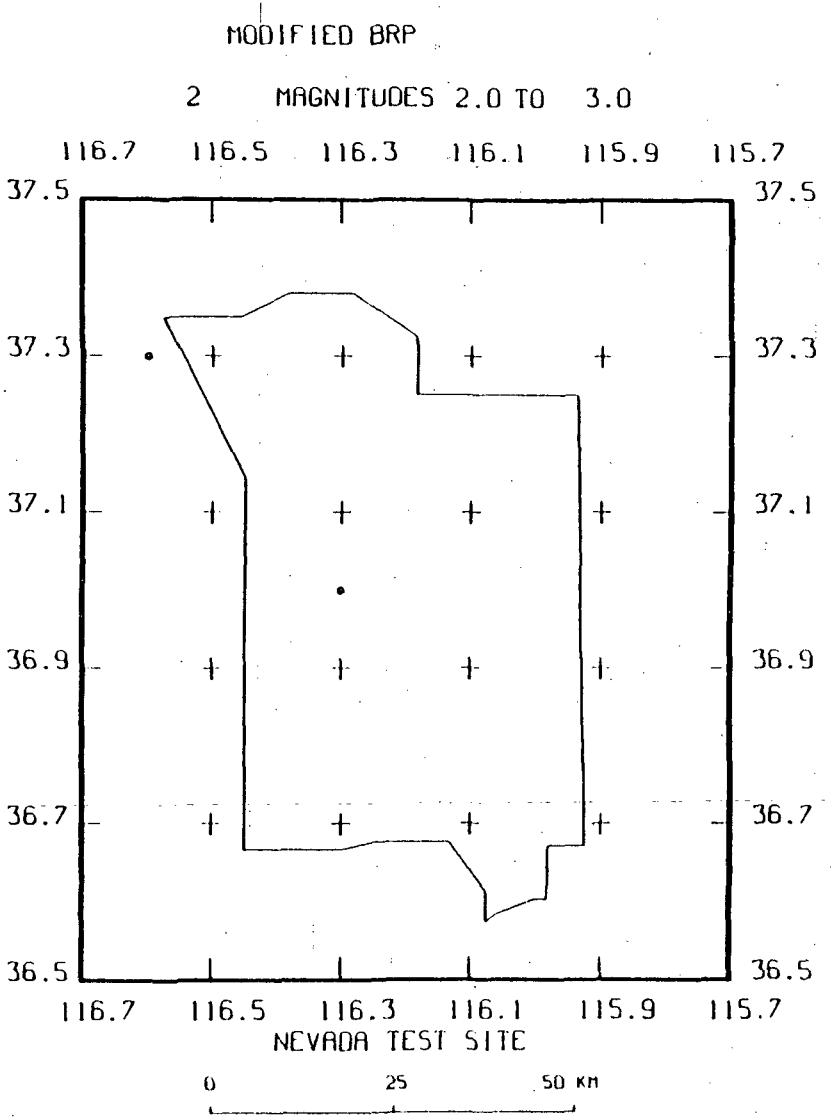

MODIFIED BRP
4 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

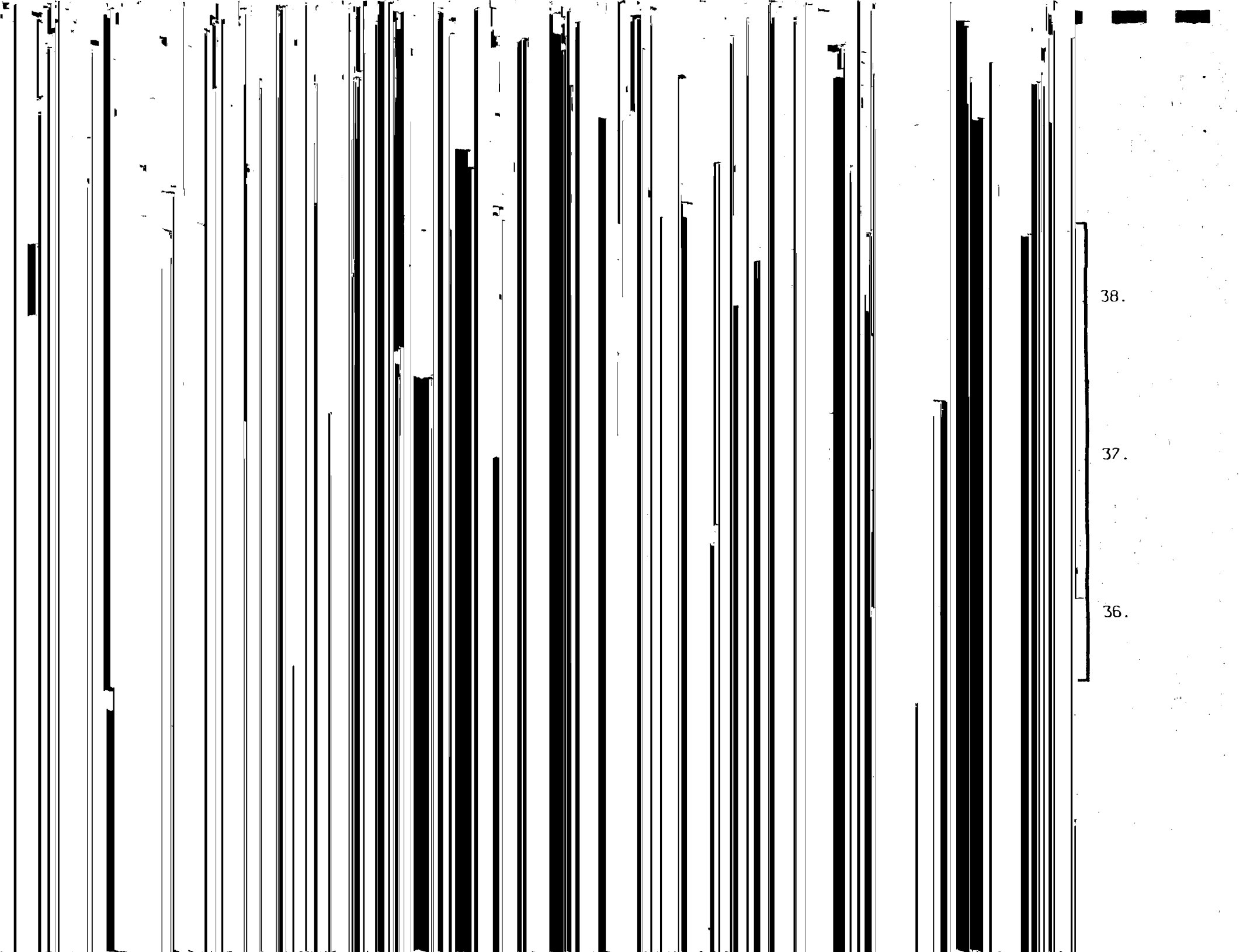

SOURCE-BRP
17 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

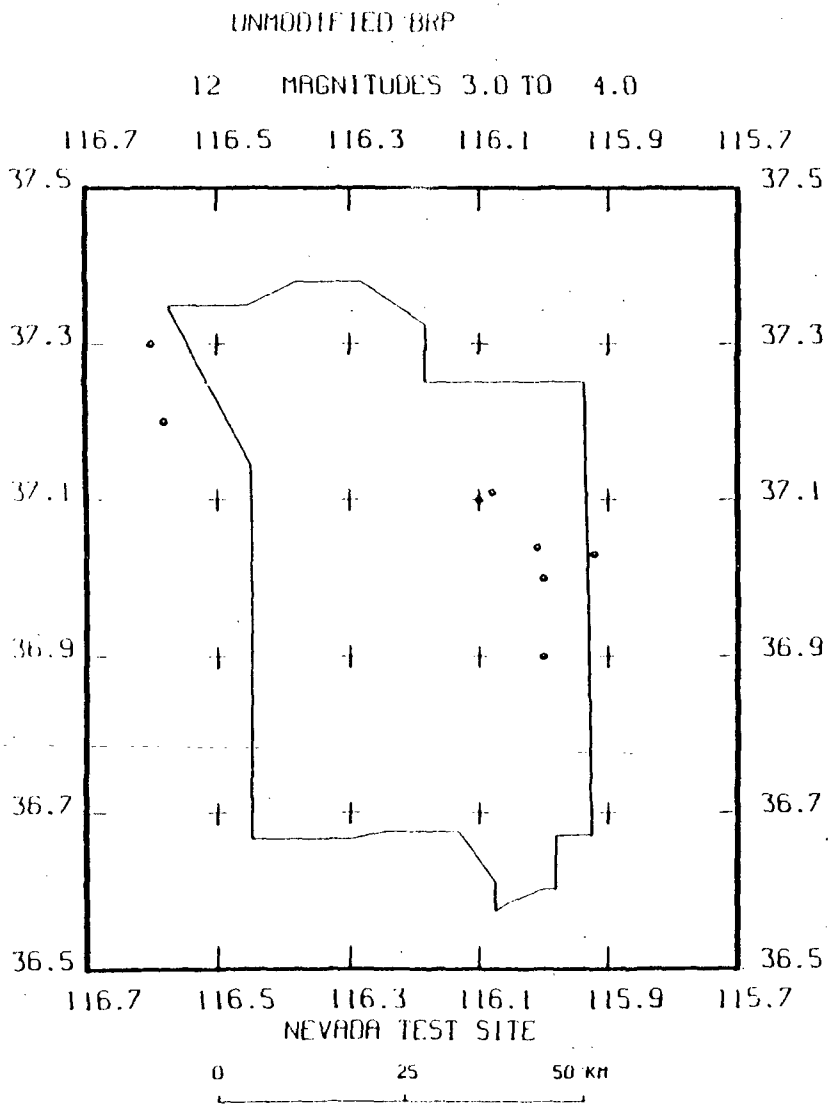

SOURCE-BRP
167 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

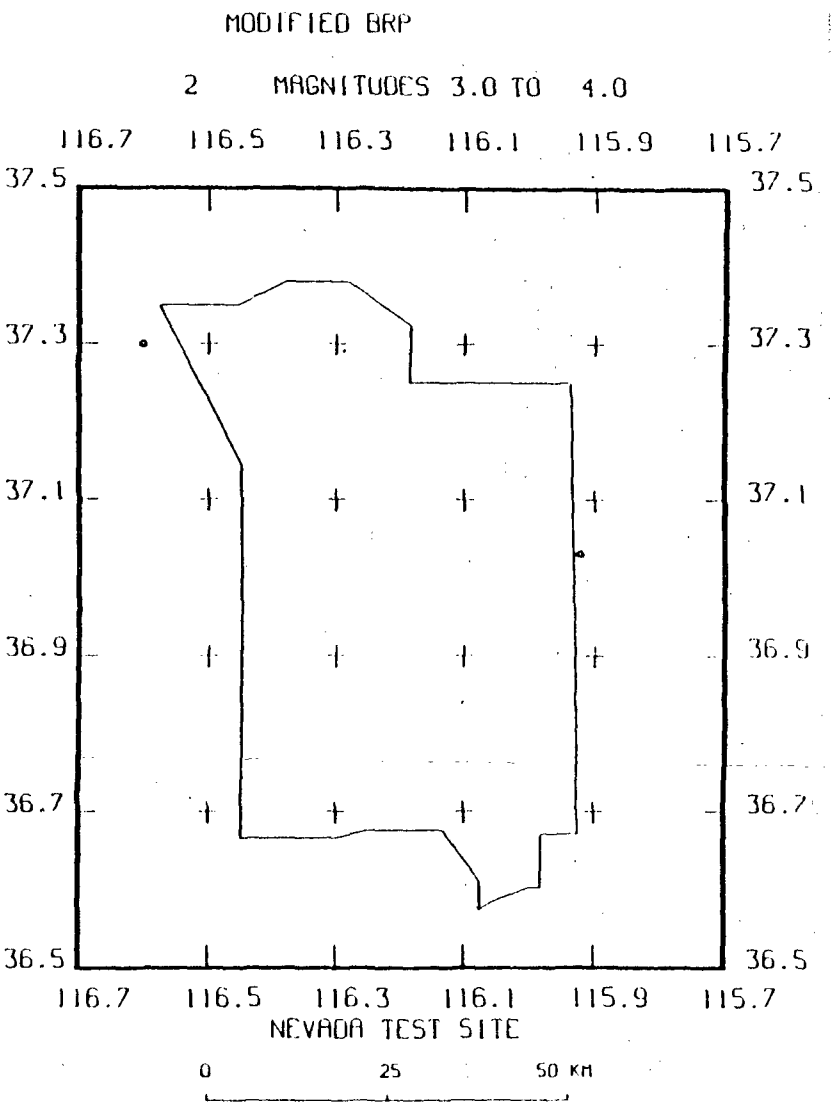

MODIFIED BRP
20 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

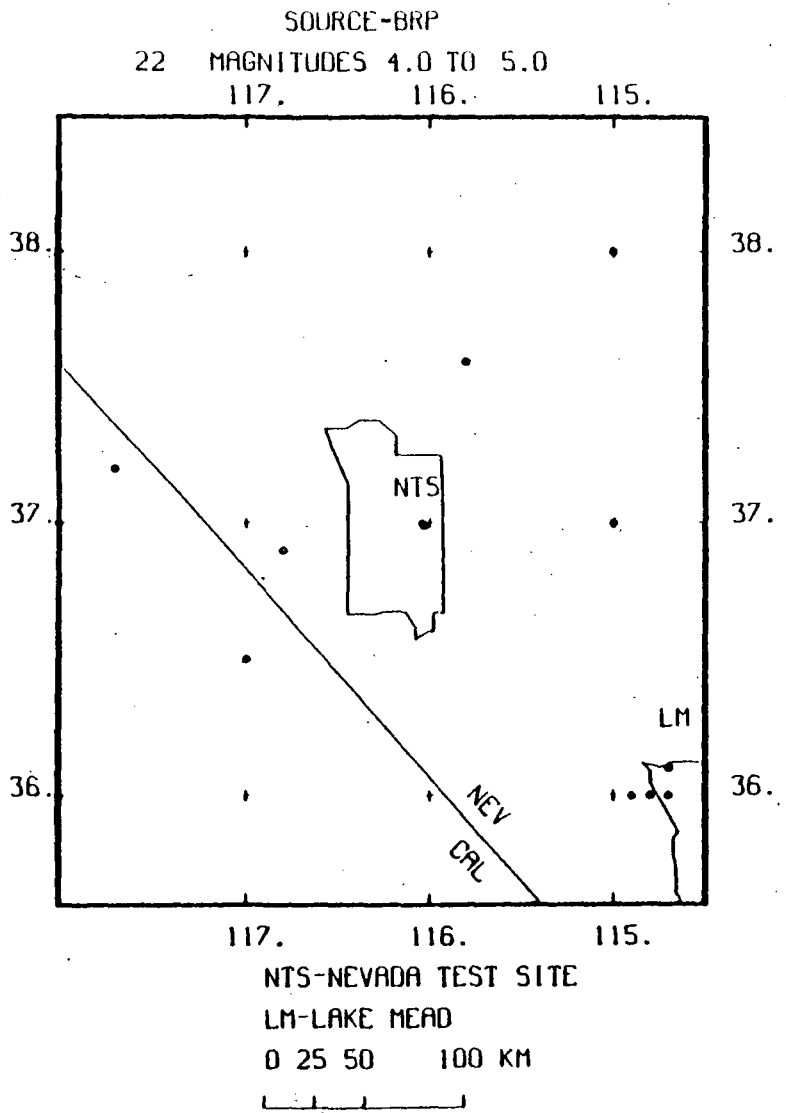

UNMODIFIED BRP
5 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

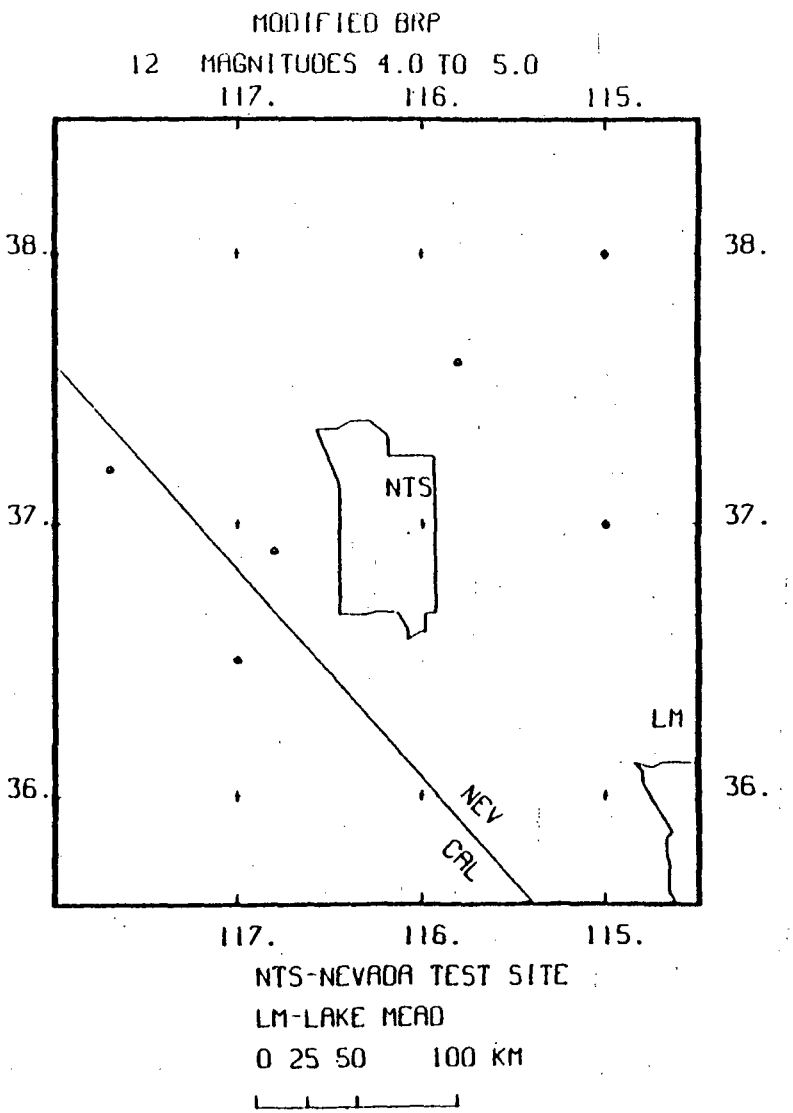

MODIFIED BRP
2 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

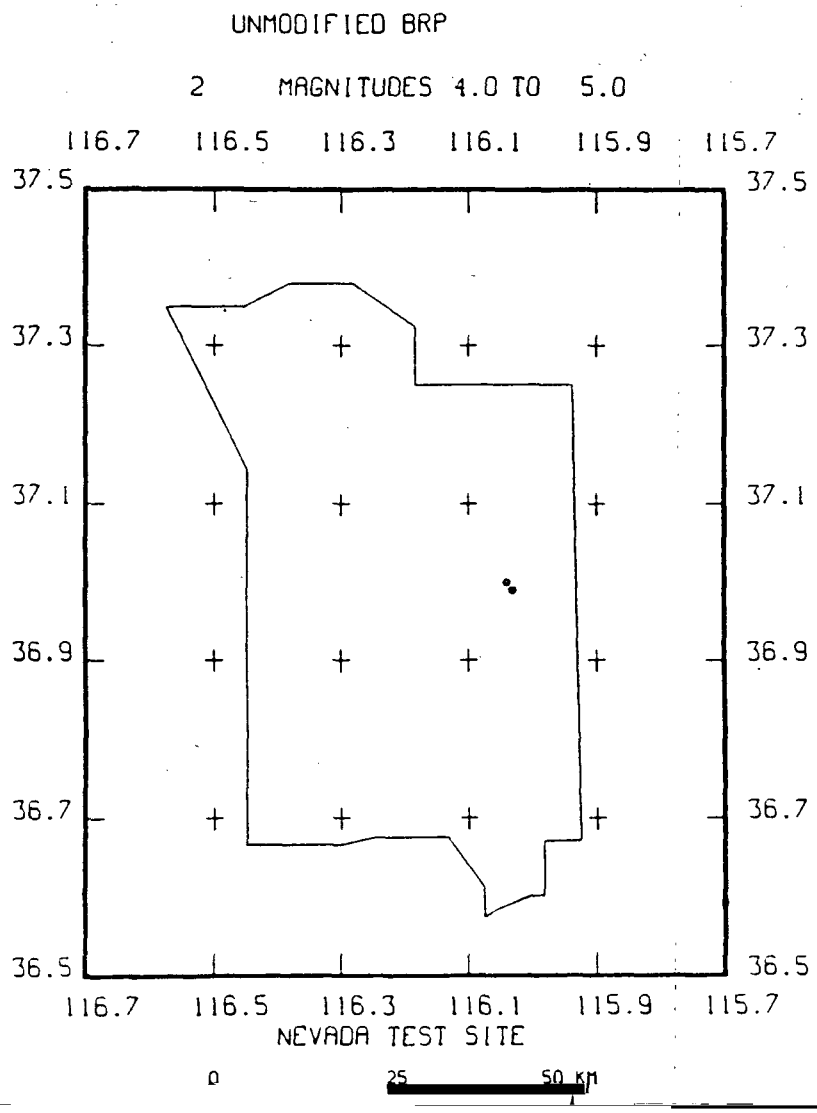

38.
37.
36.

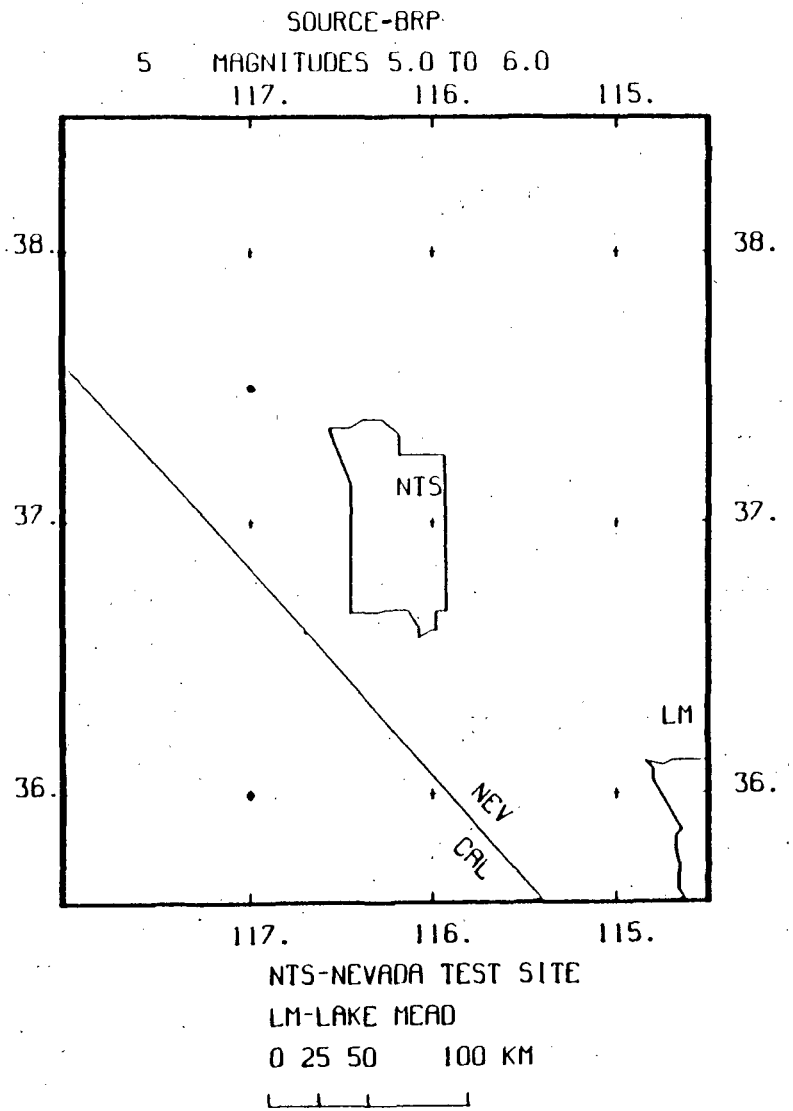

UNMODIFIED BRP
12 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

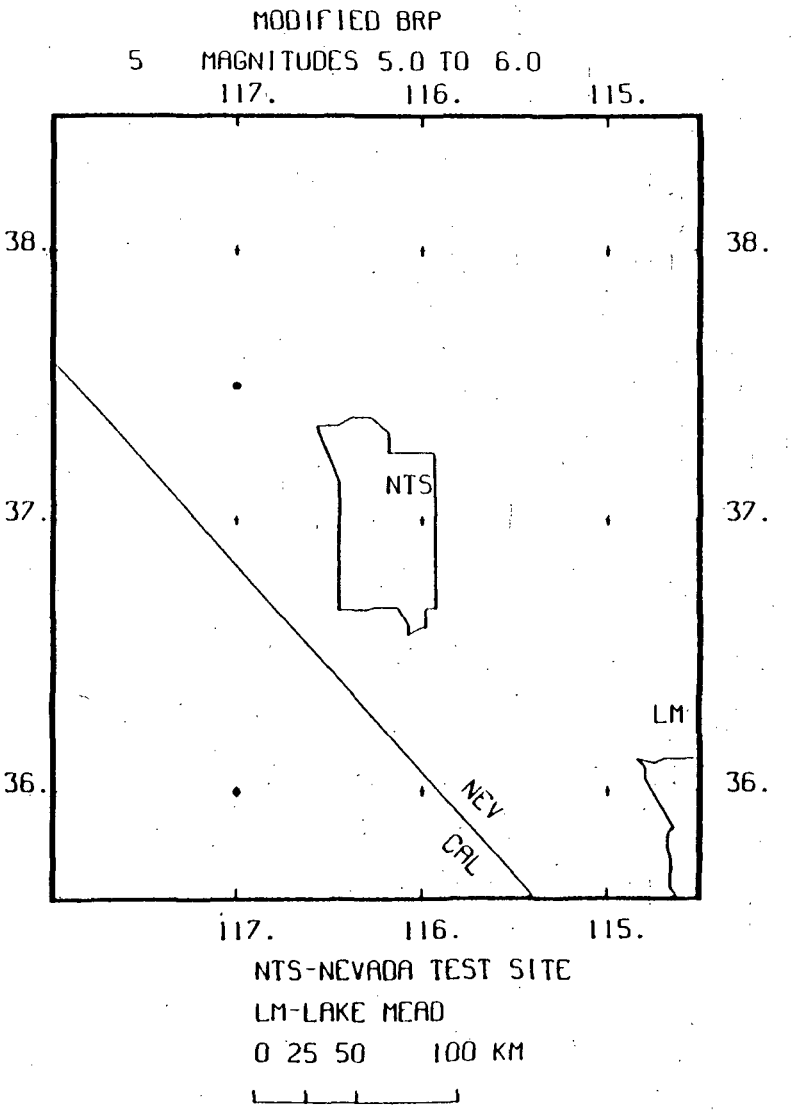

MODIFIED BRP
2 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

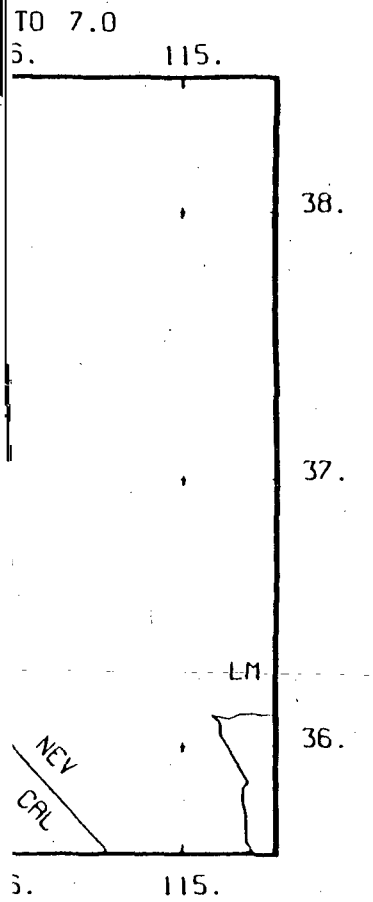

SOURCE-BRP
22 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED BRP
12 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED BRP
2 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM


SOURCE-BRP
5 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED BRP
5 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

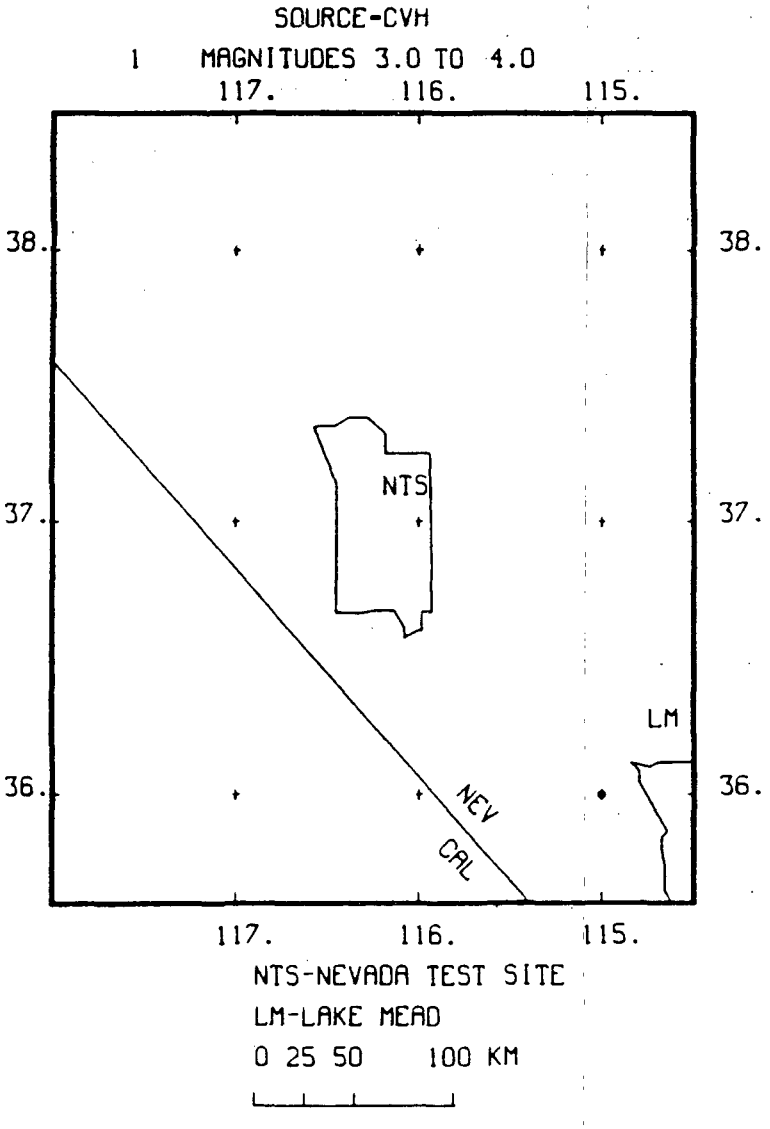


TEST SITE

00 KM

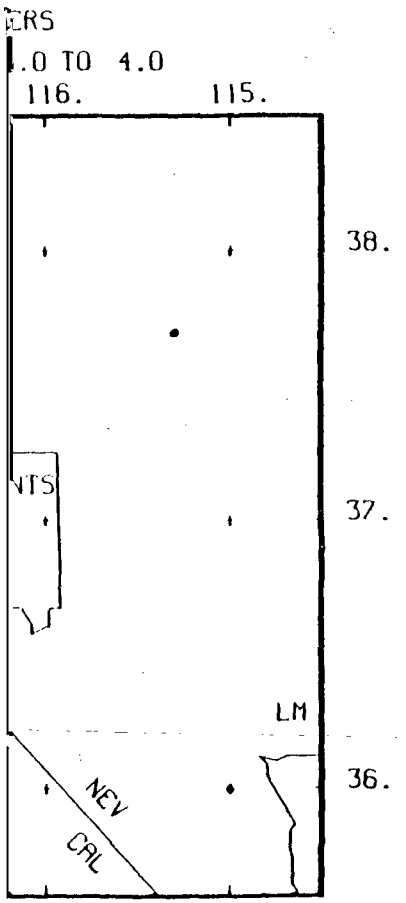
APPENDIX E

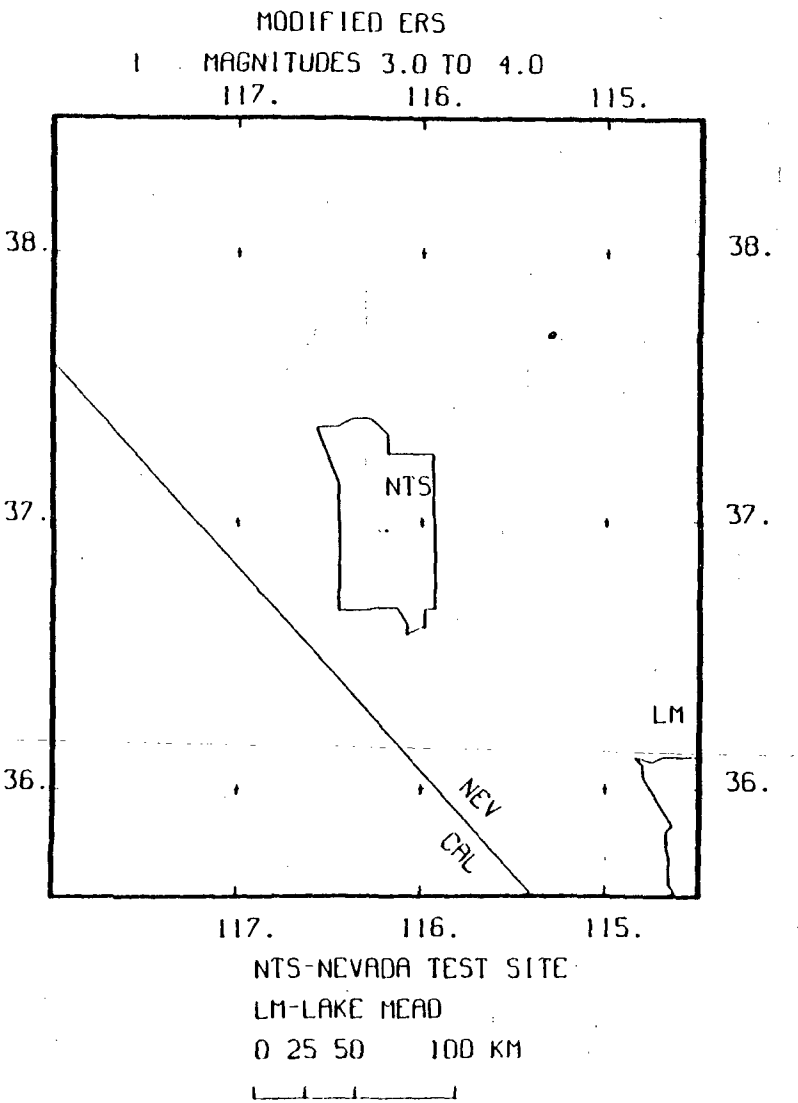
SOURCE - CVH


SOURCE-CVH
1 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

APPENDIX F

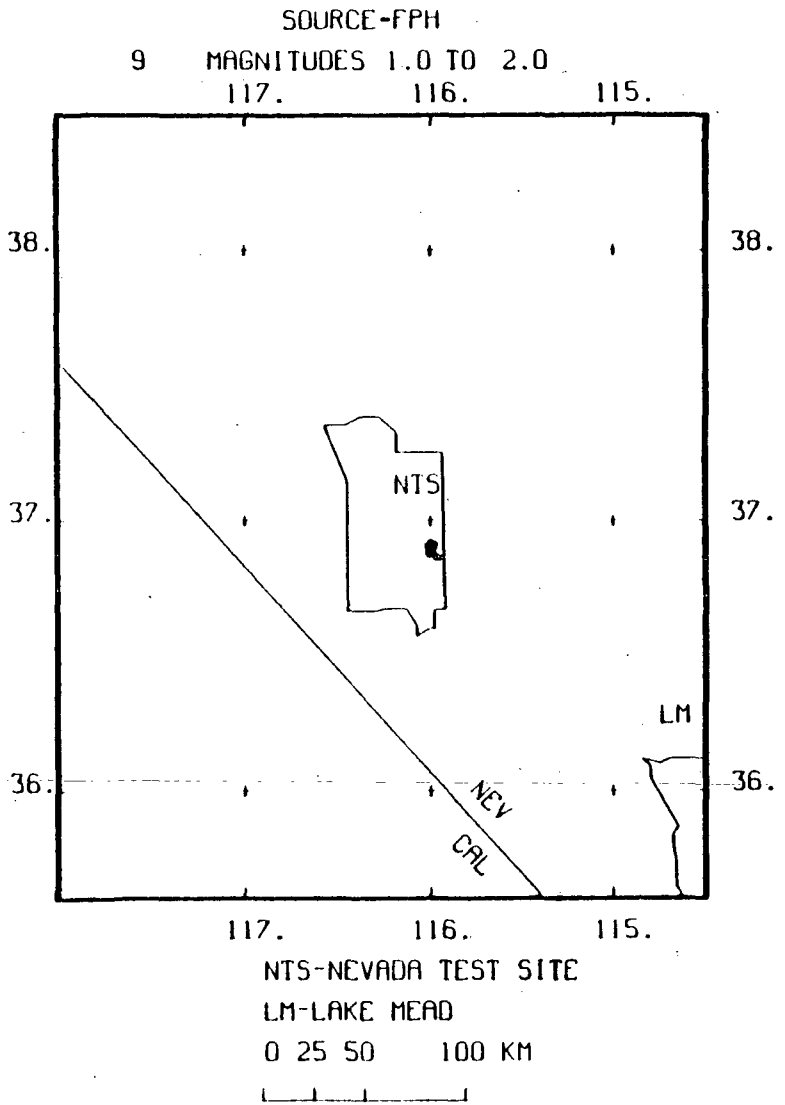
SOURCE - ERS

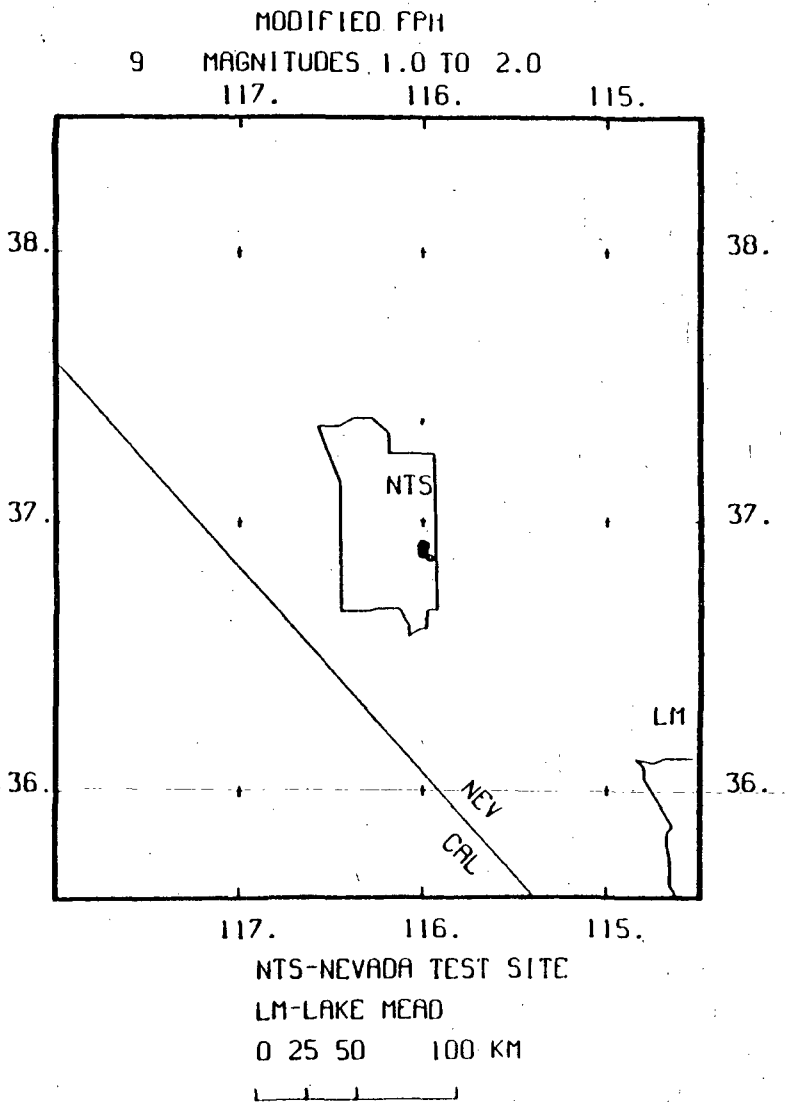

ERS
.0 TO 4.0
116.
115.
38.
37.
NTS
LM
36.
NEV
CAL
116.
115.
DA TEST SITE
MEAD
100 KM


MODIFIED ERS
MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
NTS
LM
36.
NEV
CAL
117.
116.
115.
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

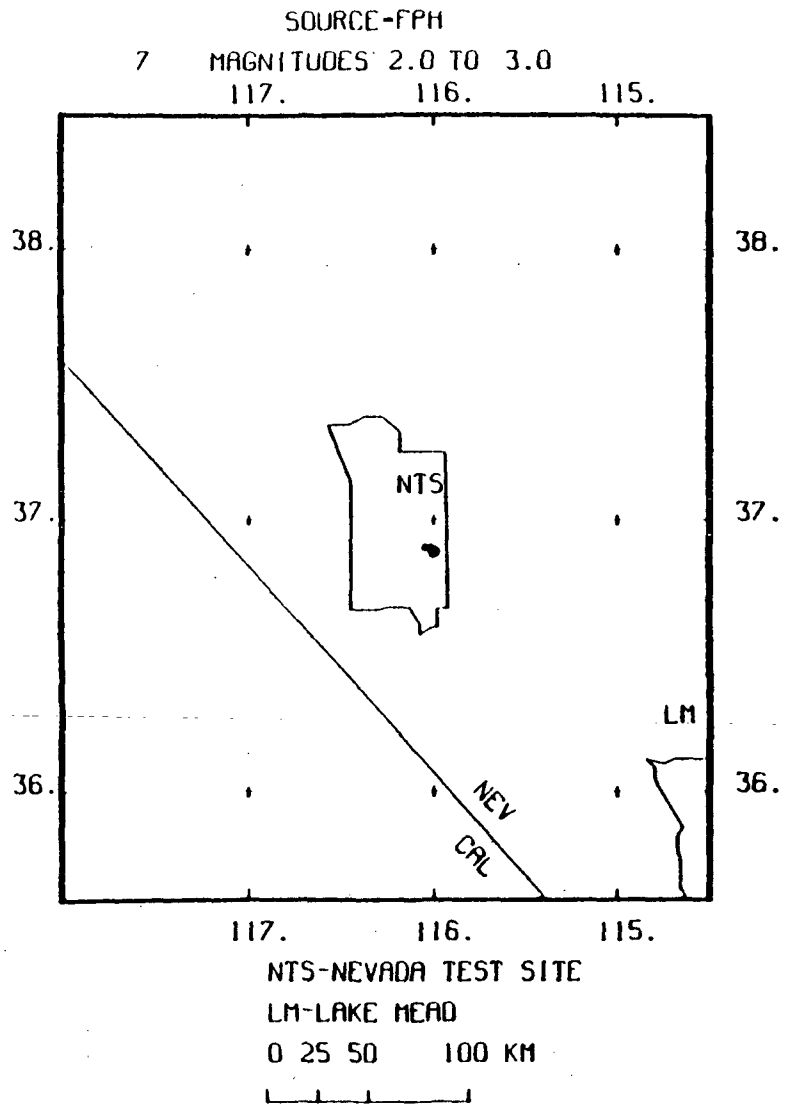
APPENDIX G

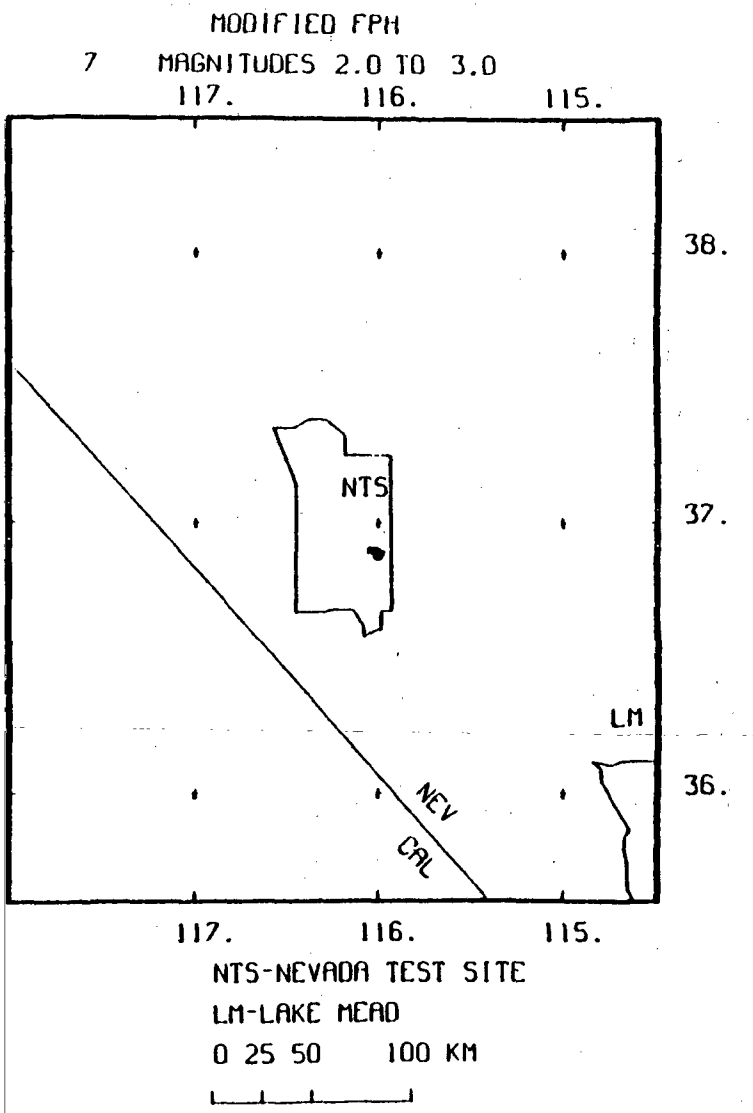
SOURCE - FPH

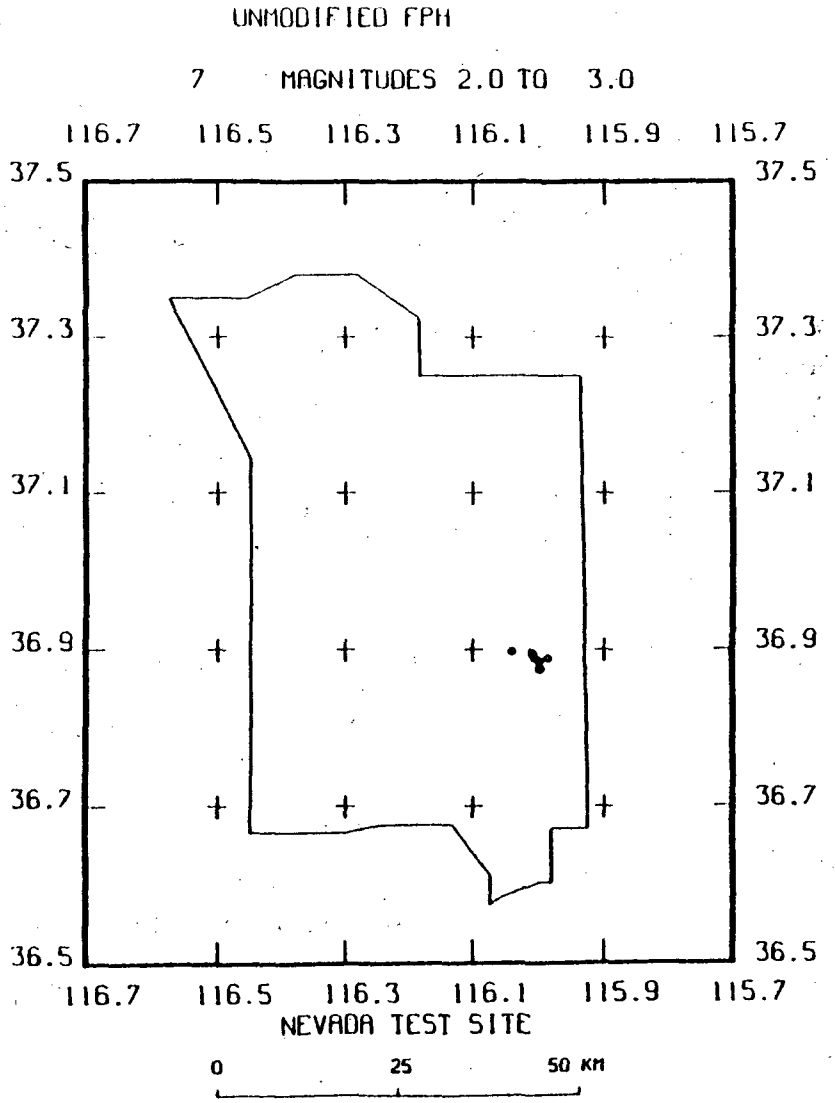

SOURCE-FPH
9 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

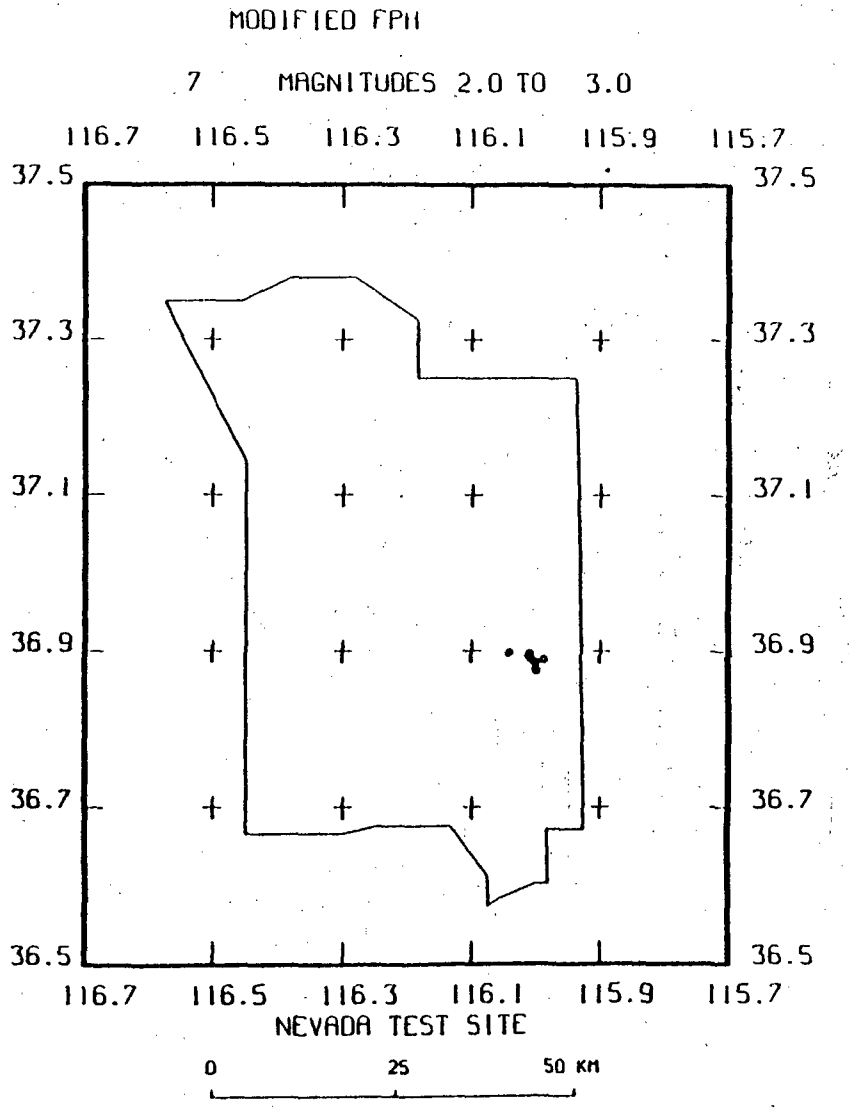

MODIFIED FPH
9 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

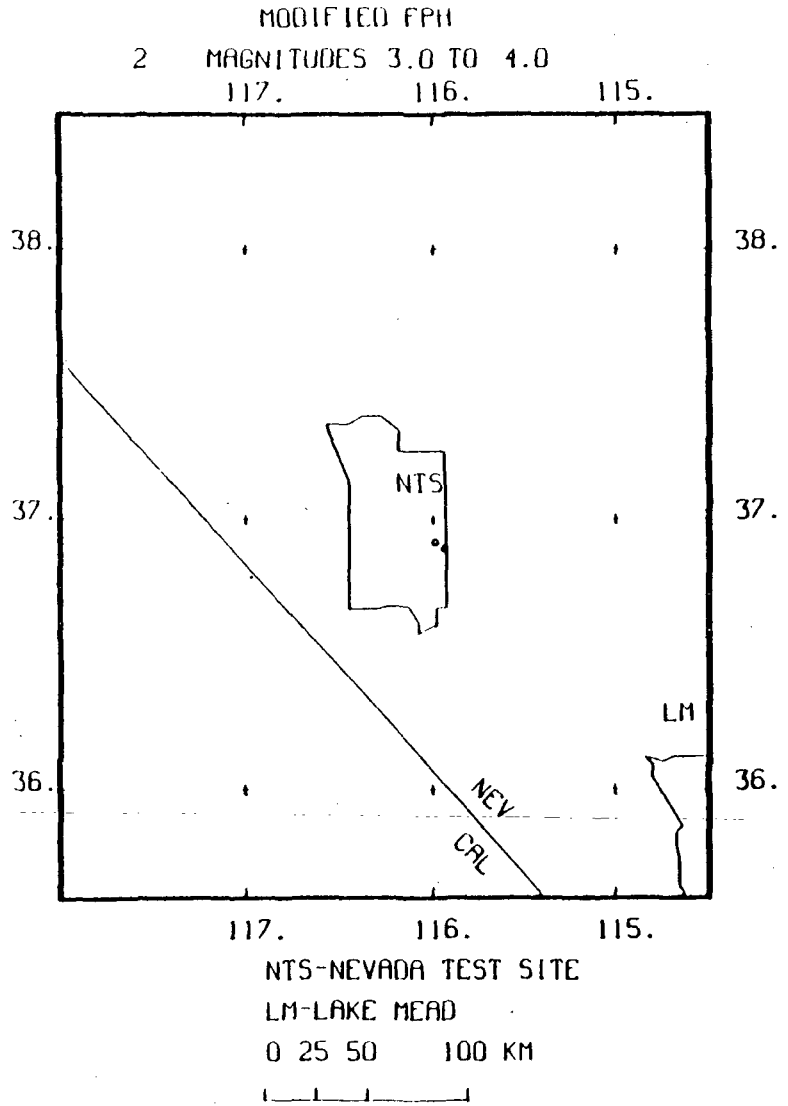

115.7
37.5
37.3
37.1
36.9
36.7
36.5
115.7

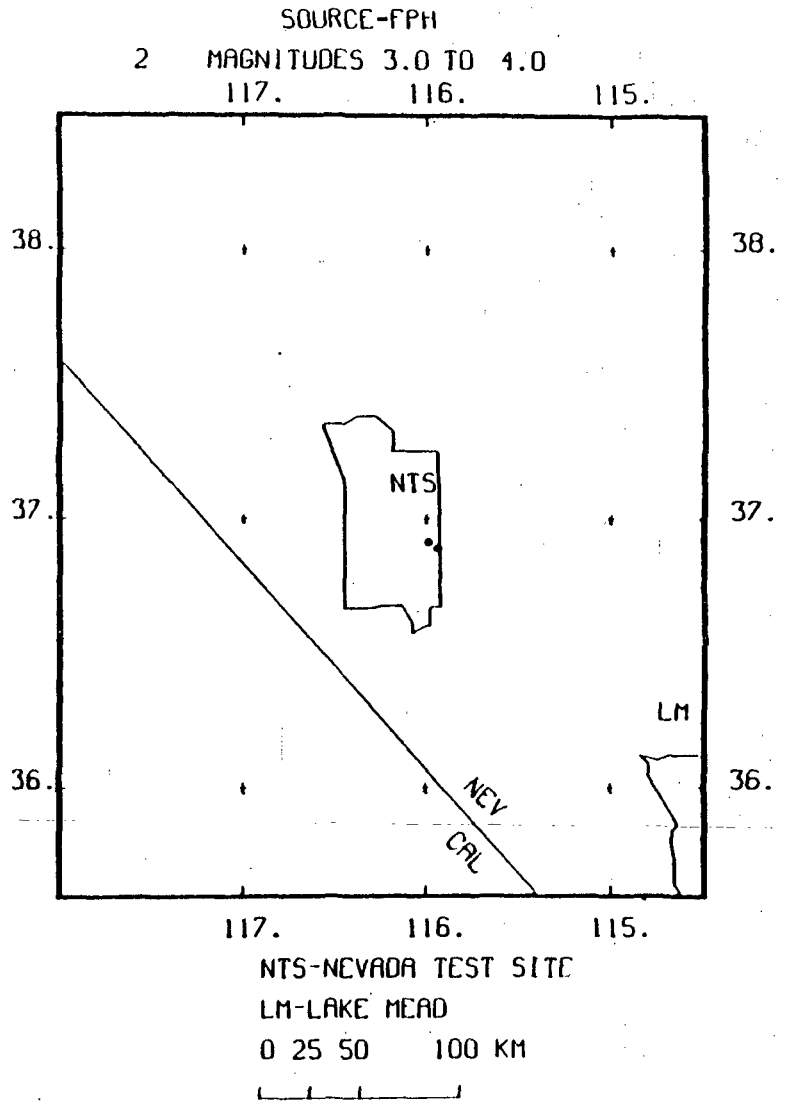

SOURCE-FPH
7 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

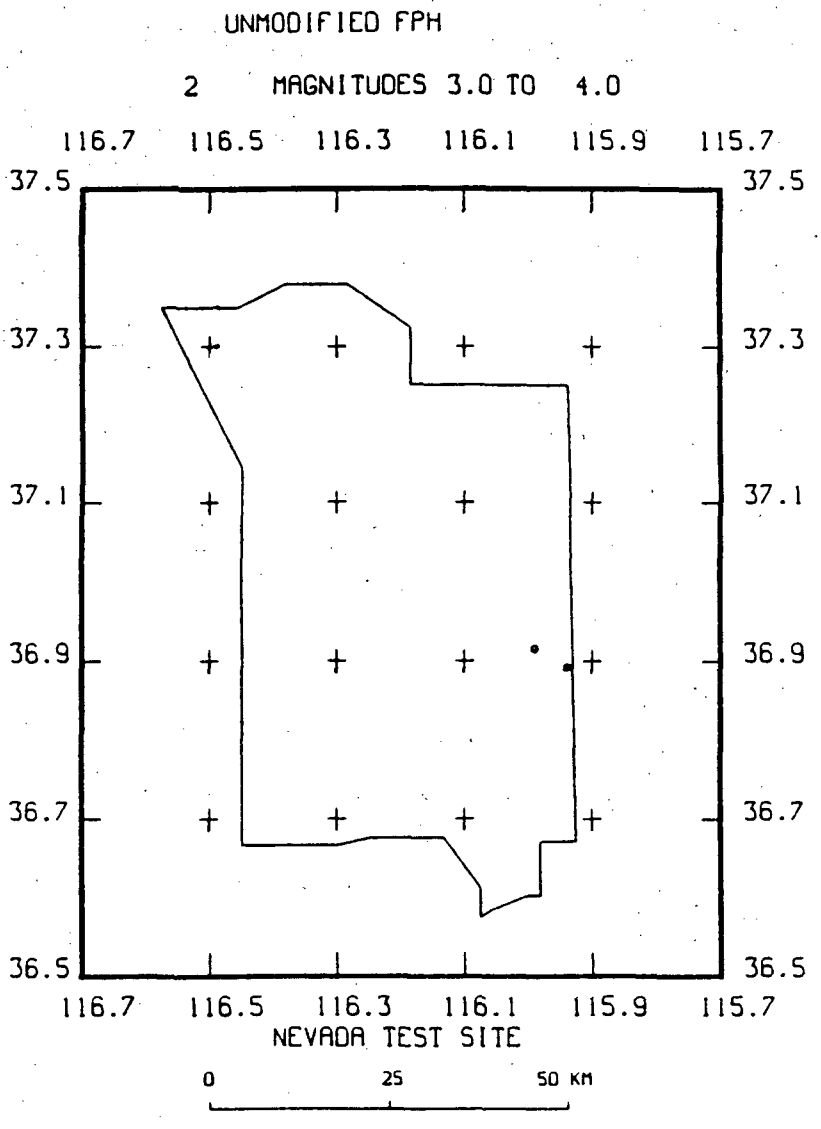

MODIFIED FPH
7 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

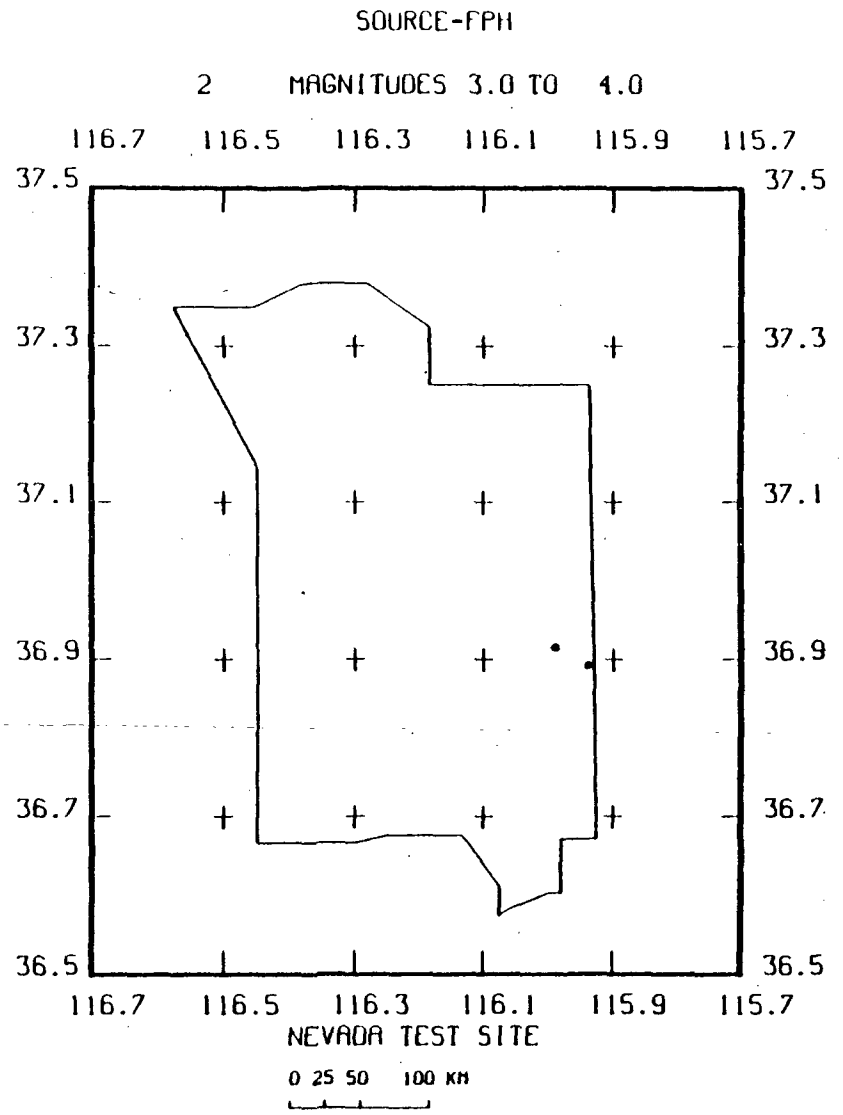

UNMODIFIED FPH
7 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

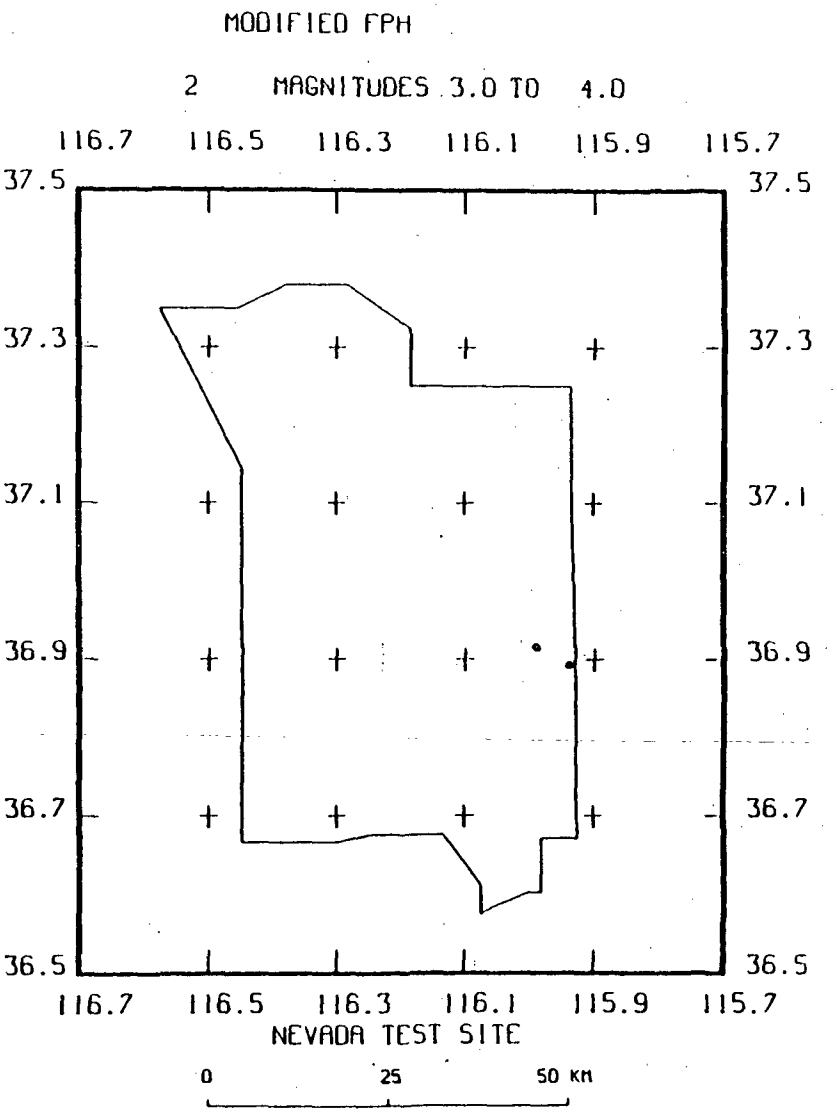

MODIFIED FPH
7 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


MODIFIED FPH
2 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


SOURCE-FPH
2 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

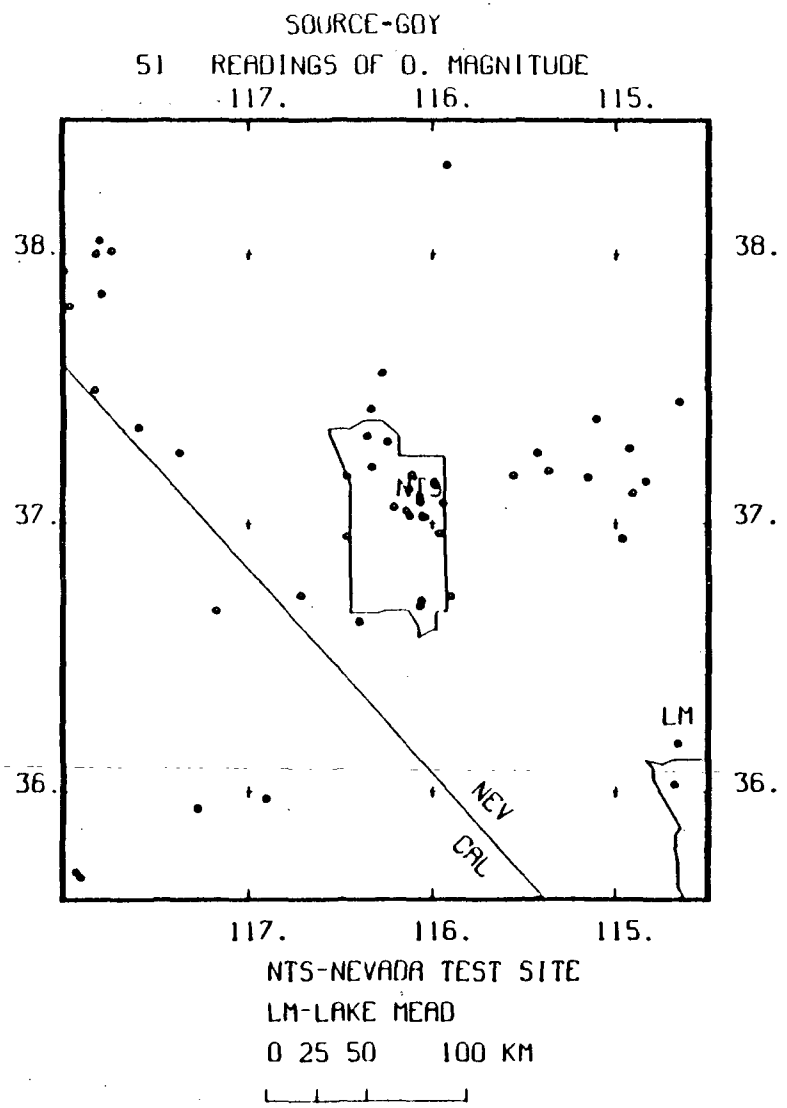

UNMODIFIED FPH
2 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

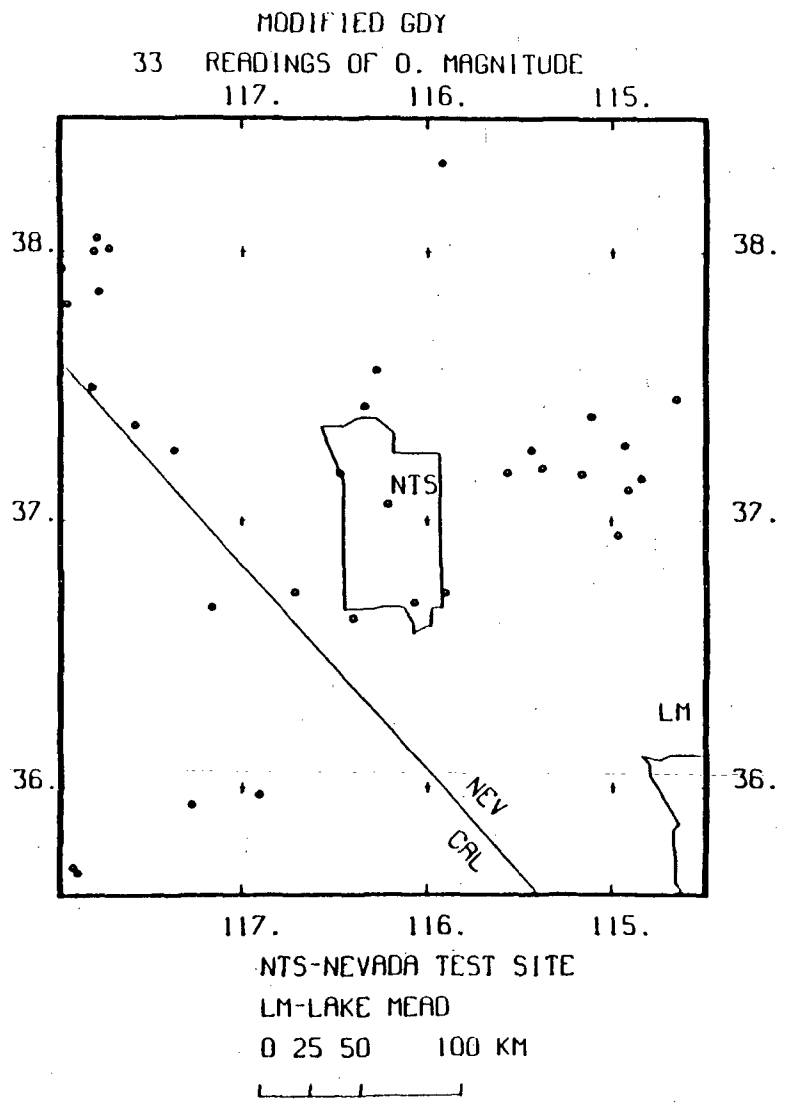

SOURCE-FPH
2 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 100 KM

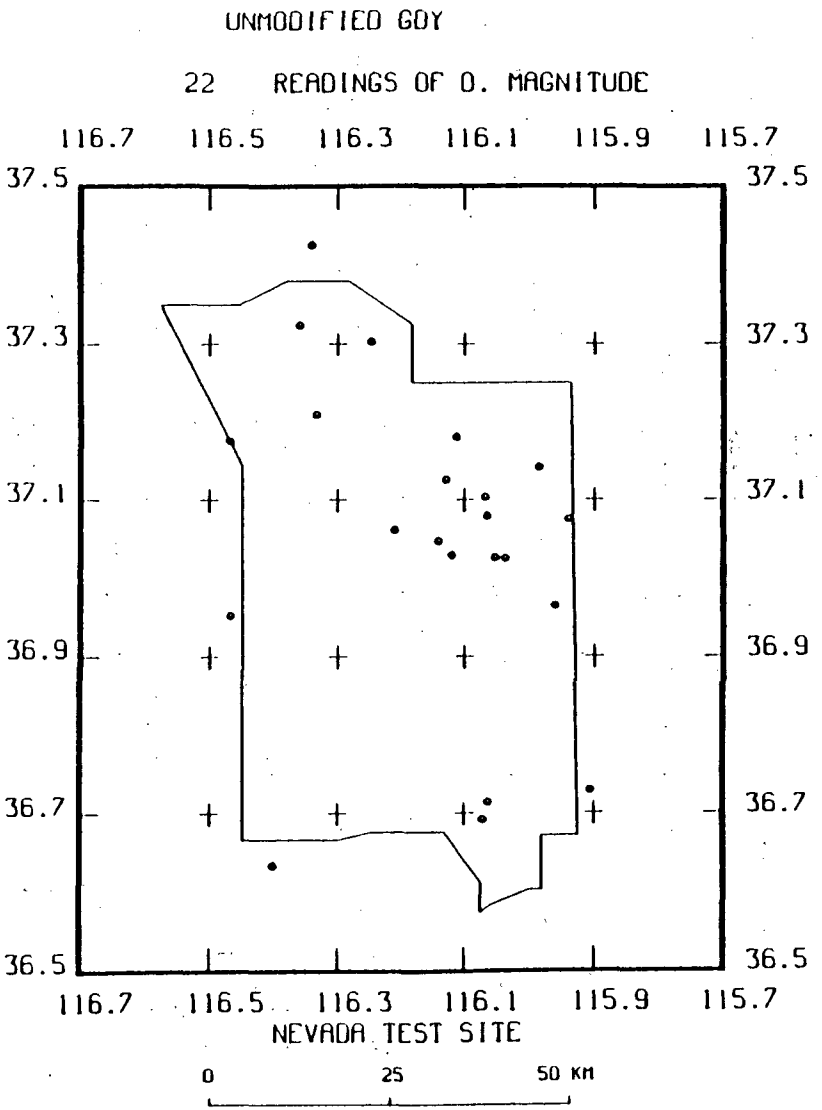

MODIFIED FPH
2 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

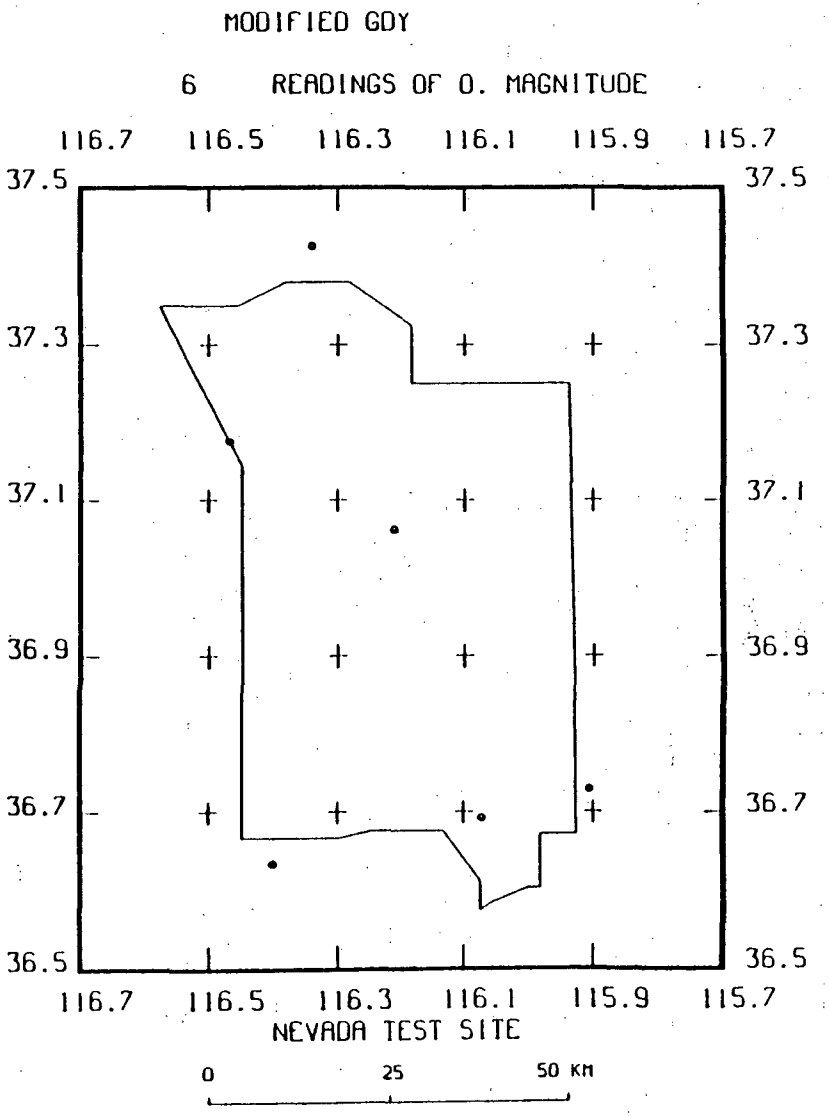
APPENDIX H

SOURCE - GDY

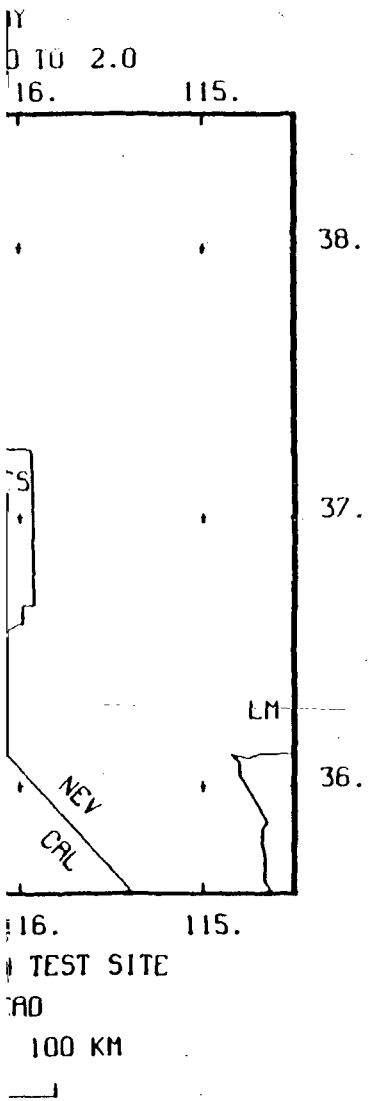

SOURCE-GDY
51 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

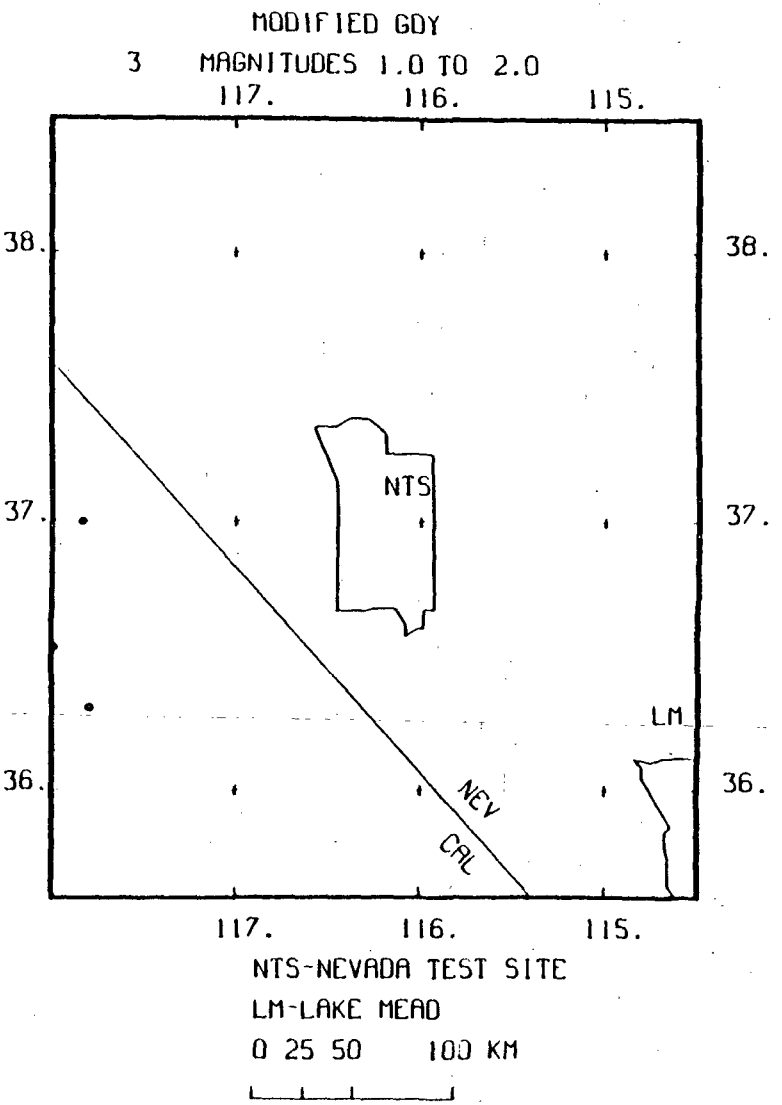

MODIFIED GDY
33 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

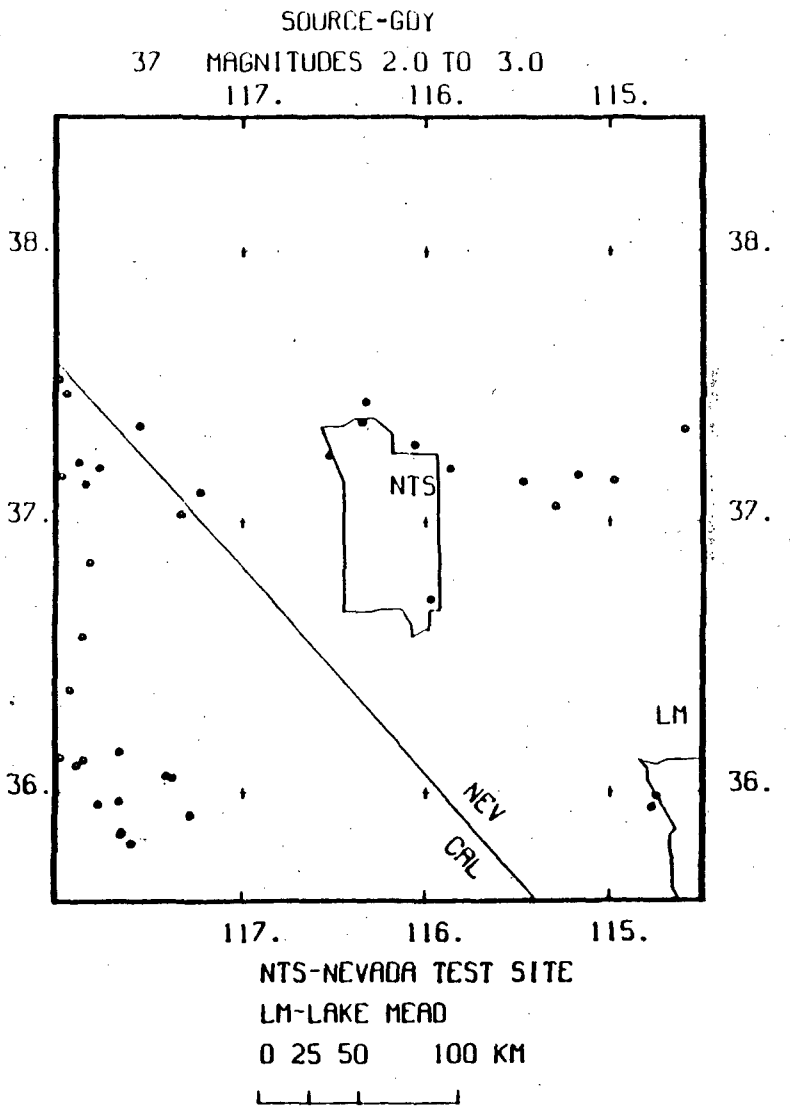

UNMODIFIED GDY
22 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

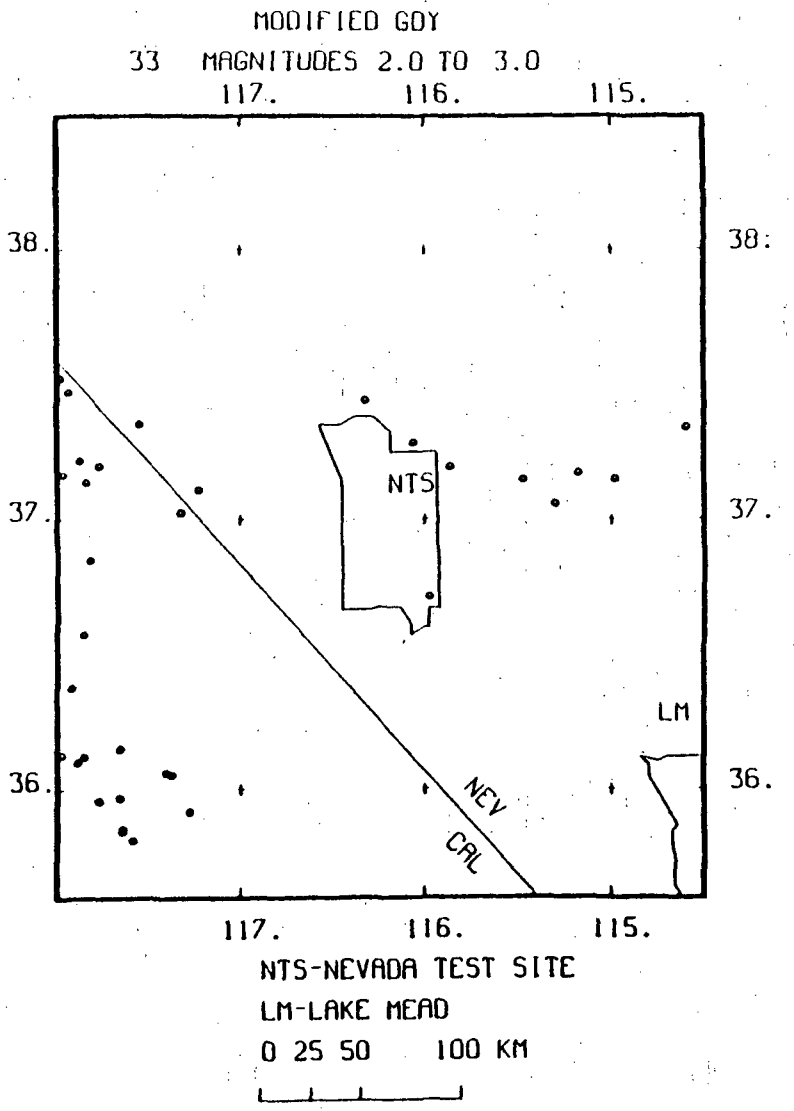

MODIFIED GDY
6 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

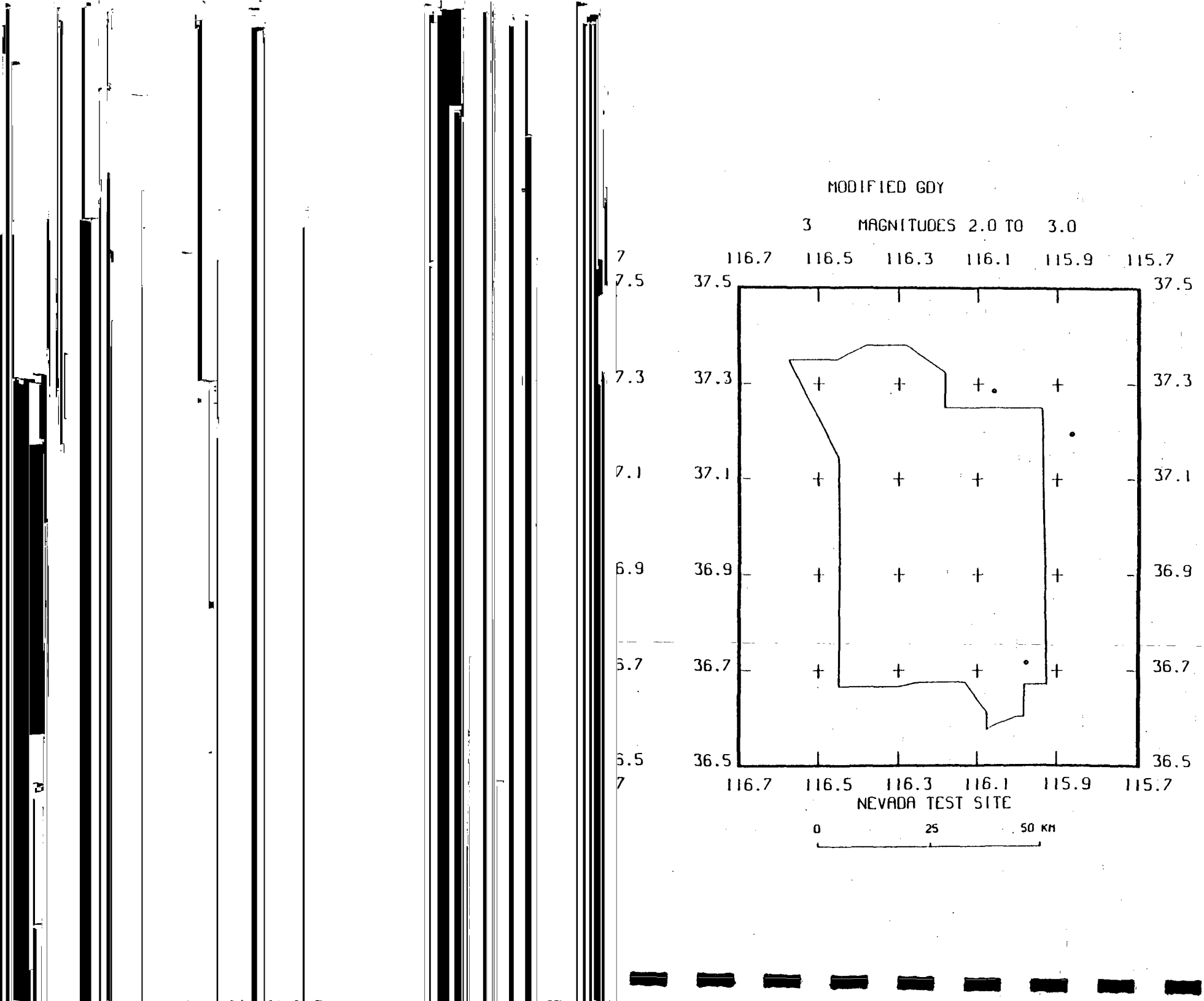
[redacted]

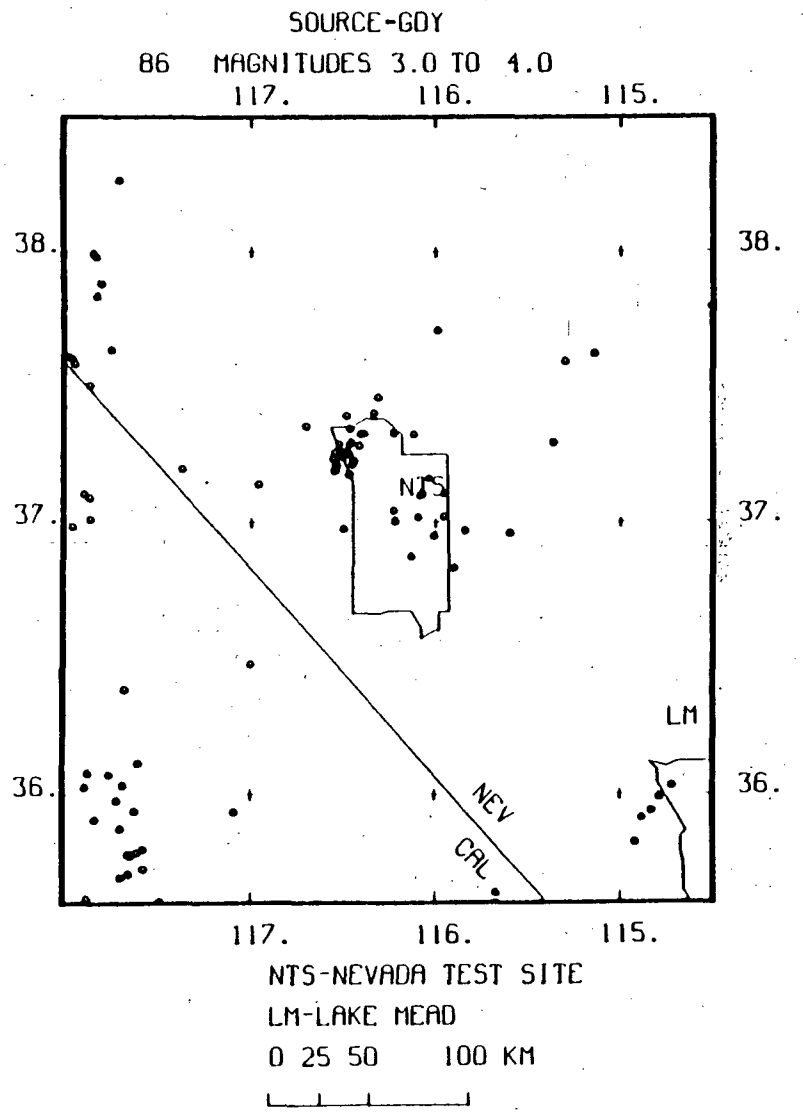

0 TO 2.0
16.
115.
38.
37.
36.
LM
NEV
CAL
16.
115.
TEST SITE
AD
100 KM

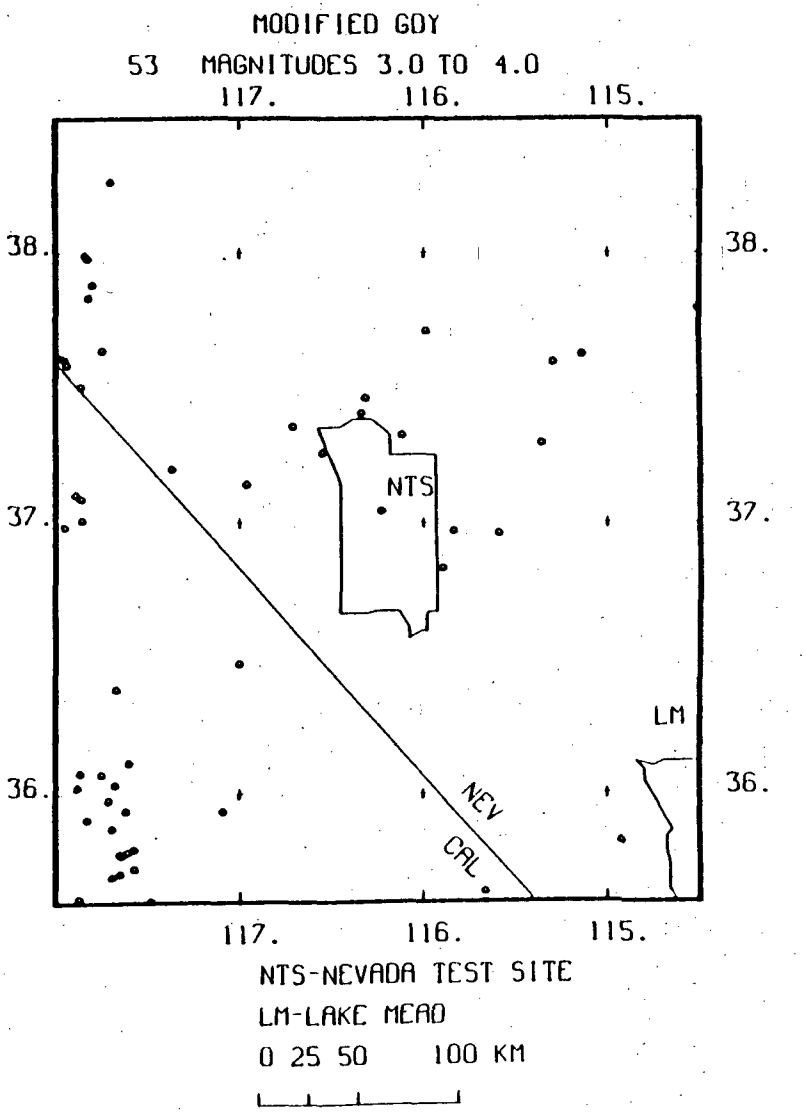

MODIFIED GDY
3 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
117.
116.
115.
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

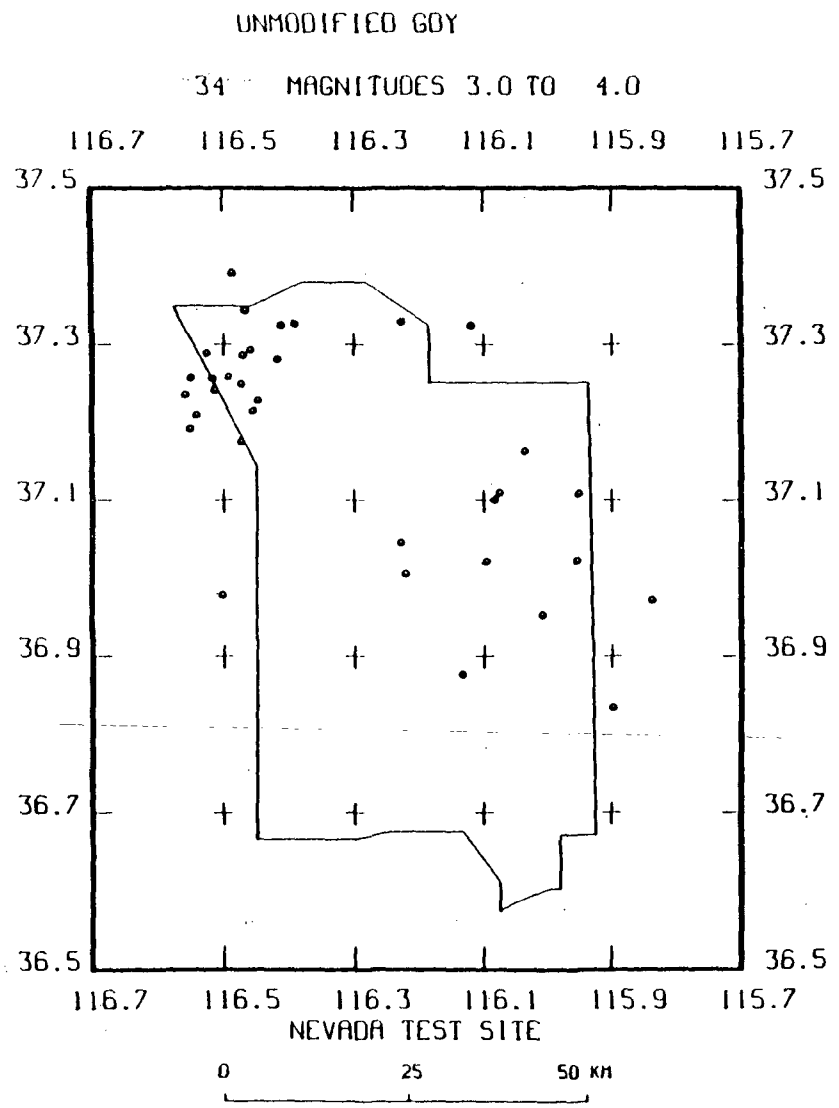

SOURCE-GDY
37 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

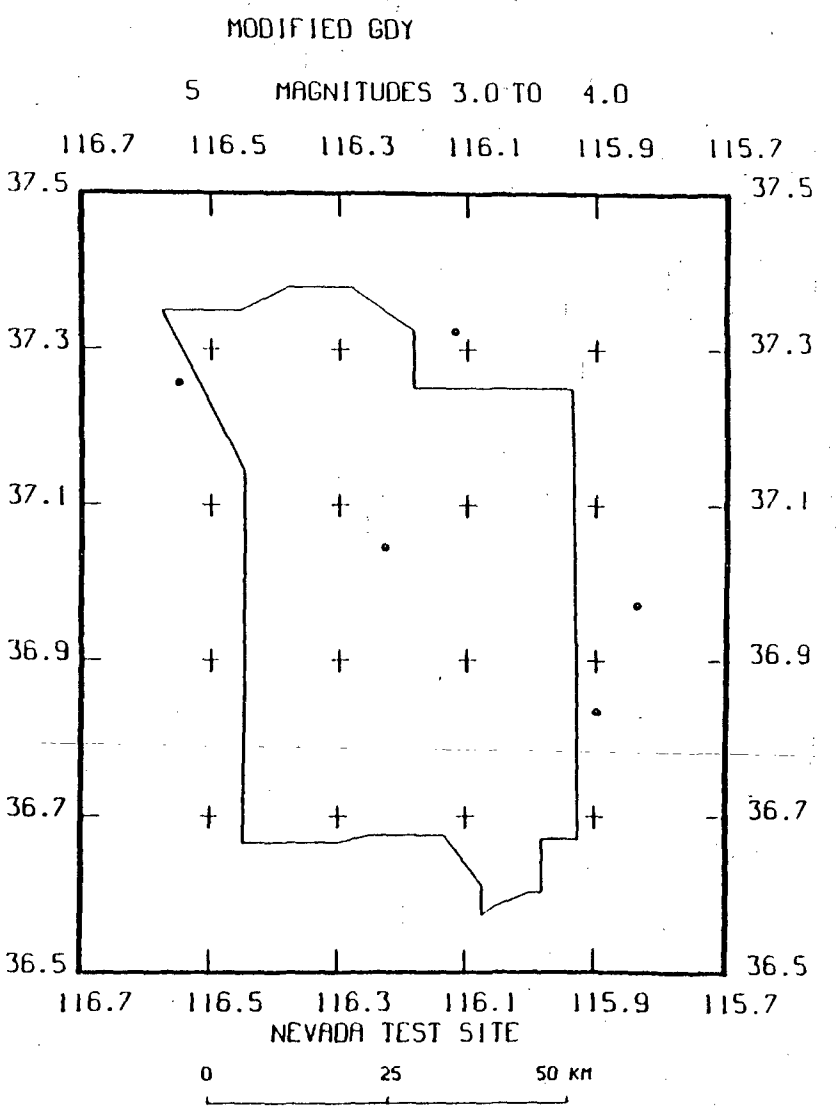

MODIFIED GDY
33 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

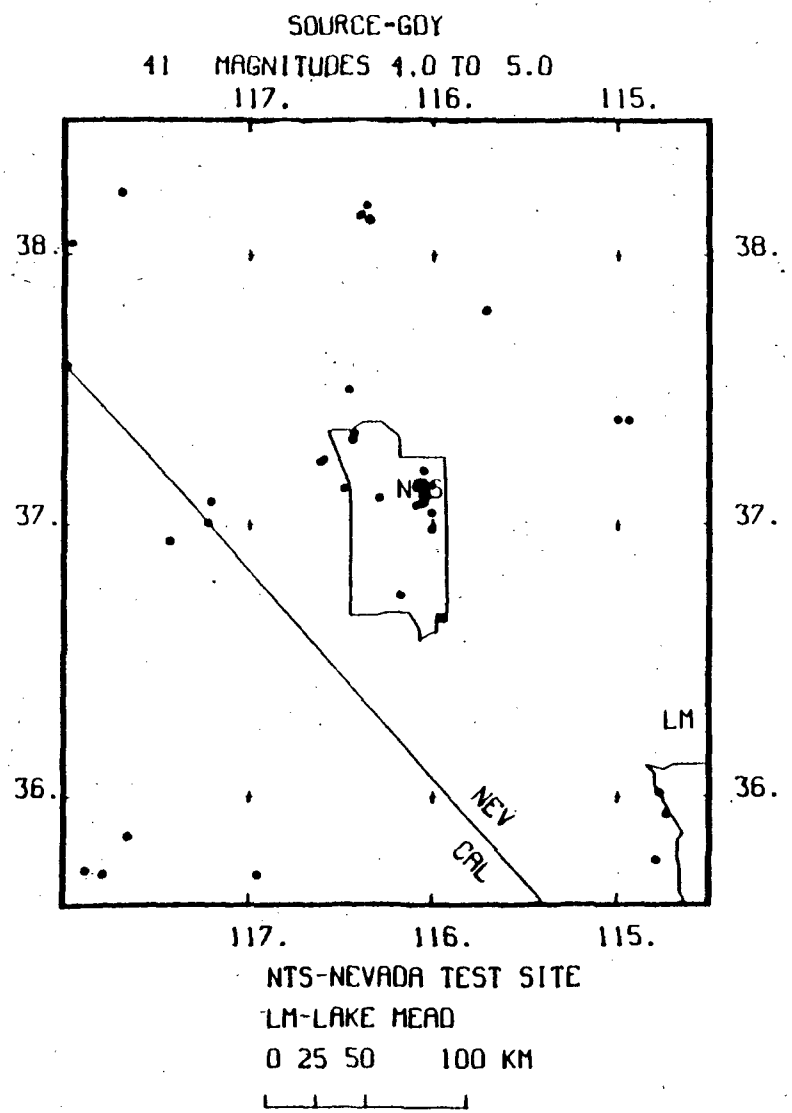

MODIFIED GDY
3 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

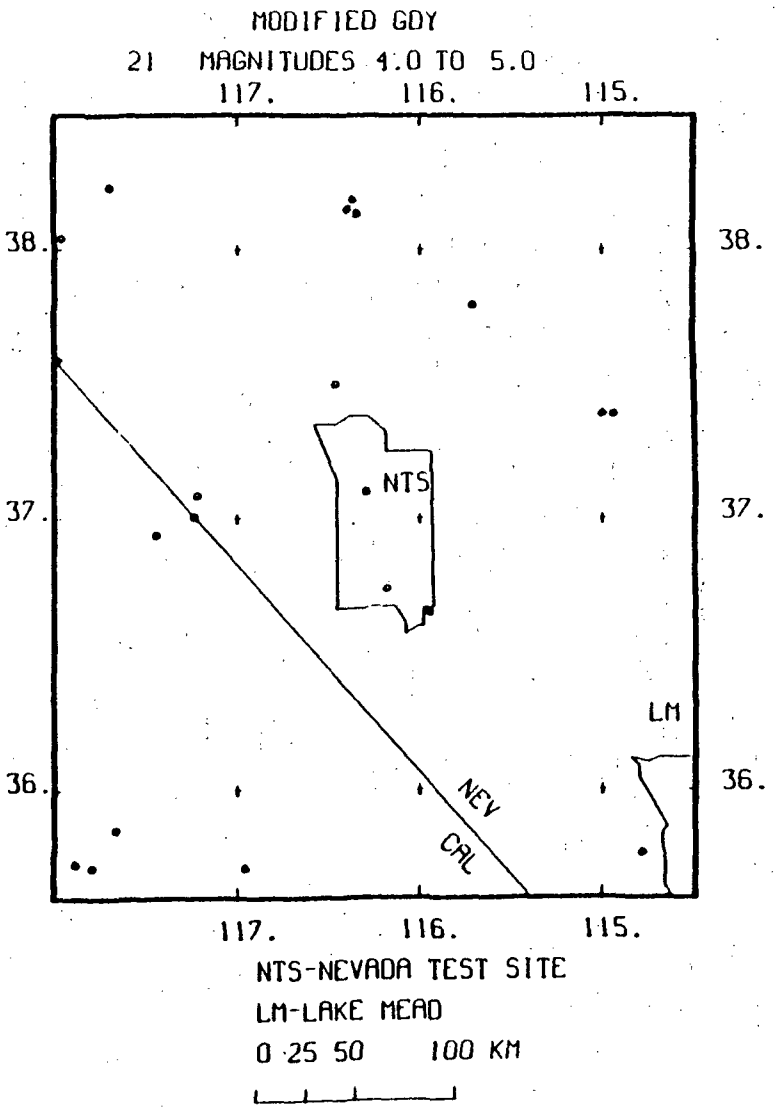

SOURCE-GDY
86 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

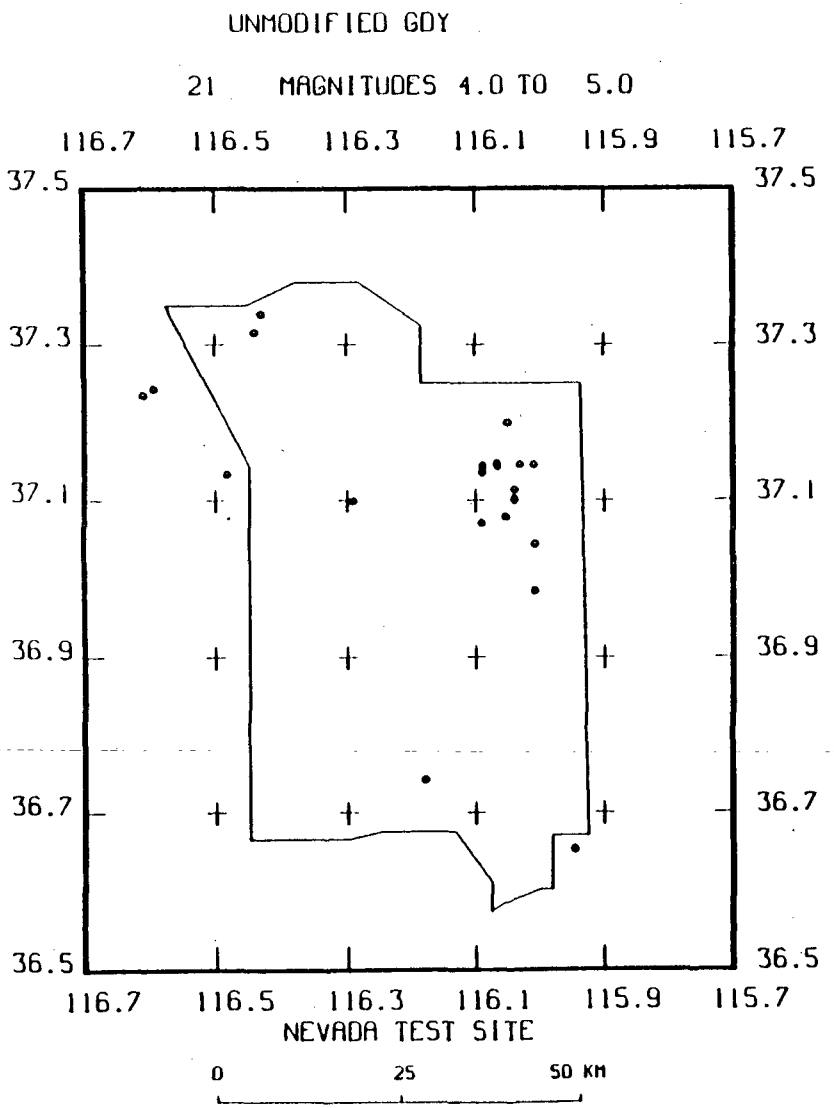

MODIFIED GDY
53 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

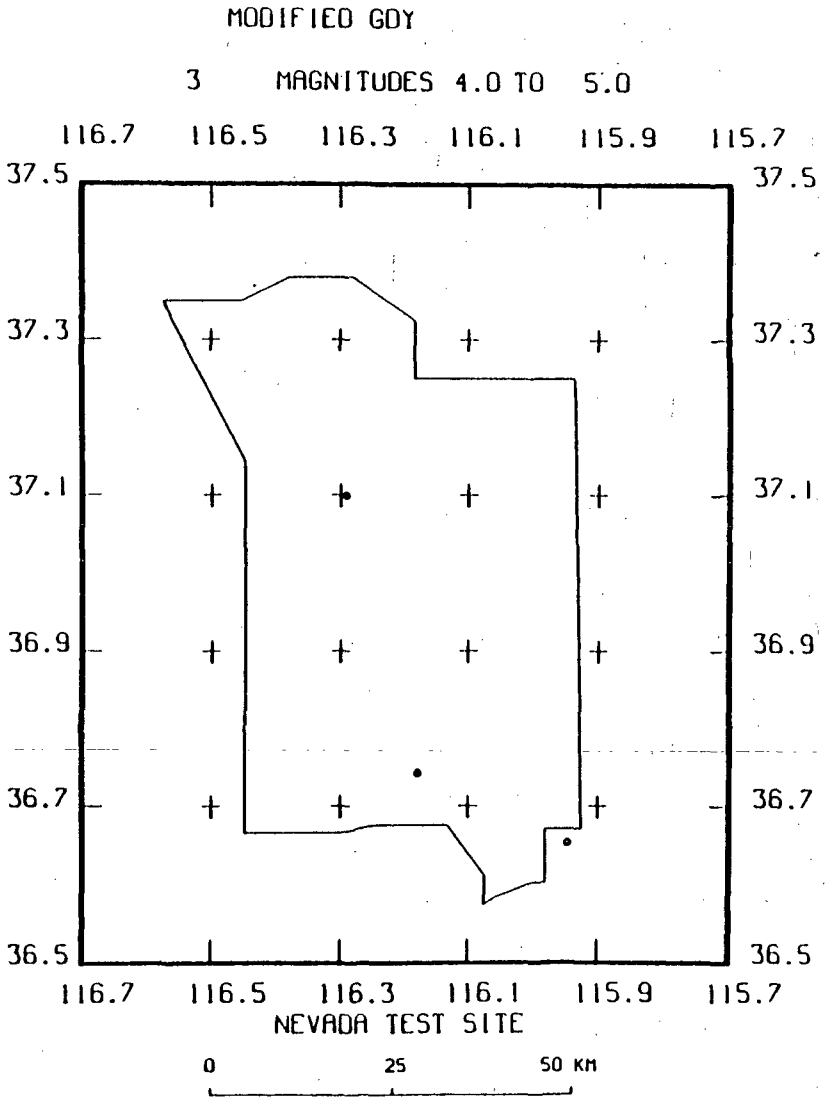

UNMODIFIED GDY
34 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

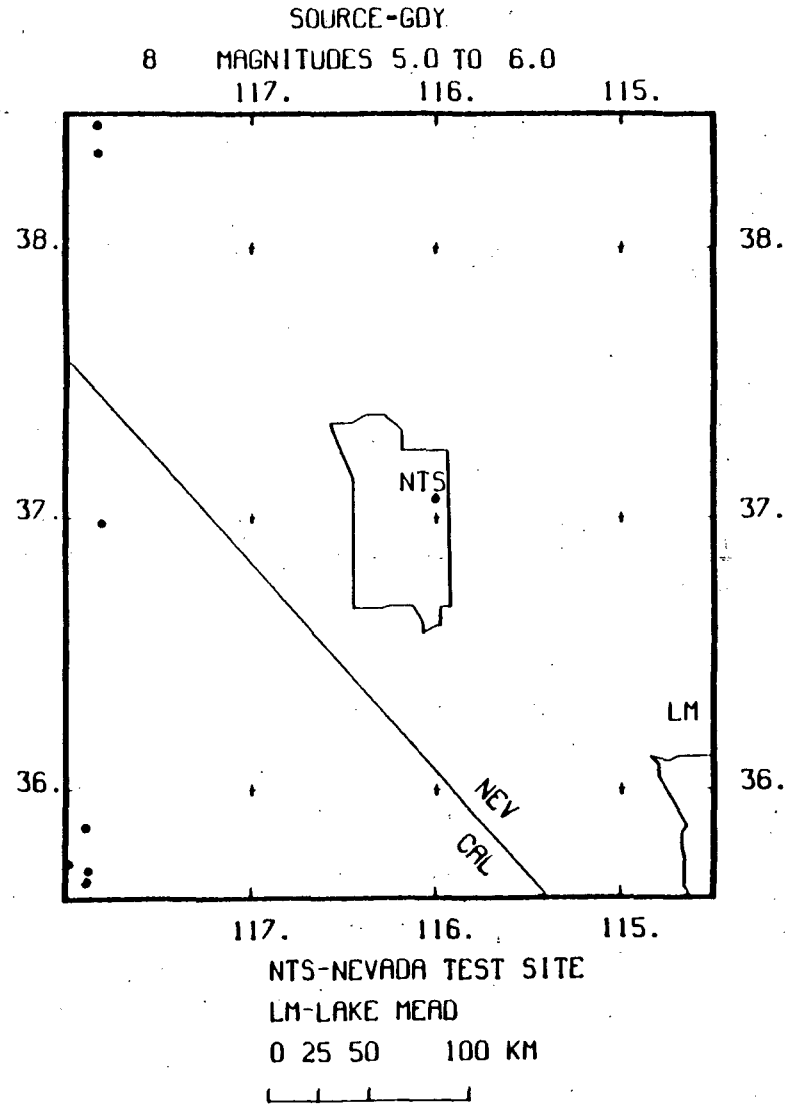

MODIFIED GDY
5 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

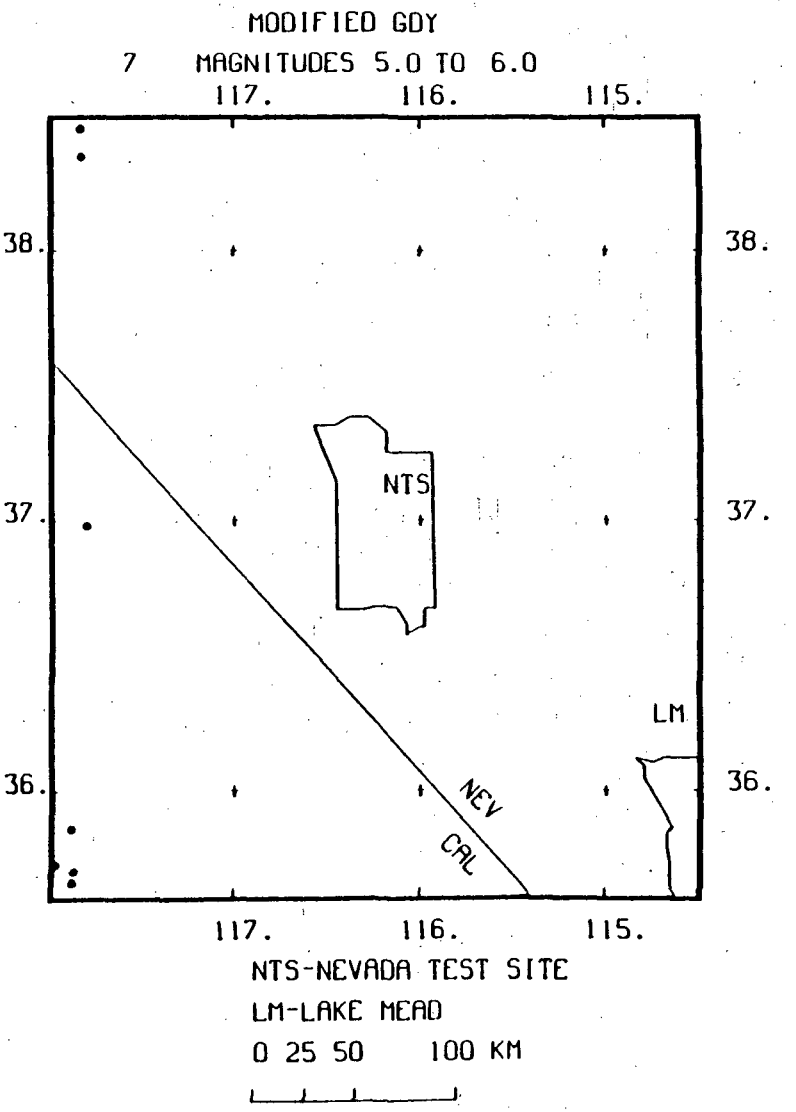

SOURCE-GDY
41 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

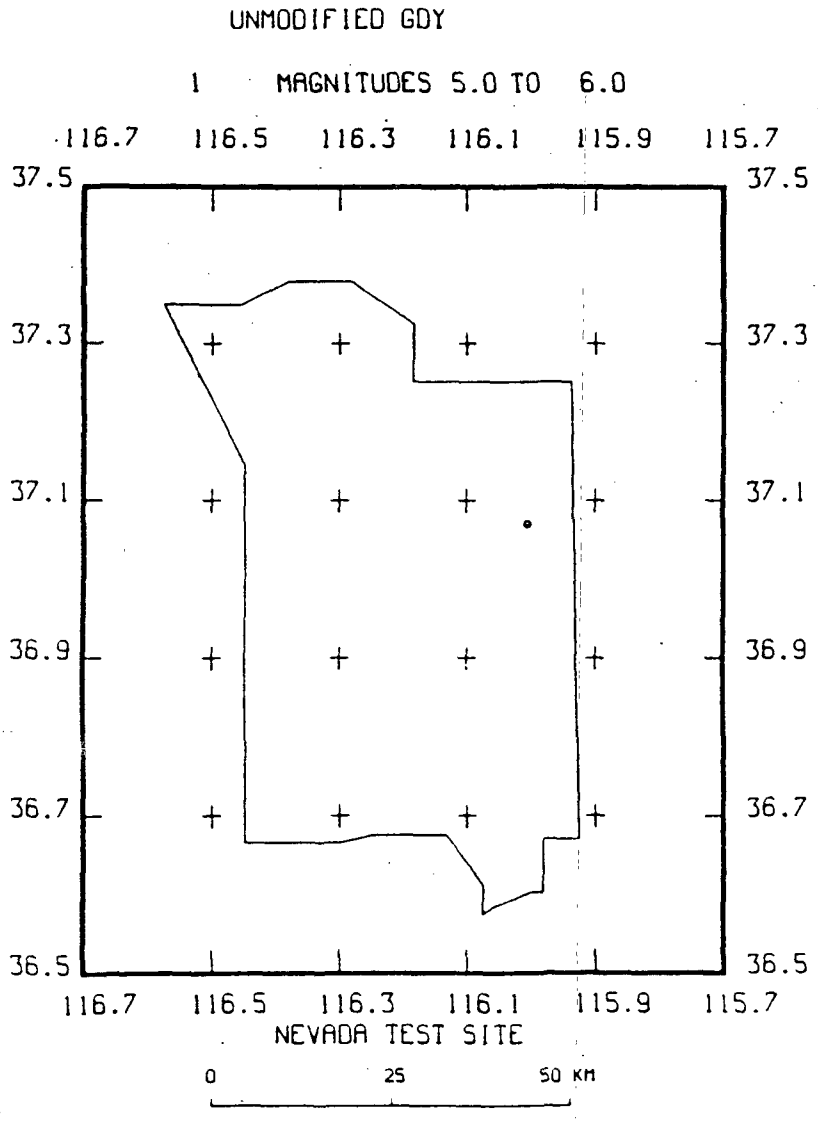

MODIFIED GDY
21 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED GDY
21 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


MODIFIED GDY
3 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

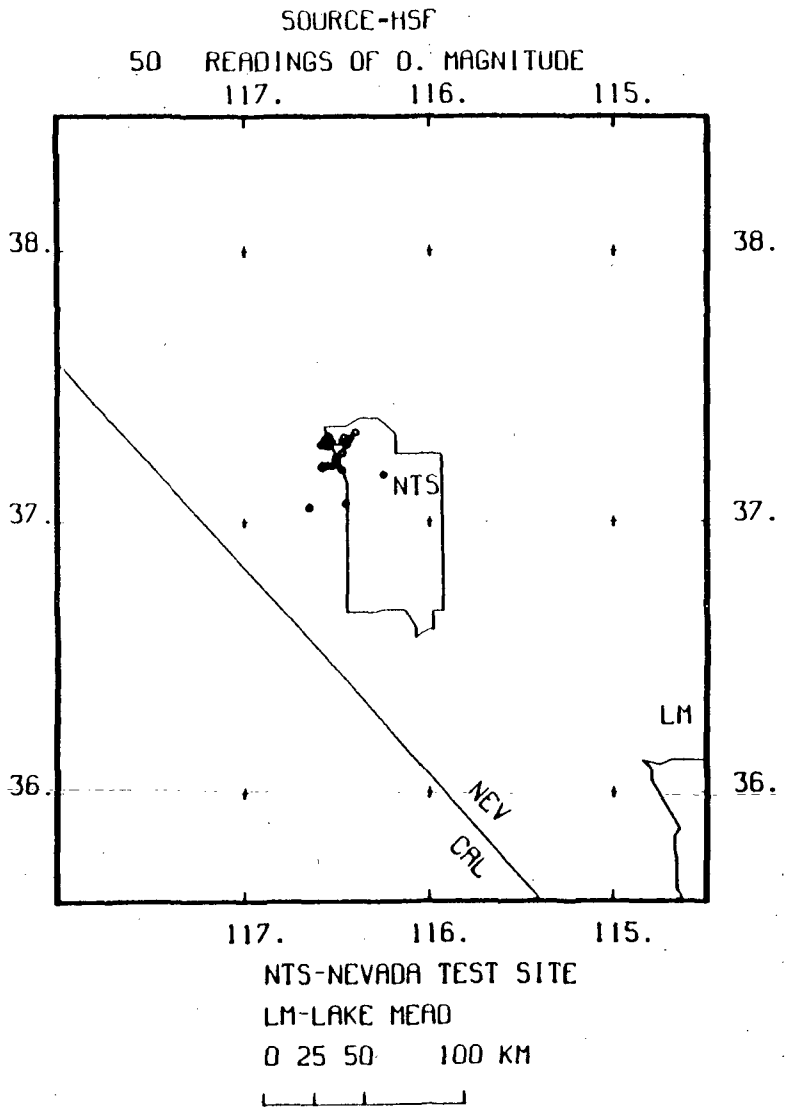

SOURCE-GDY
8 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

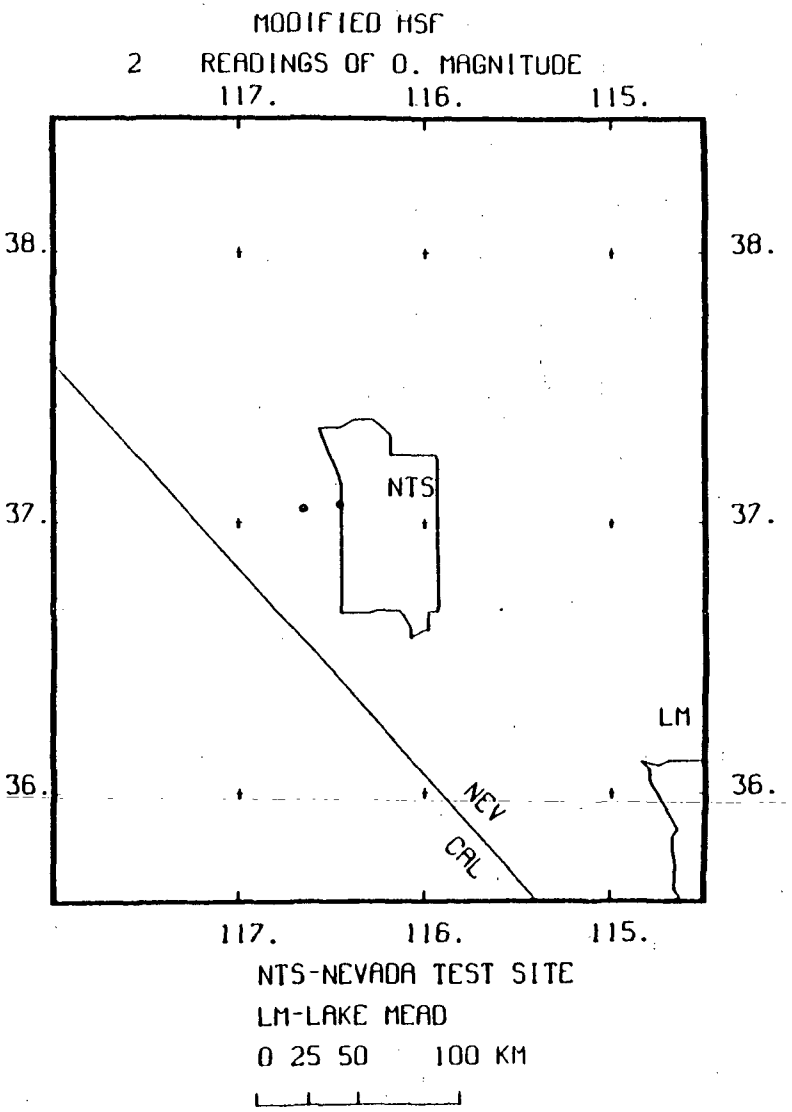

MODIFIED GDY
7 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

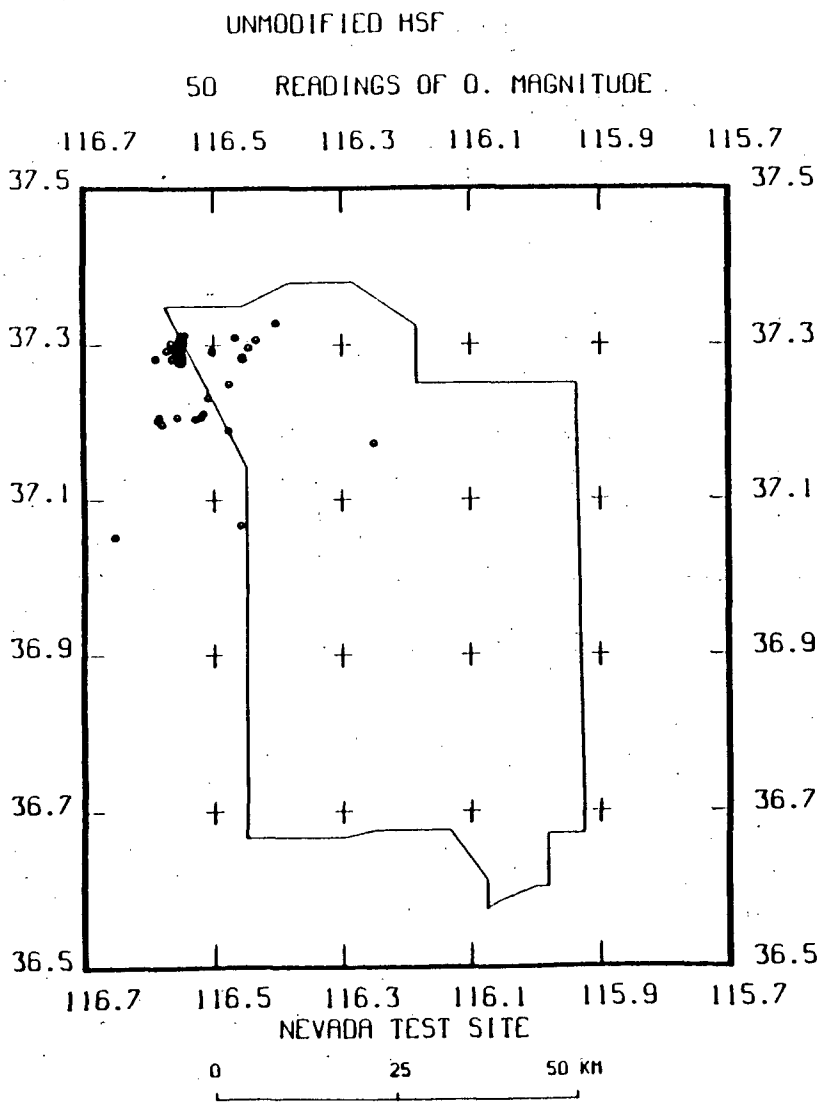

UNMODIFIED GDY
1 MAGNITUDES 5.0 TO 6.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

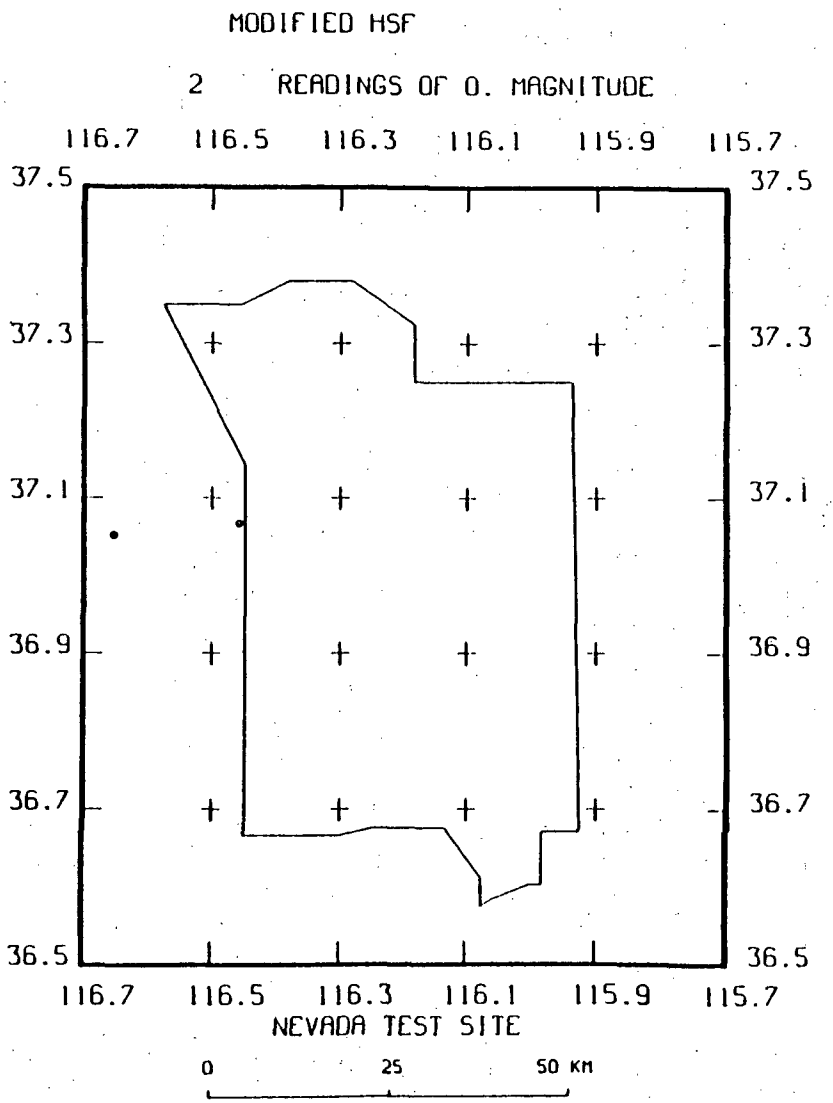
APPENDIX I

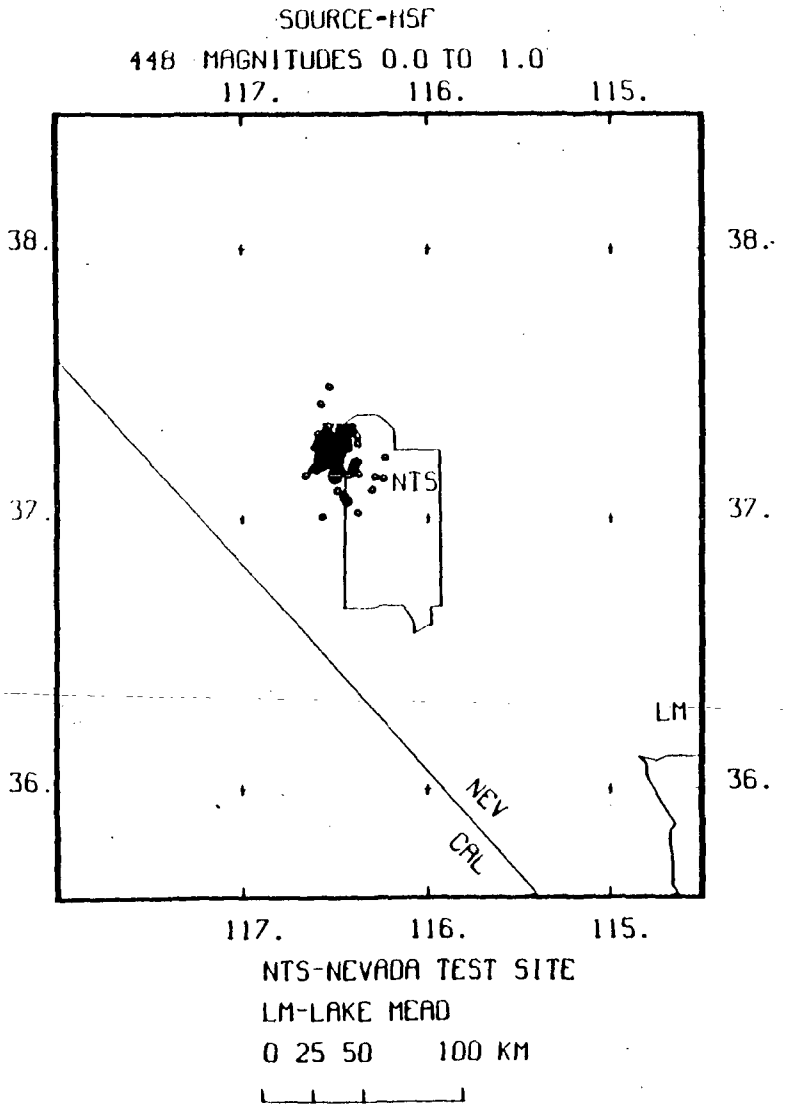
SOURCE - HSF

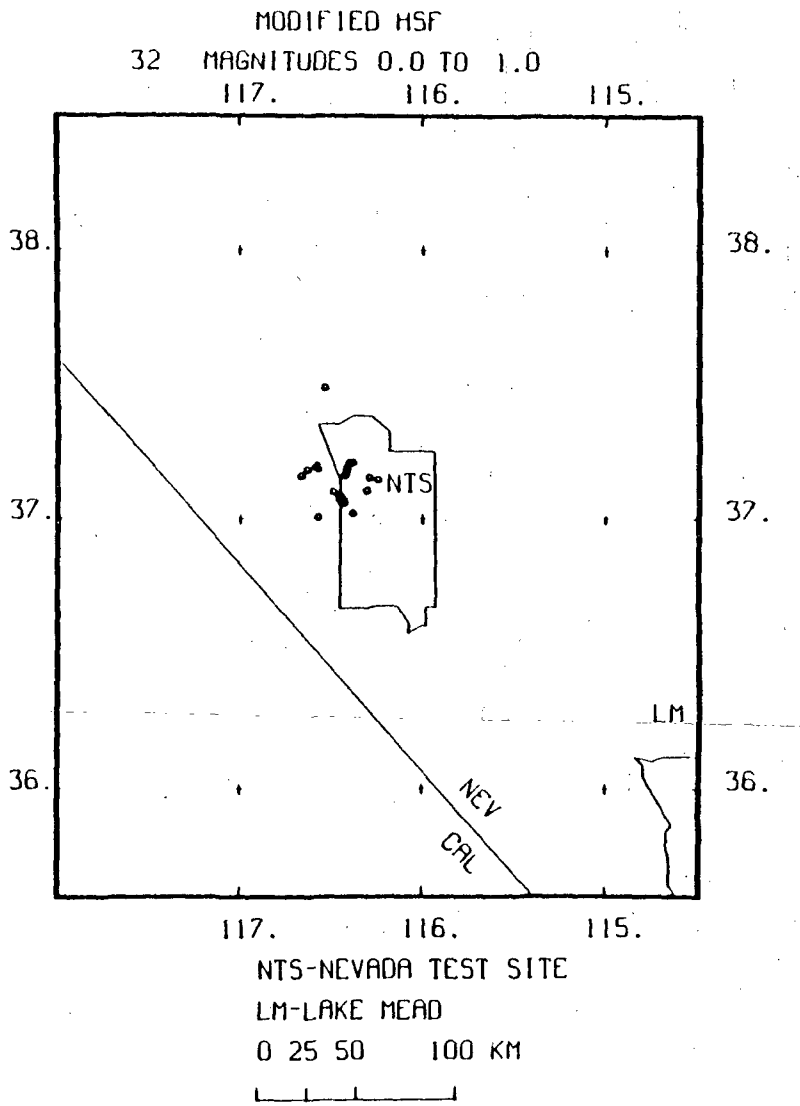

SOURCE-HSF
50 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

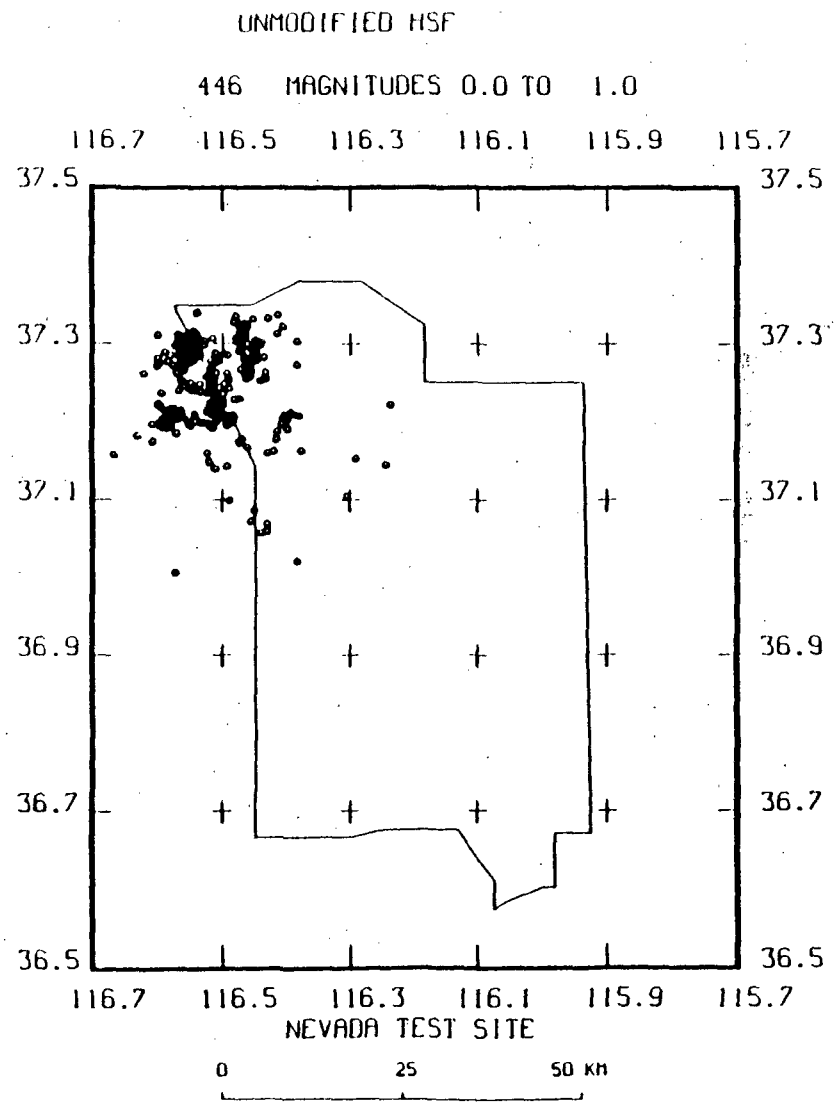

MODIFIED HSF
2 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

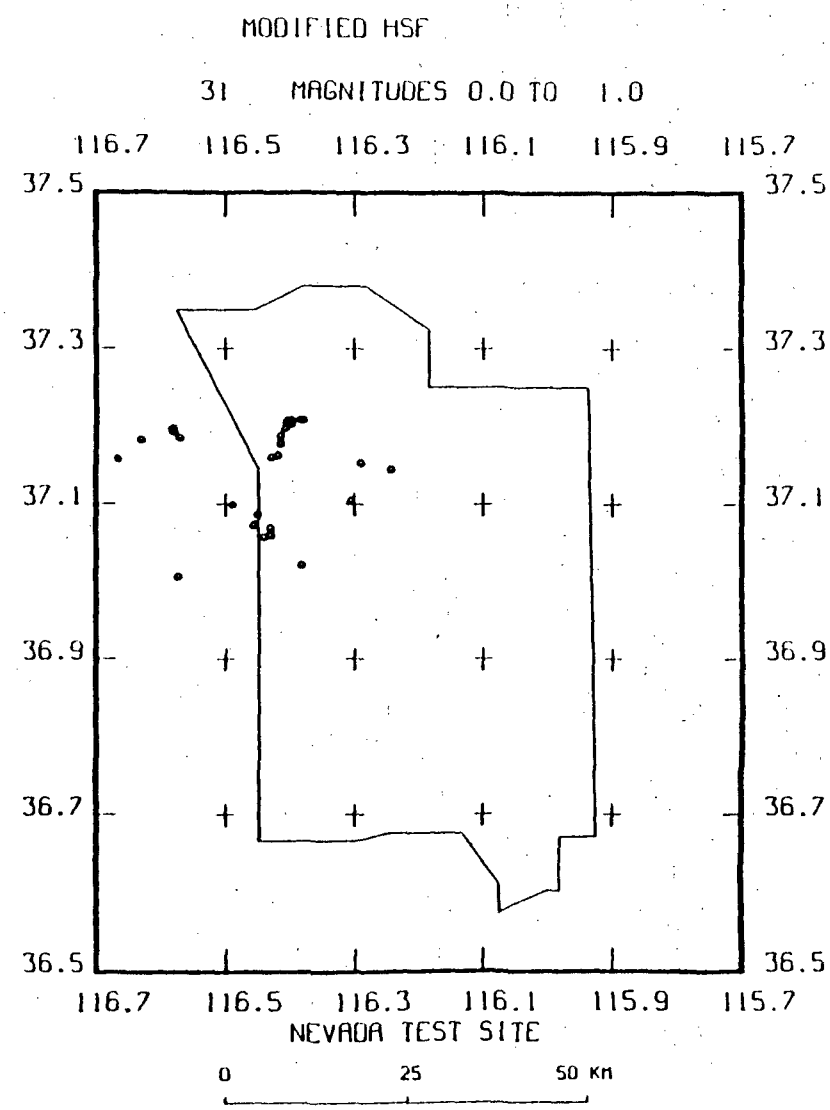

UNMODIFIED HSF
50 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

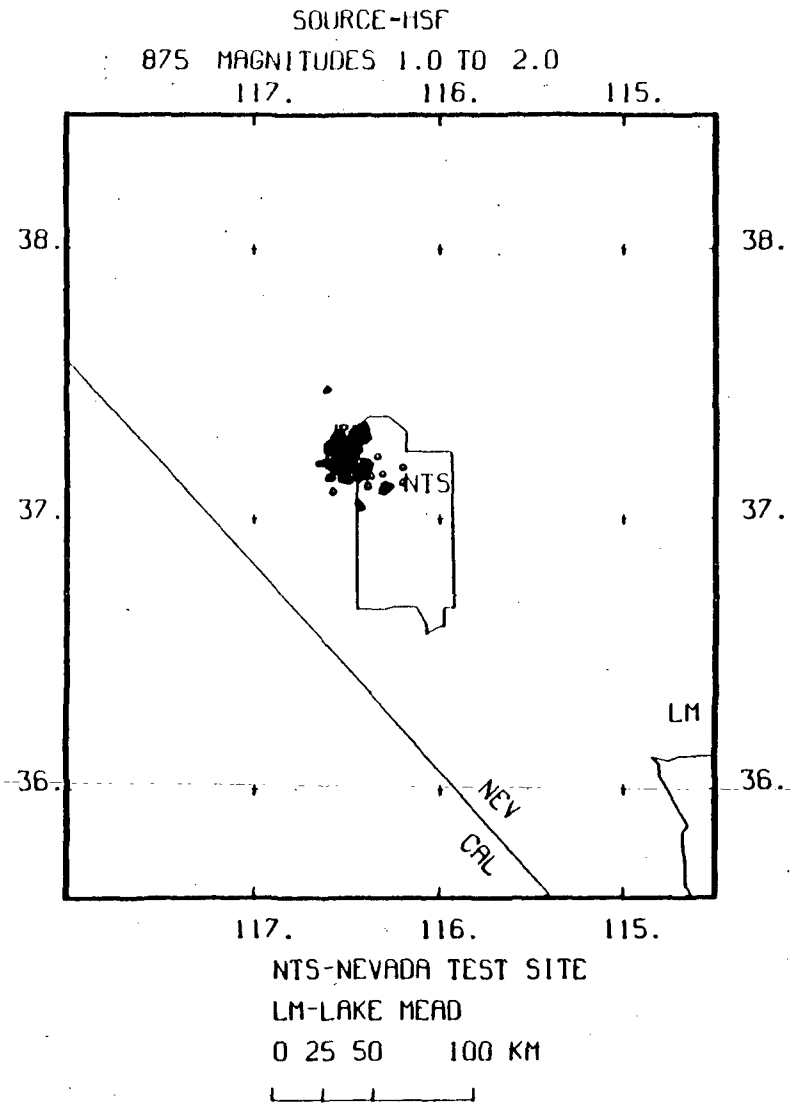

MODIFIED HSF
2 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

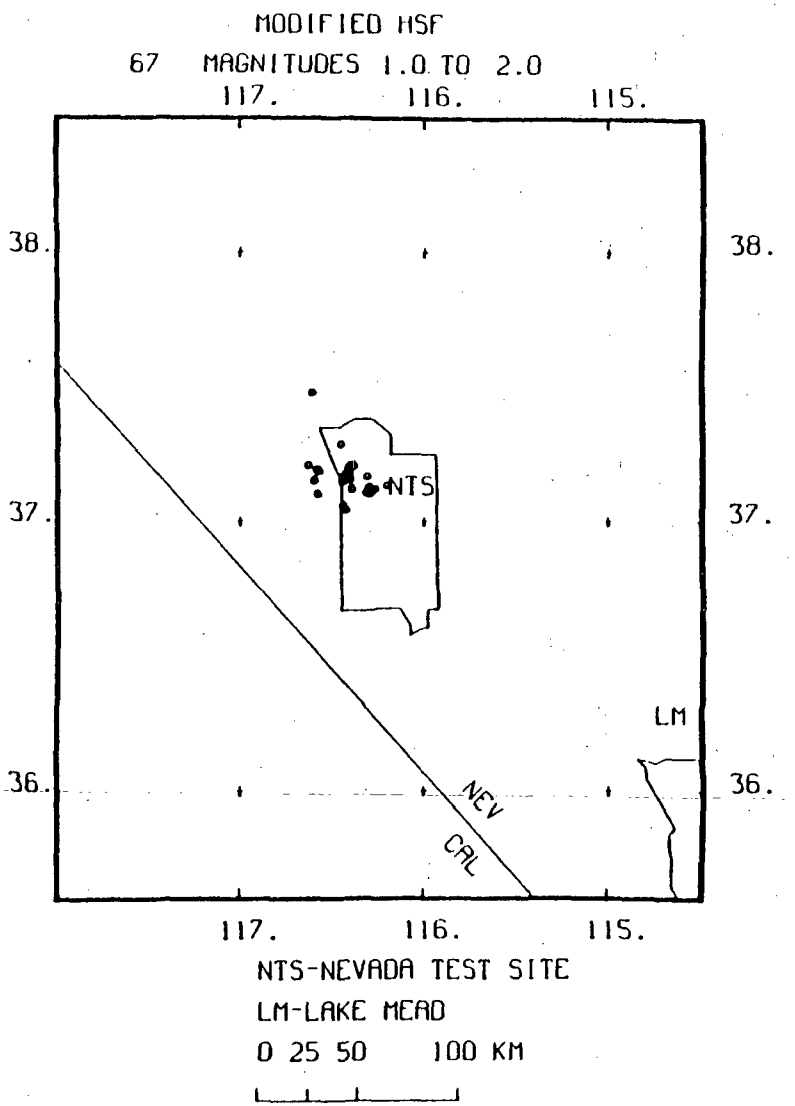

SOURCE-MSF
448 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

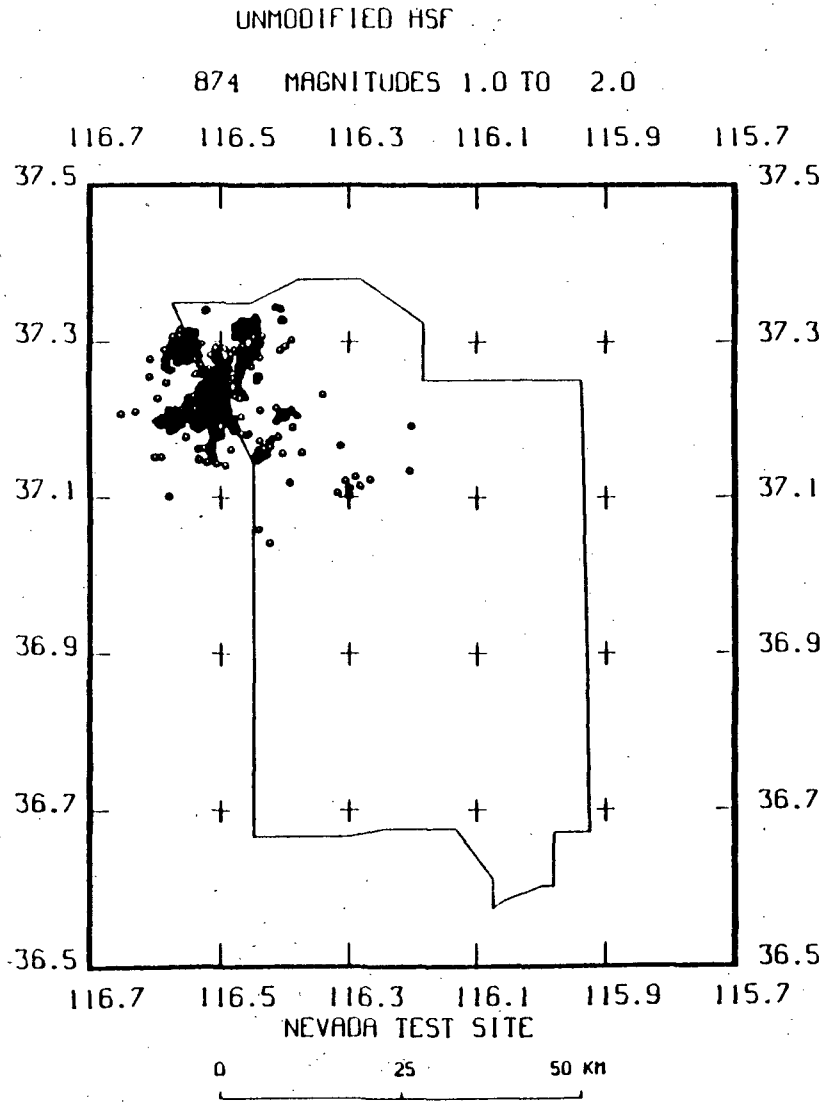

MODIFIED MSF
32 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

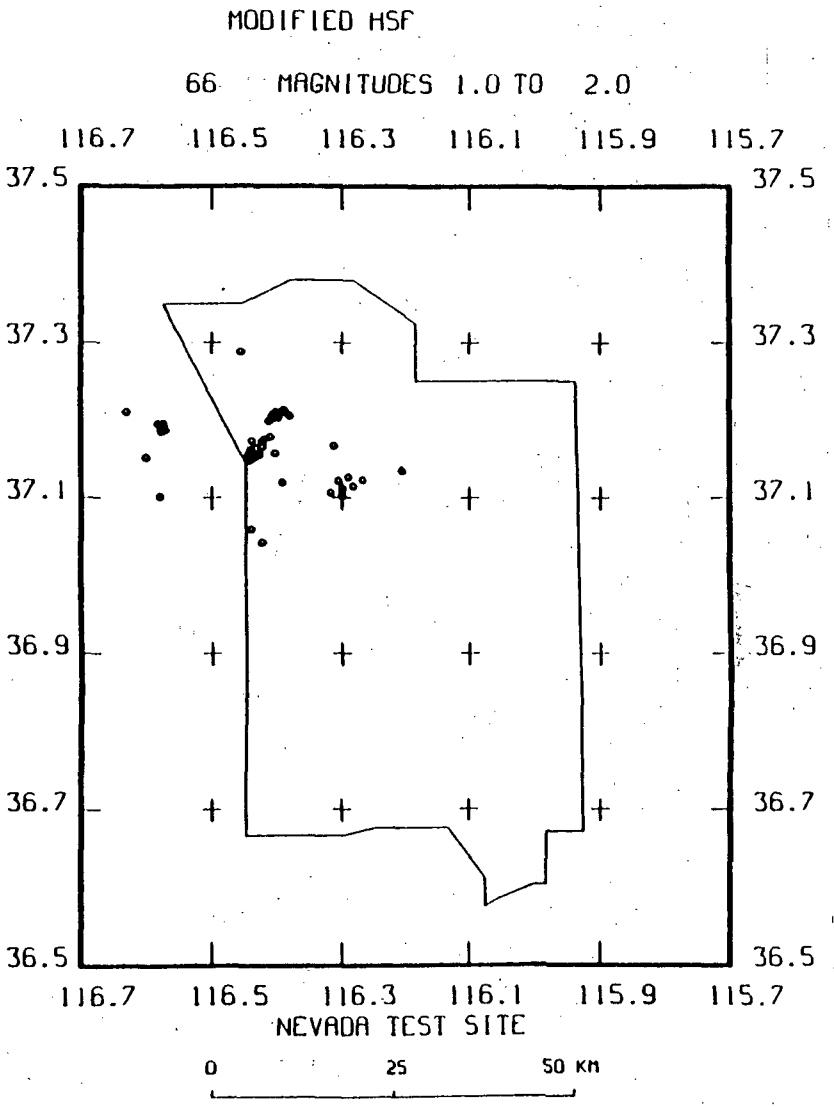

UNMODIFIED HSF
446 MAGNITUDES 0.0 TO 1.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

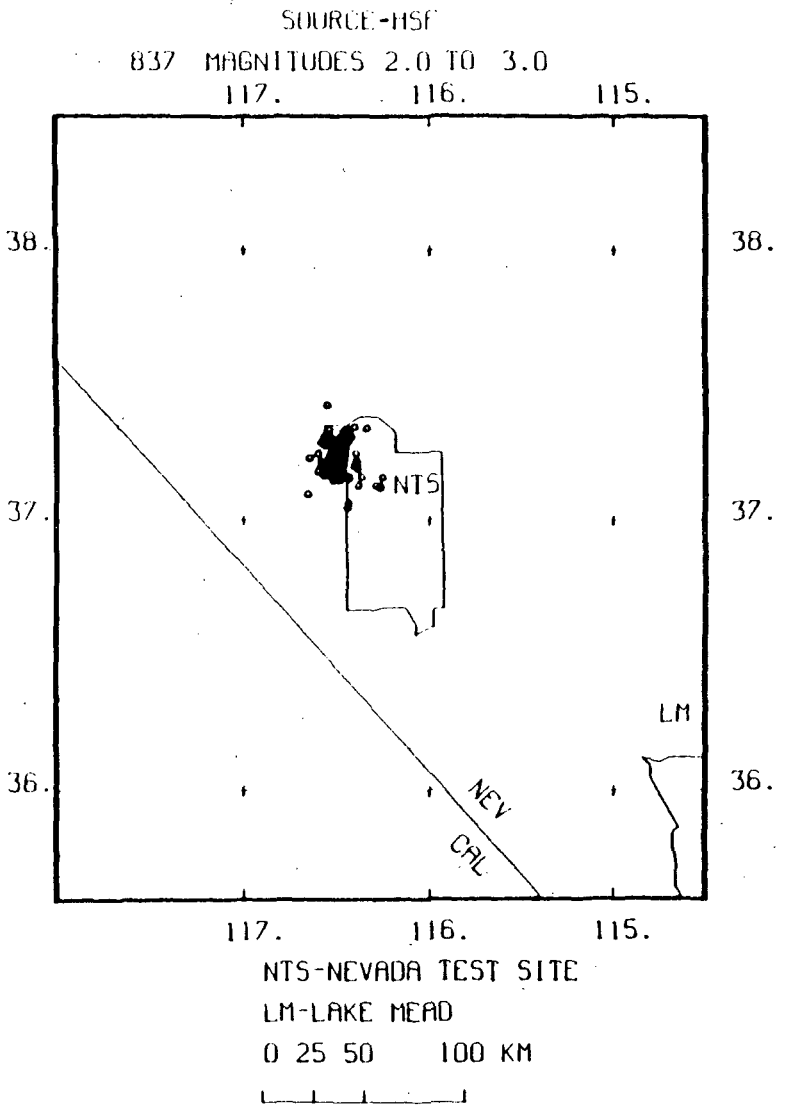

MODIFIED HSF
31 MAGNITUDES 0.0 TO 1.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

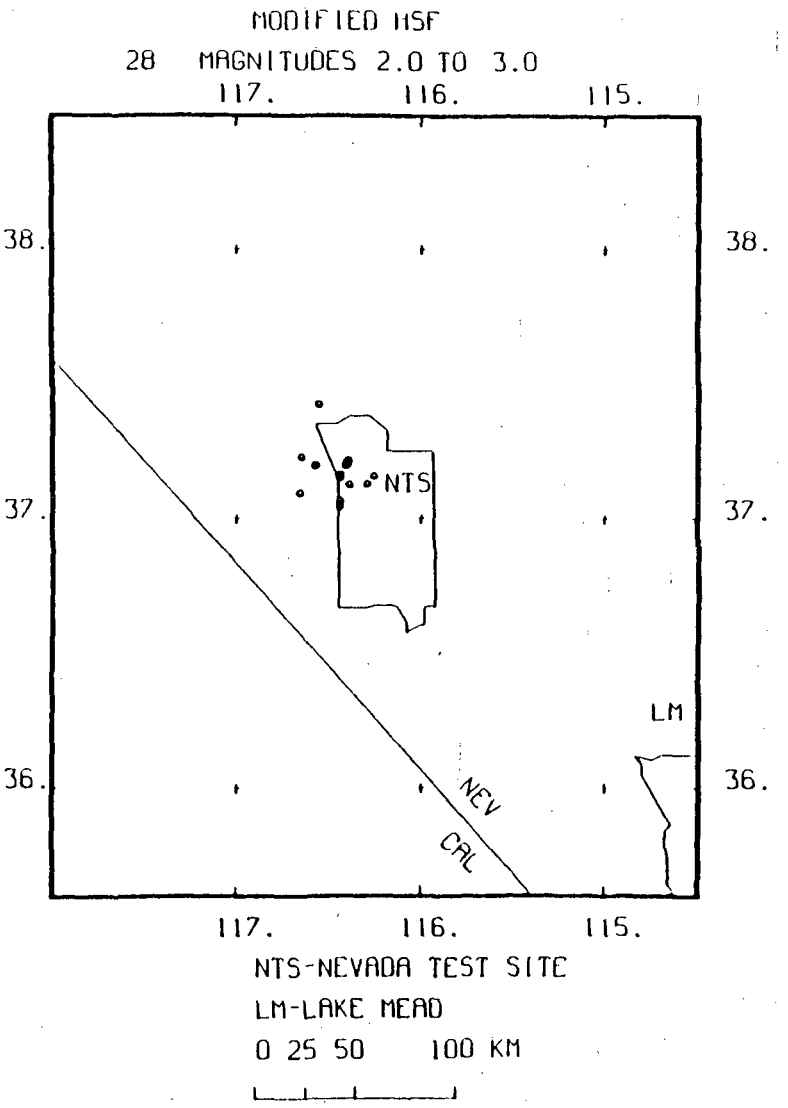

SOURCE-HSF
875 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

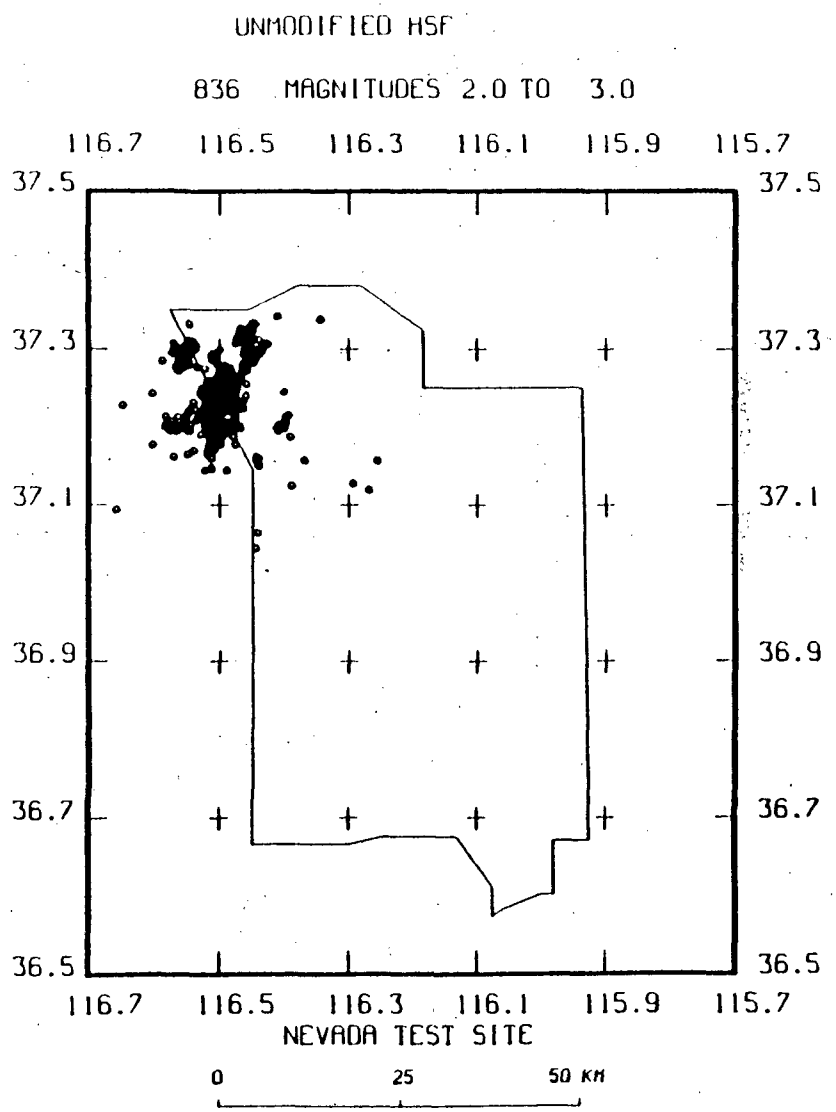

MODIFIED HSF
67 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

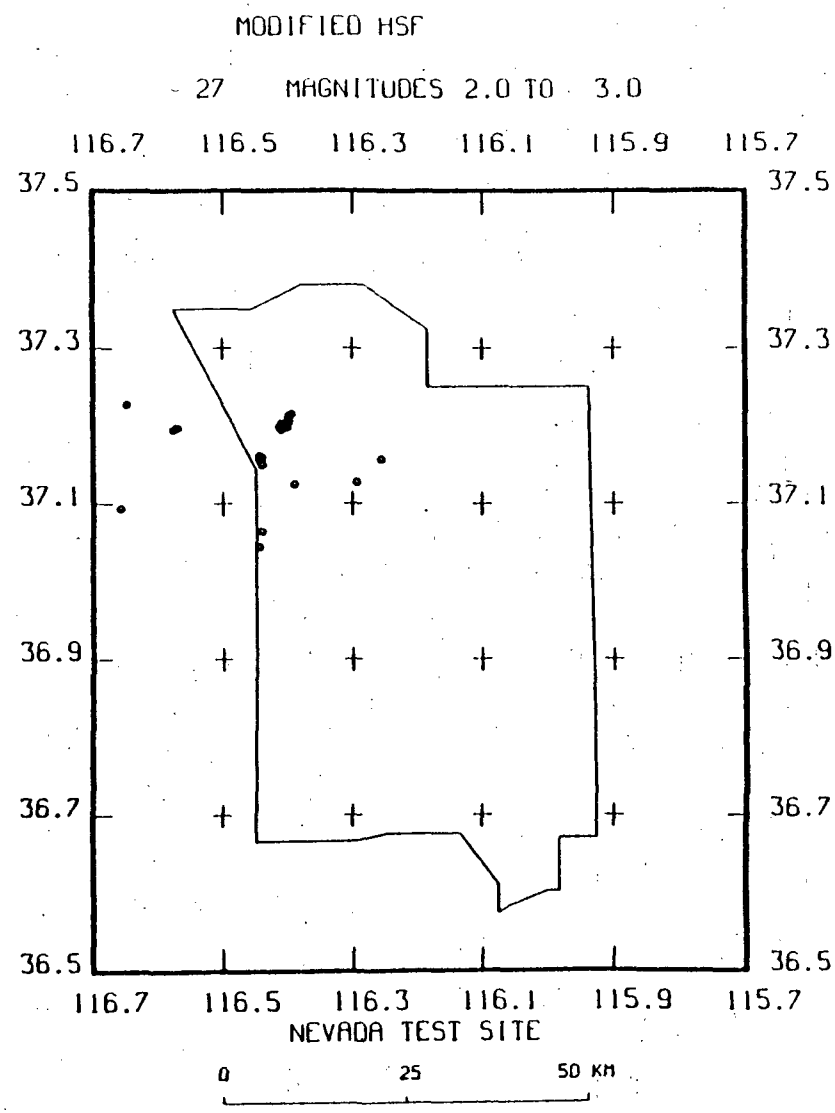

UNMODIFIED HSF
874 MAGNITUDES 1.0 TO 2.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

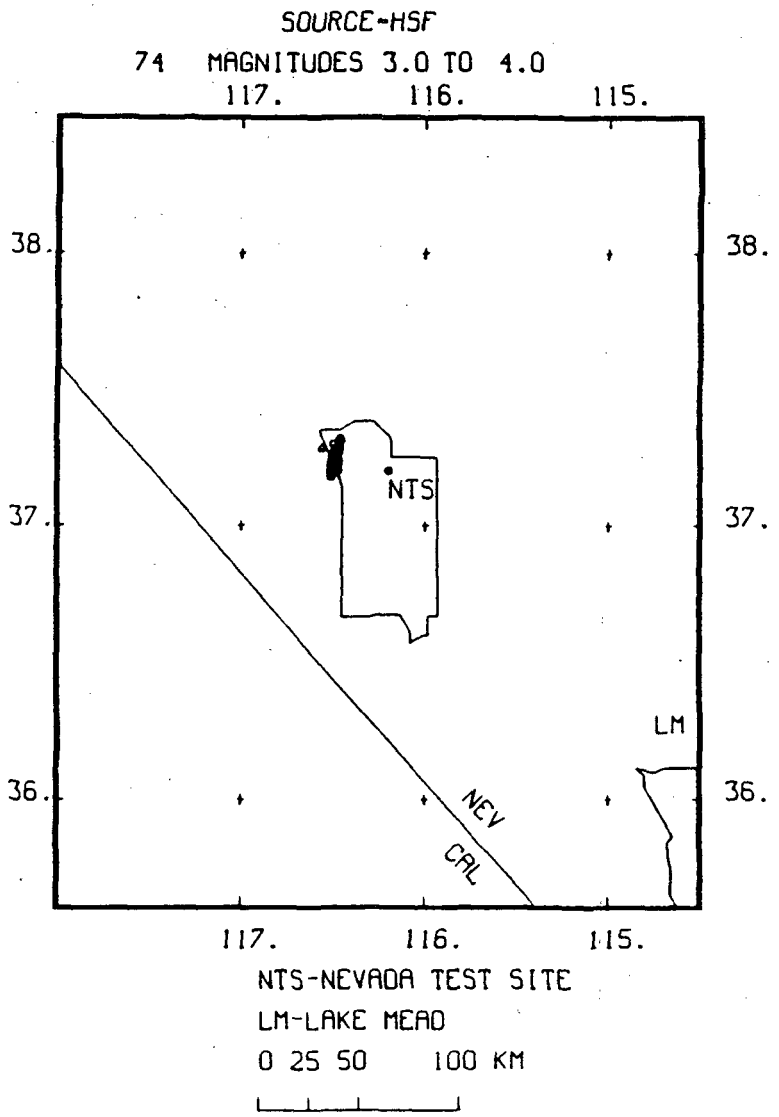

MODIFIED HSF
66 MAGNITUDES 1.0 TO 2.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

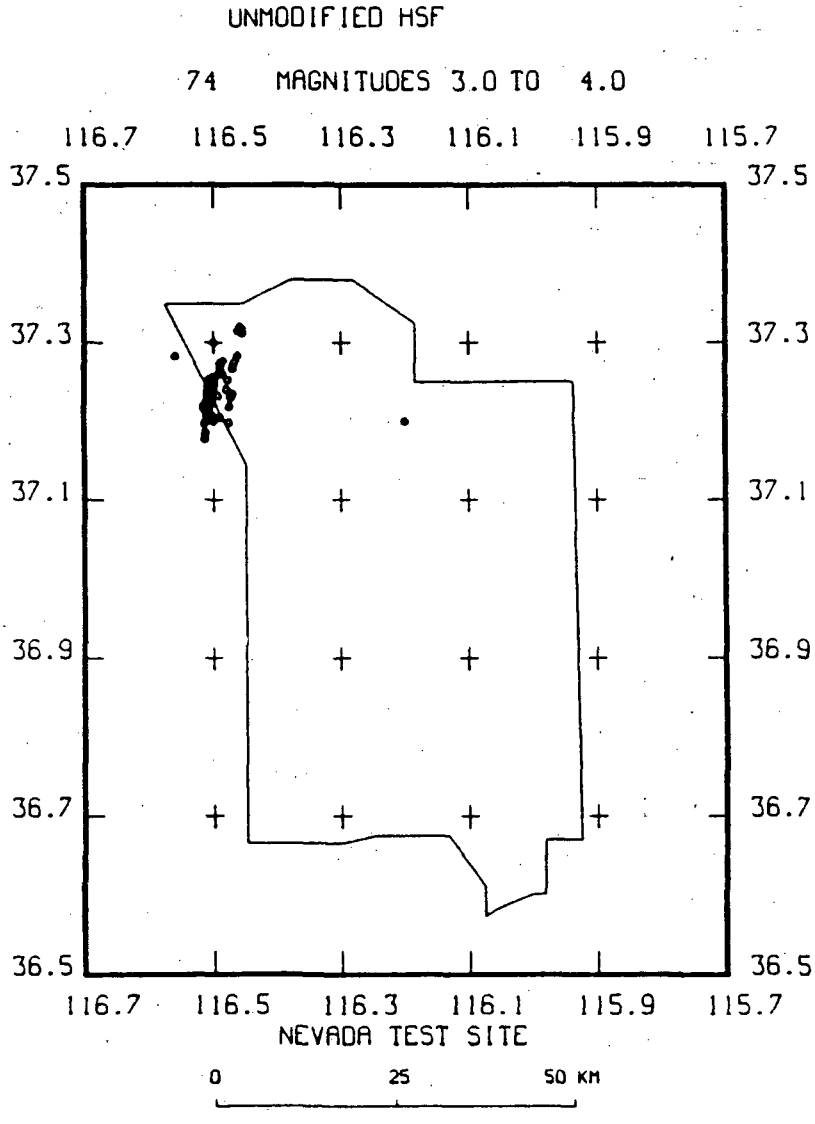

SOURCE-HSF
837 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

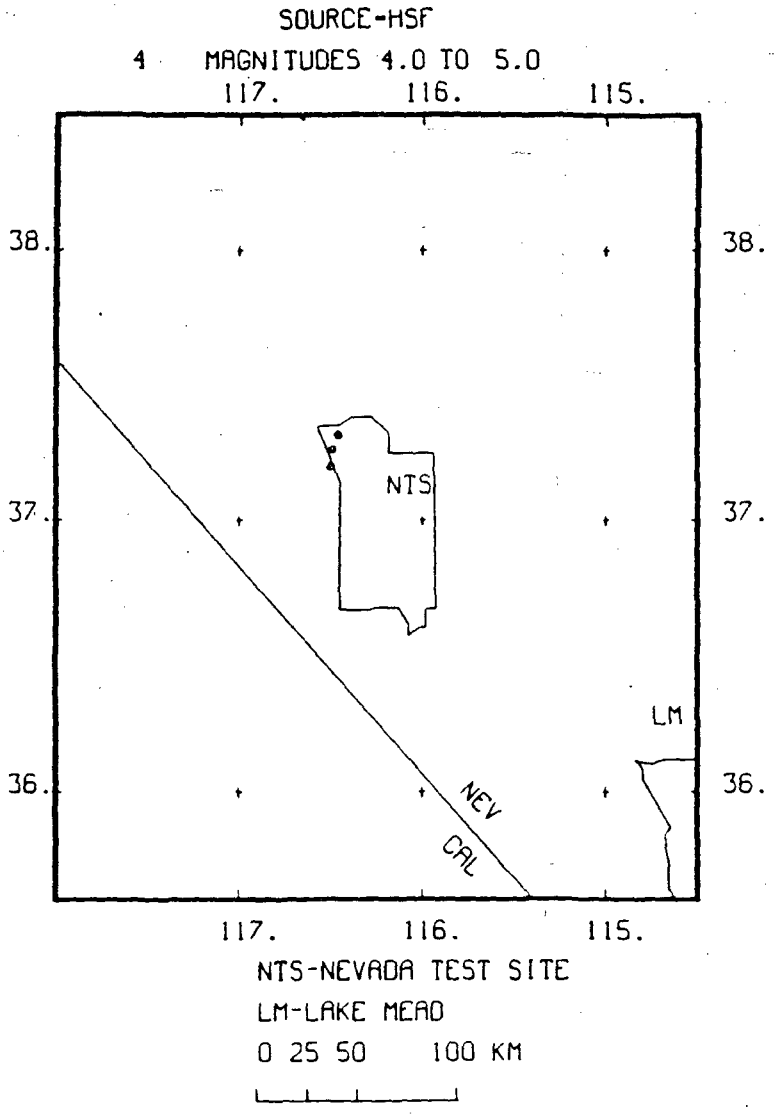

MODIFIED HSF
28 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED HSF
836 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

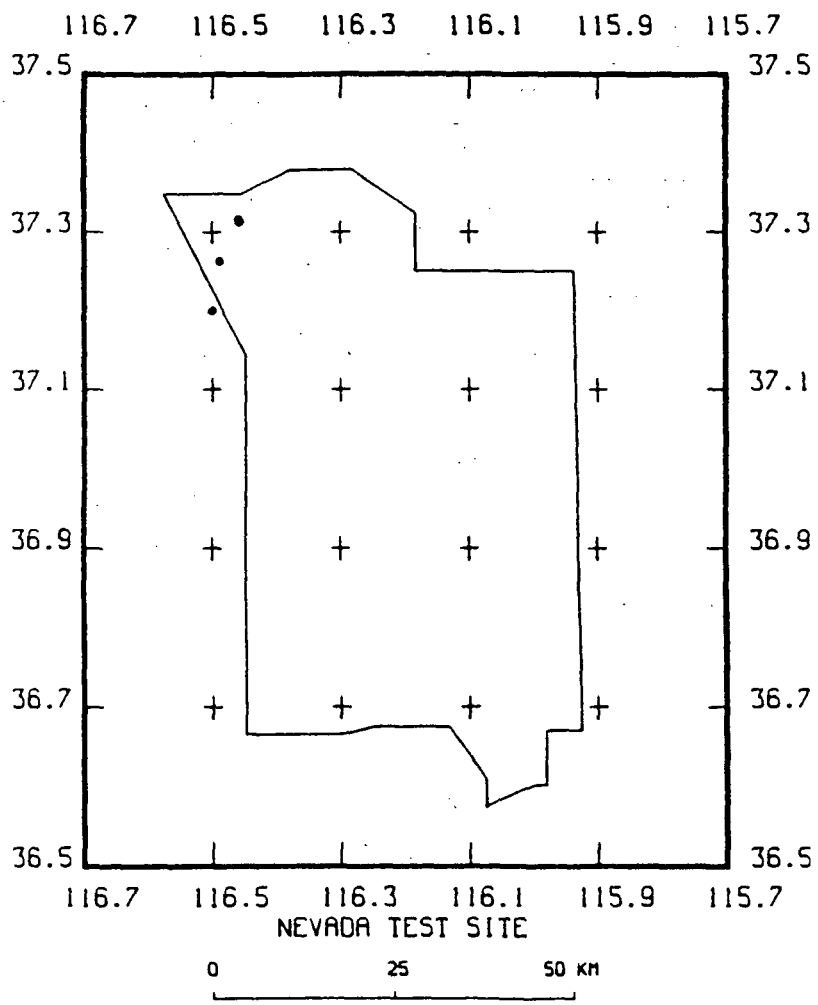

MODIFIED HSF
27 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


SOURCE-HSF
74 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED HSF
74 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

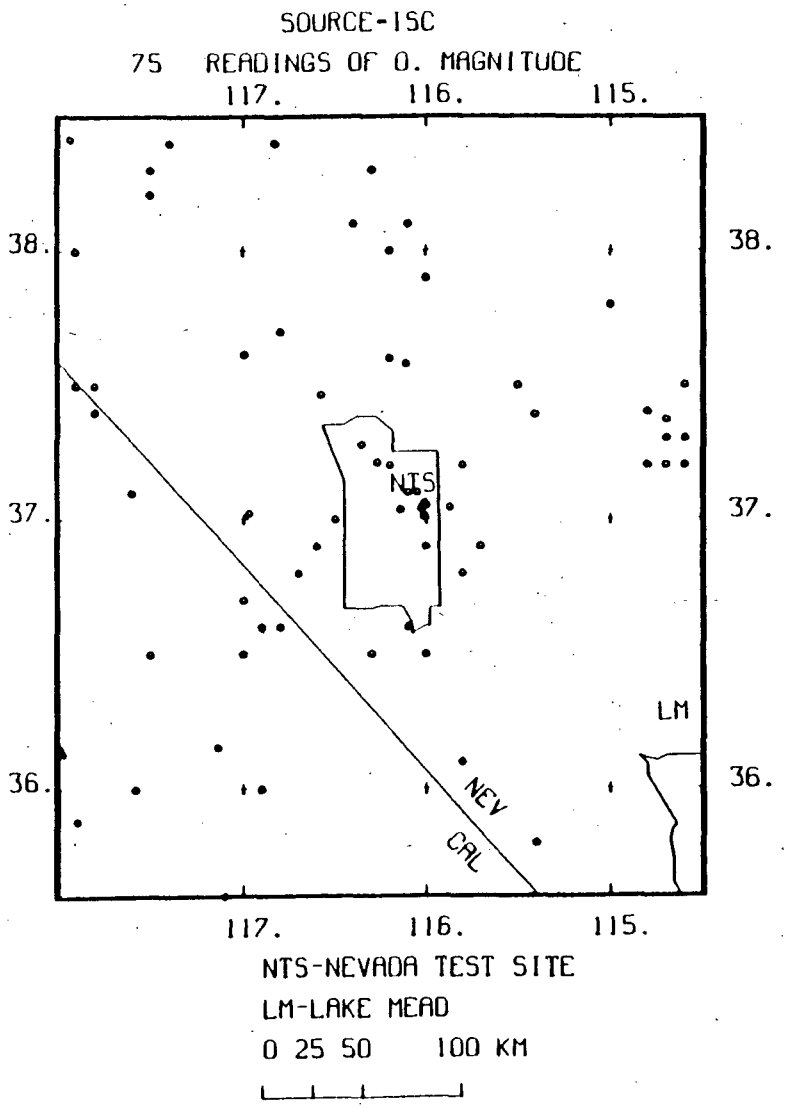

SOURCE-HSF
4 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

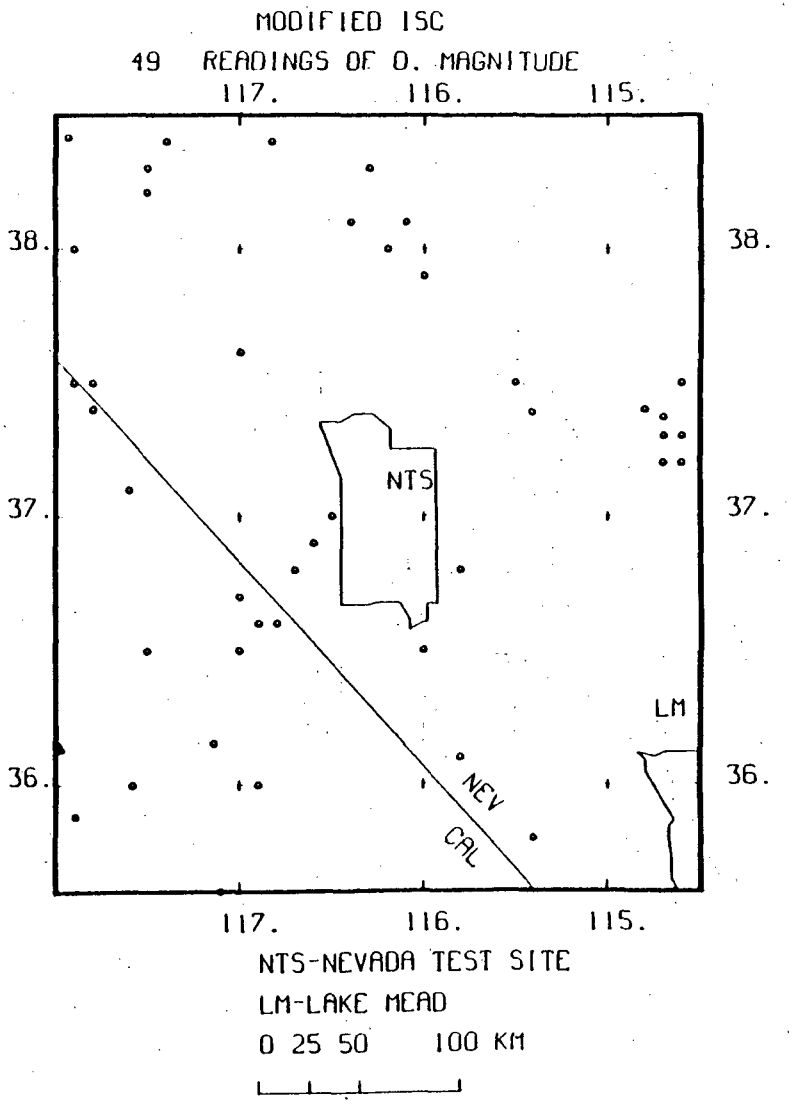
UNMODIFIED HSF

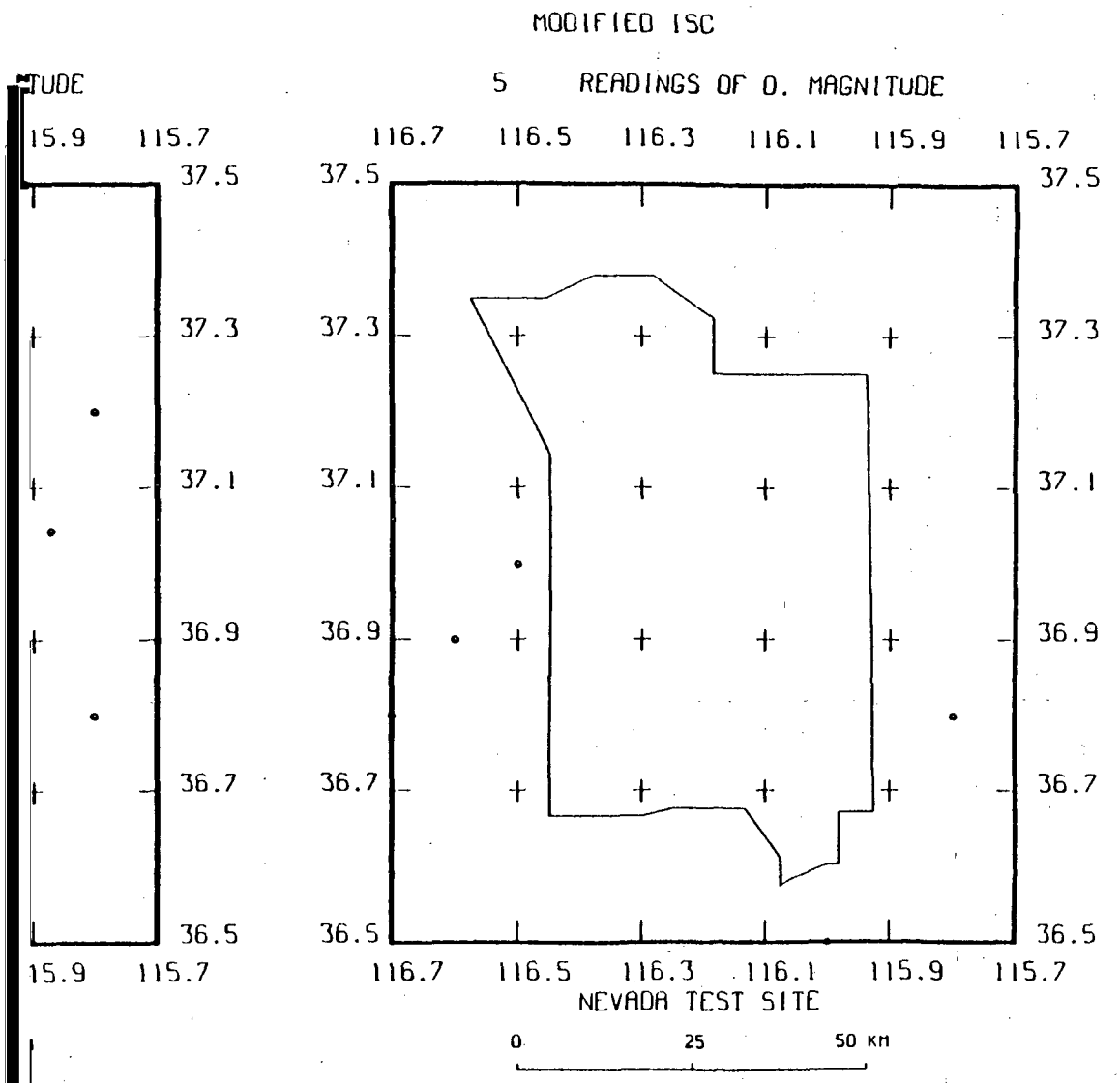


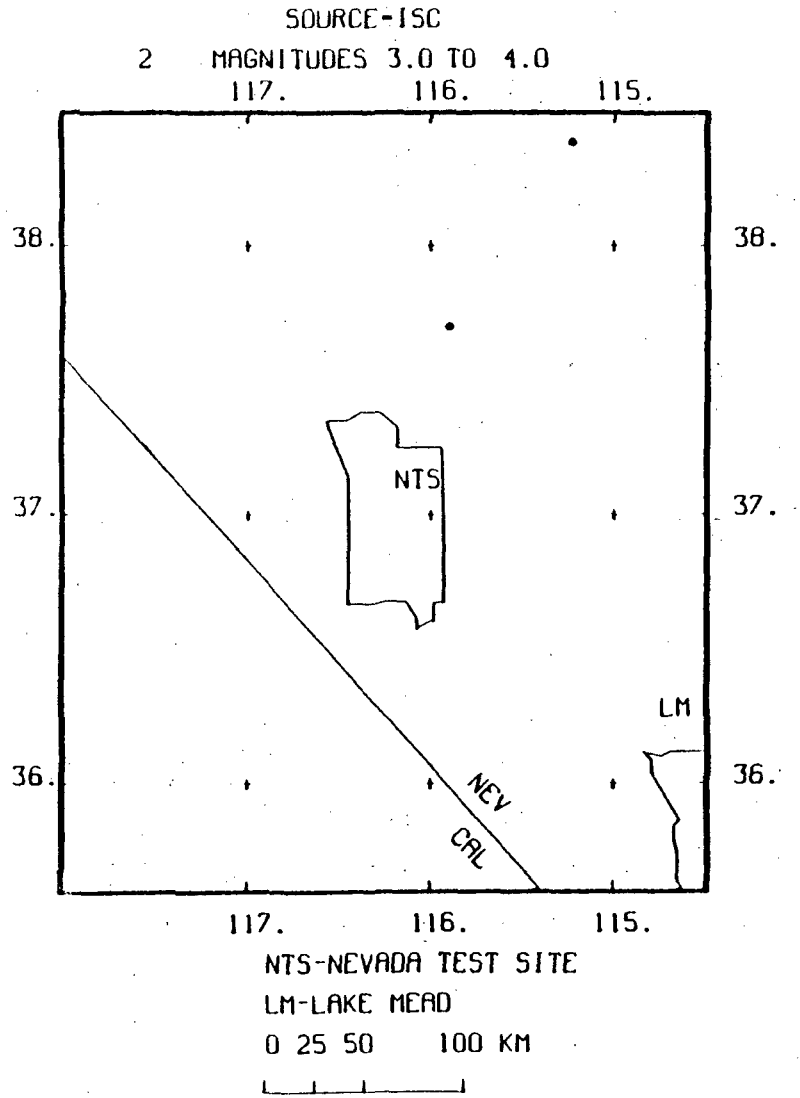
APPENDIX J

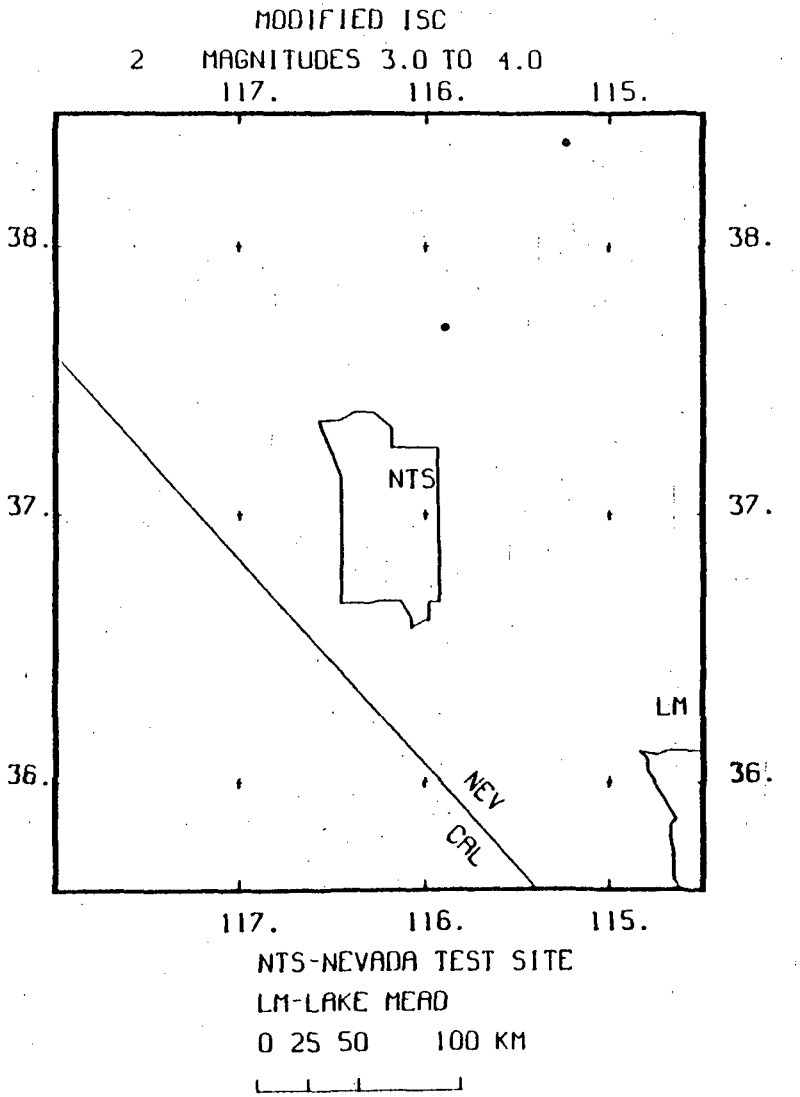
SOURCE - ISC

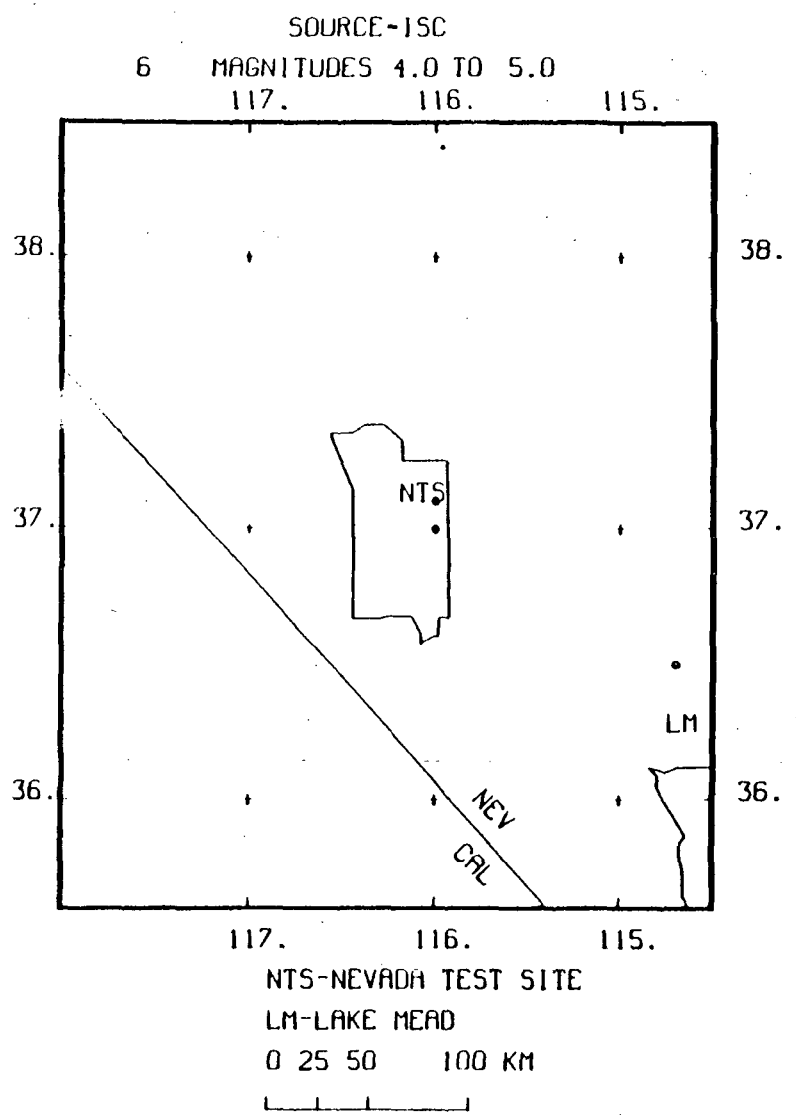

SOURCE-ISC
75 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

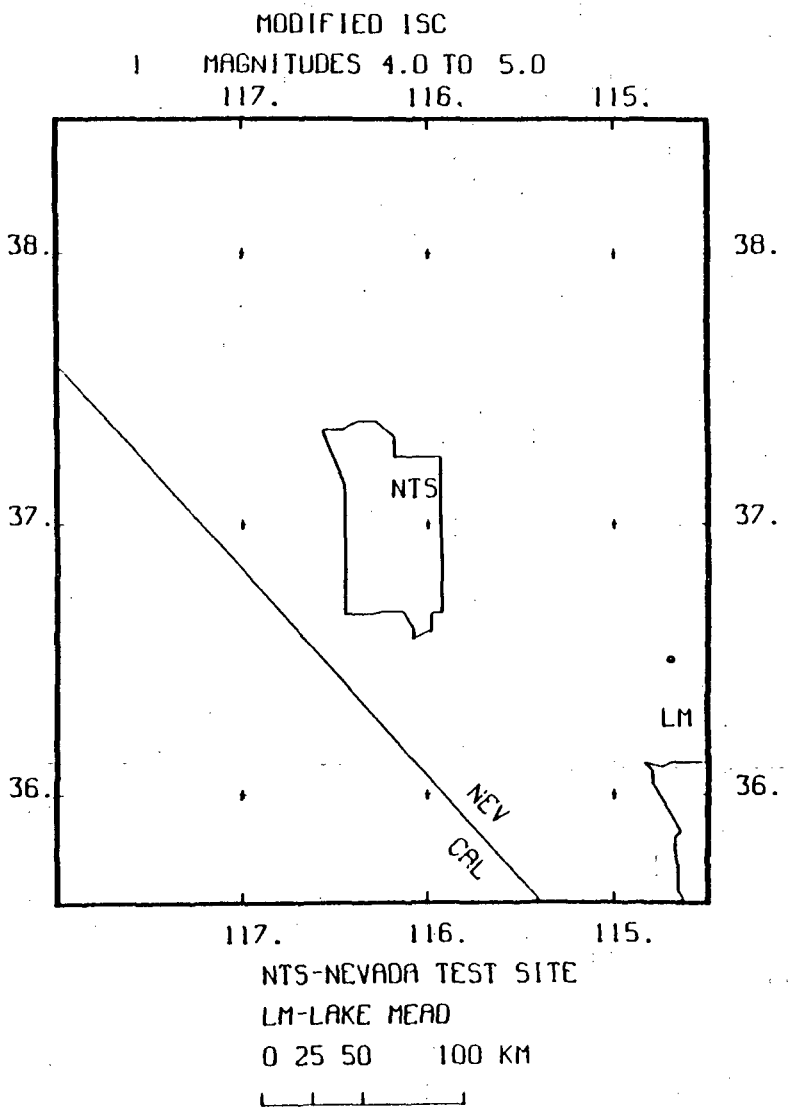

MODIFIED ISC
49 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

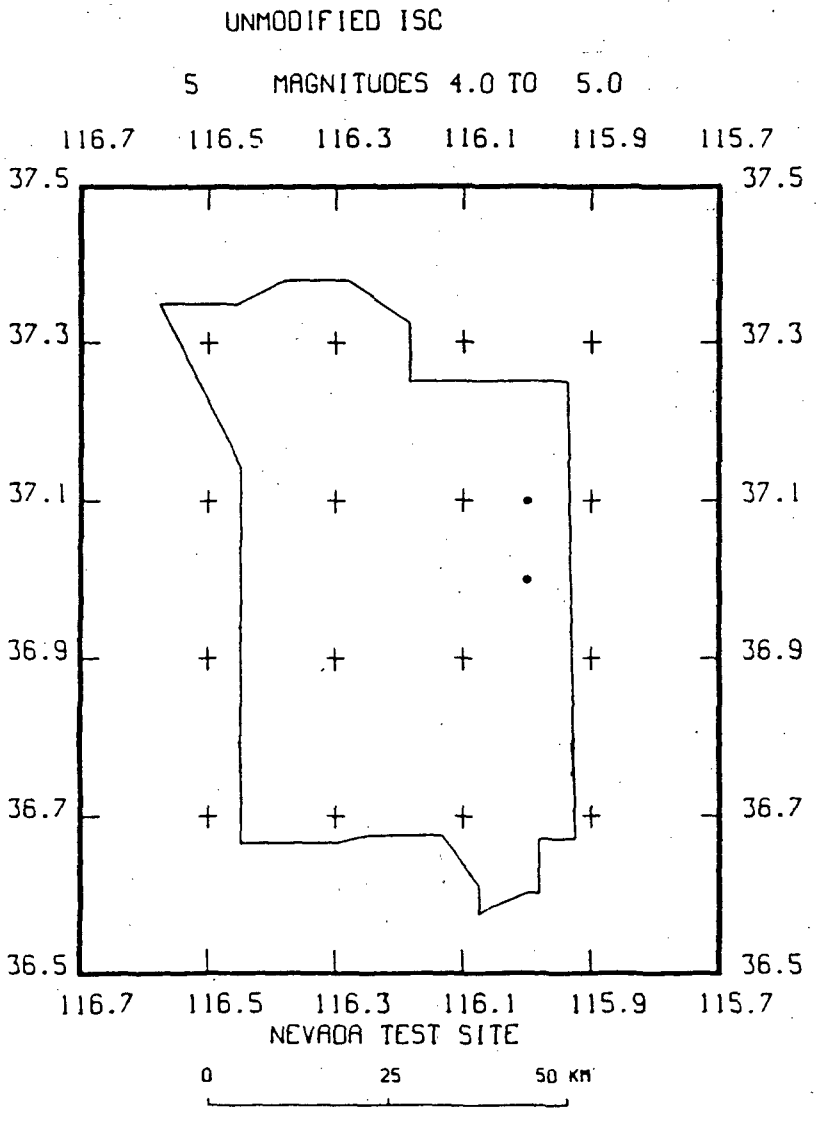

TUDE
15.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
MODIFIED ISC
5 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
NEVADA TEST SITE
0
25
50 KM


SOURCE-ISC
2 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED ISC
2 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

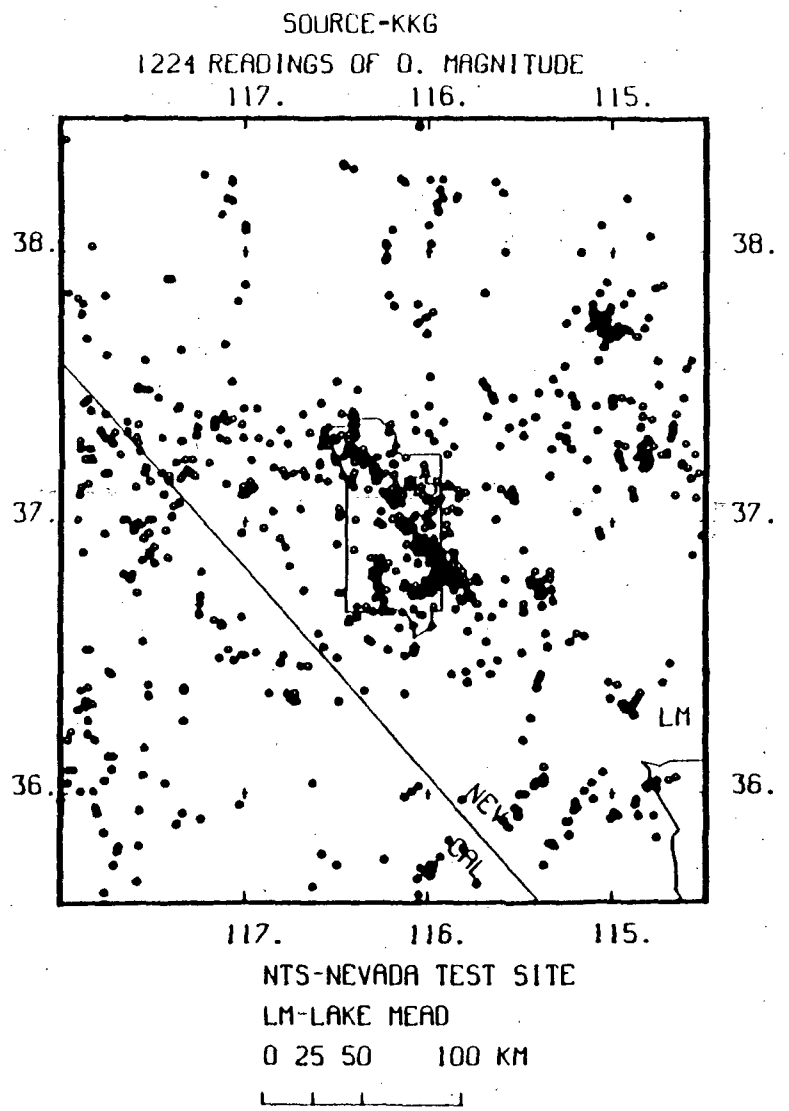

SOURCE-ISC
6 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

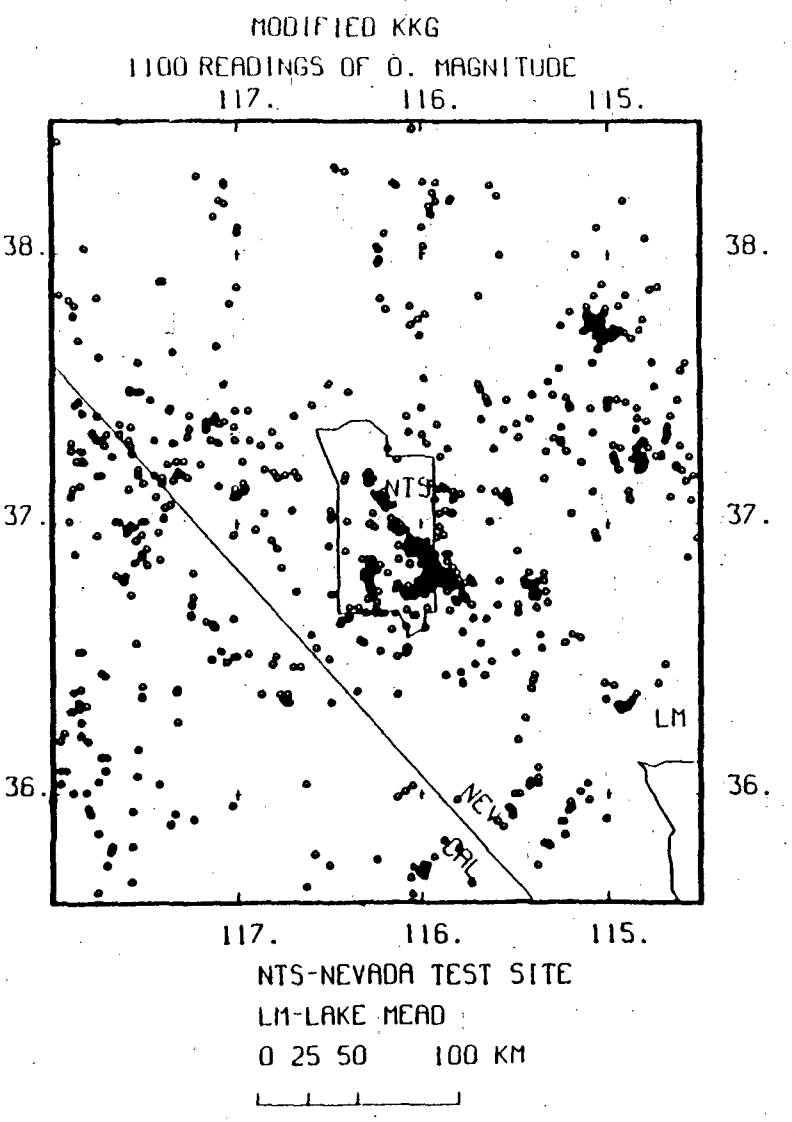

MODIFIED ISC
1 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

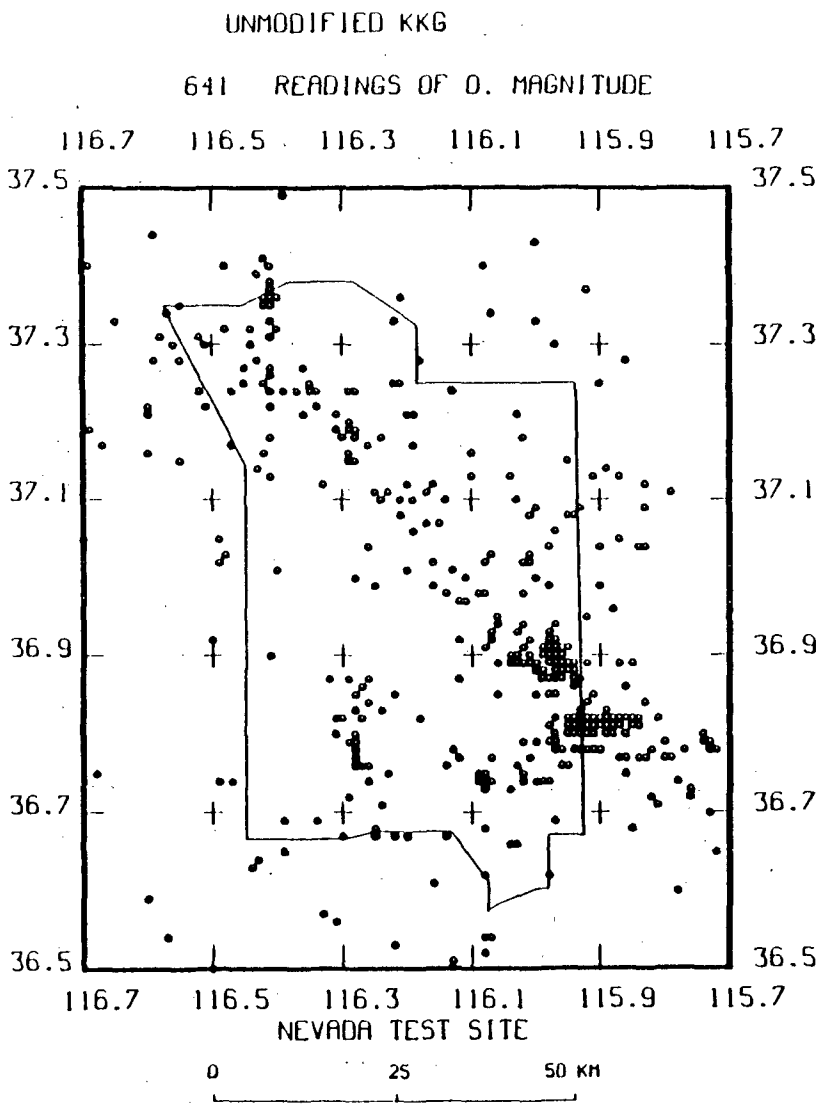

UNMODIFIED ISC
5 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

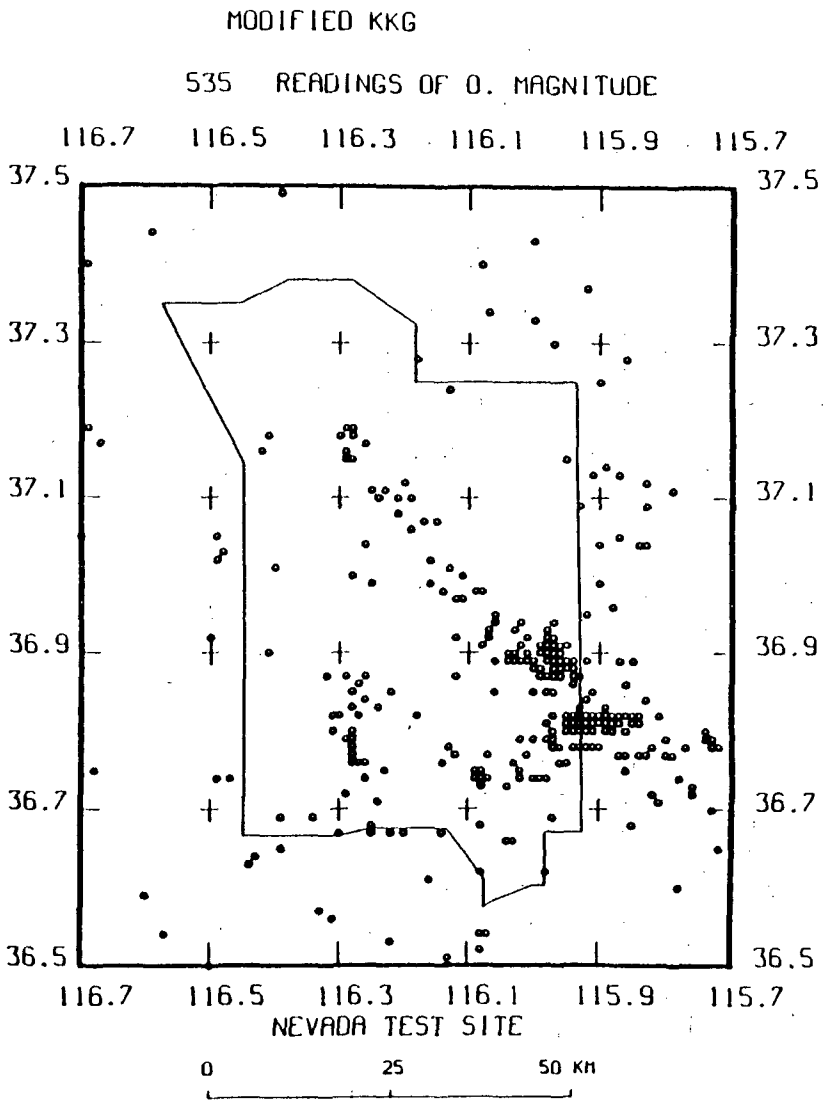
APPENDIX K

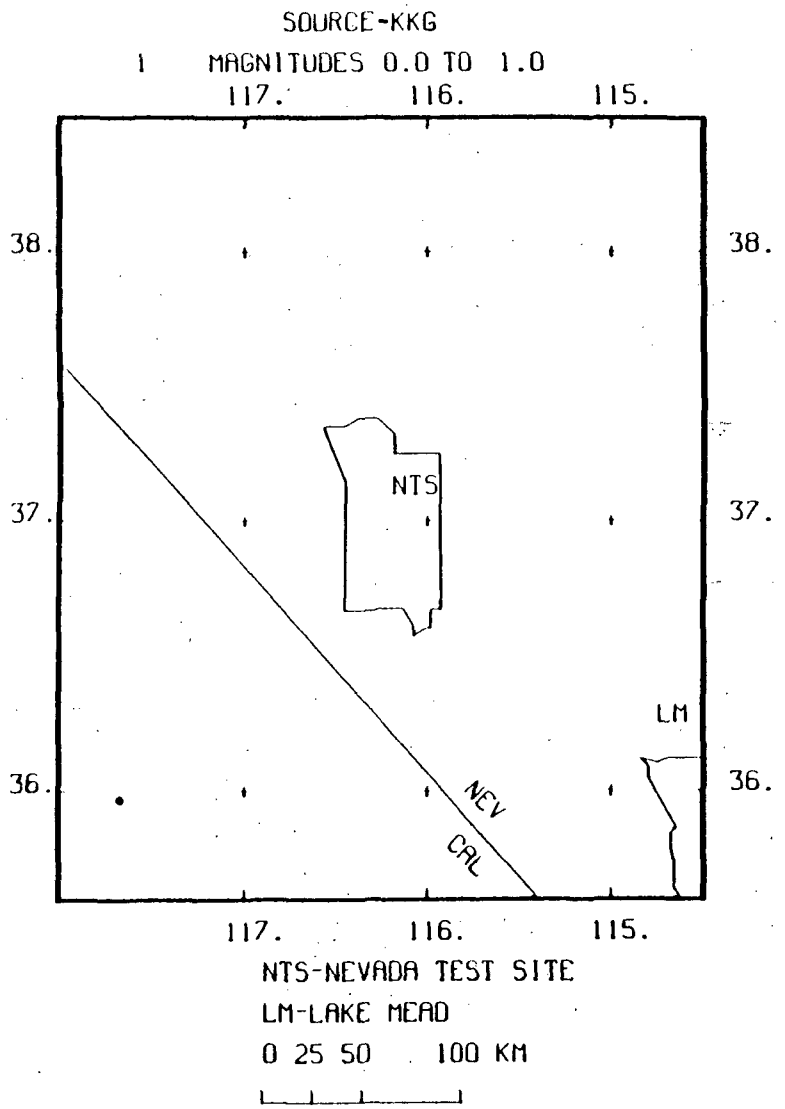
SOURCE - KKG

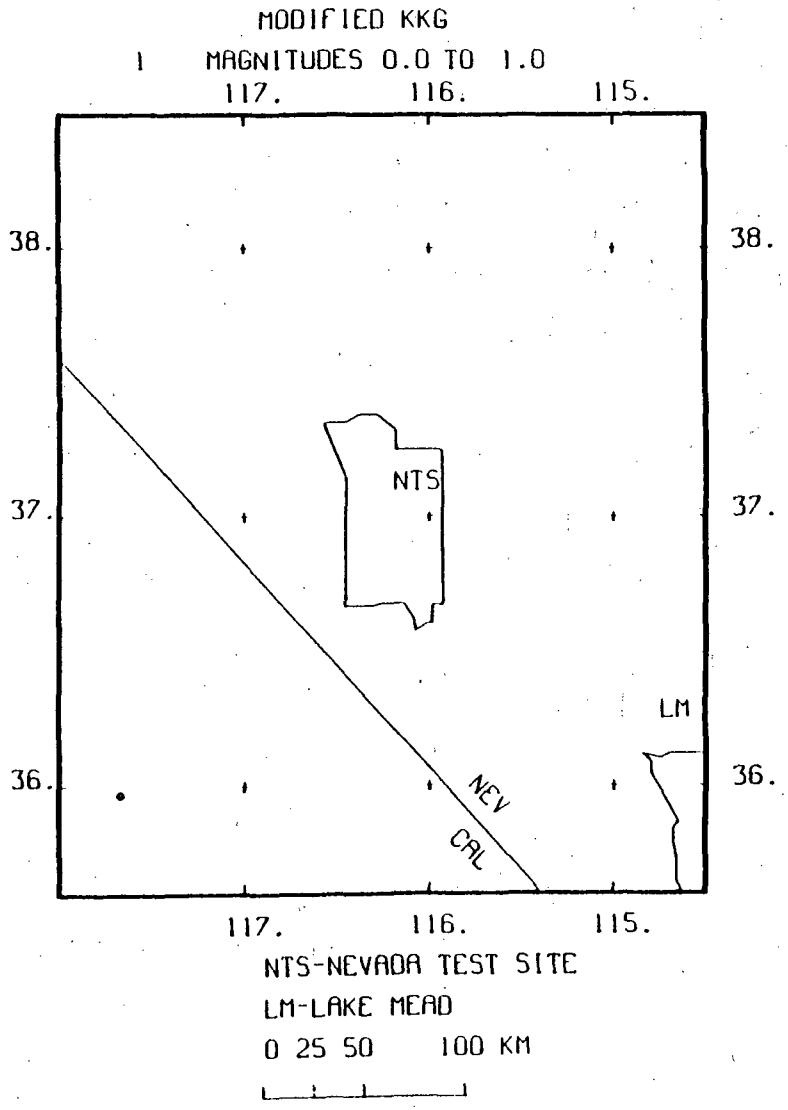

SOURCE-KKG
1224 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

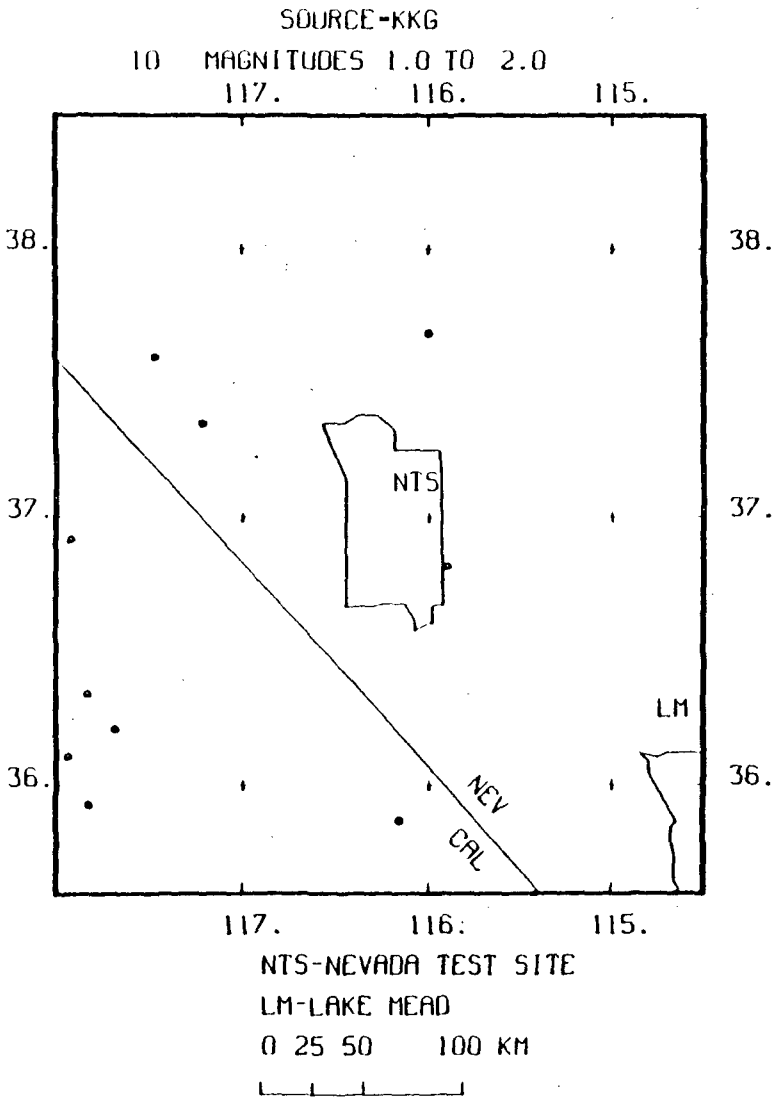

MODIFIED KKG
1100 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

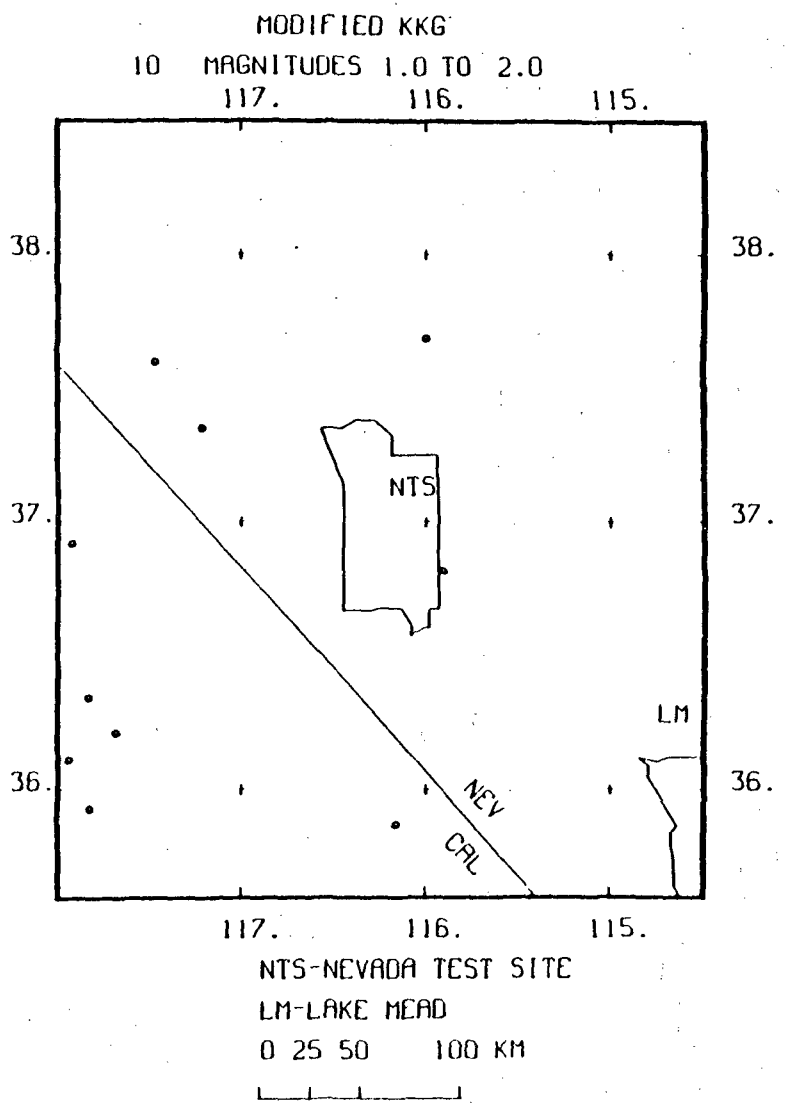

UNMODIFIED KKG
641 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

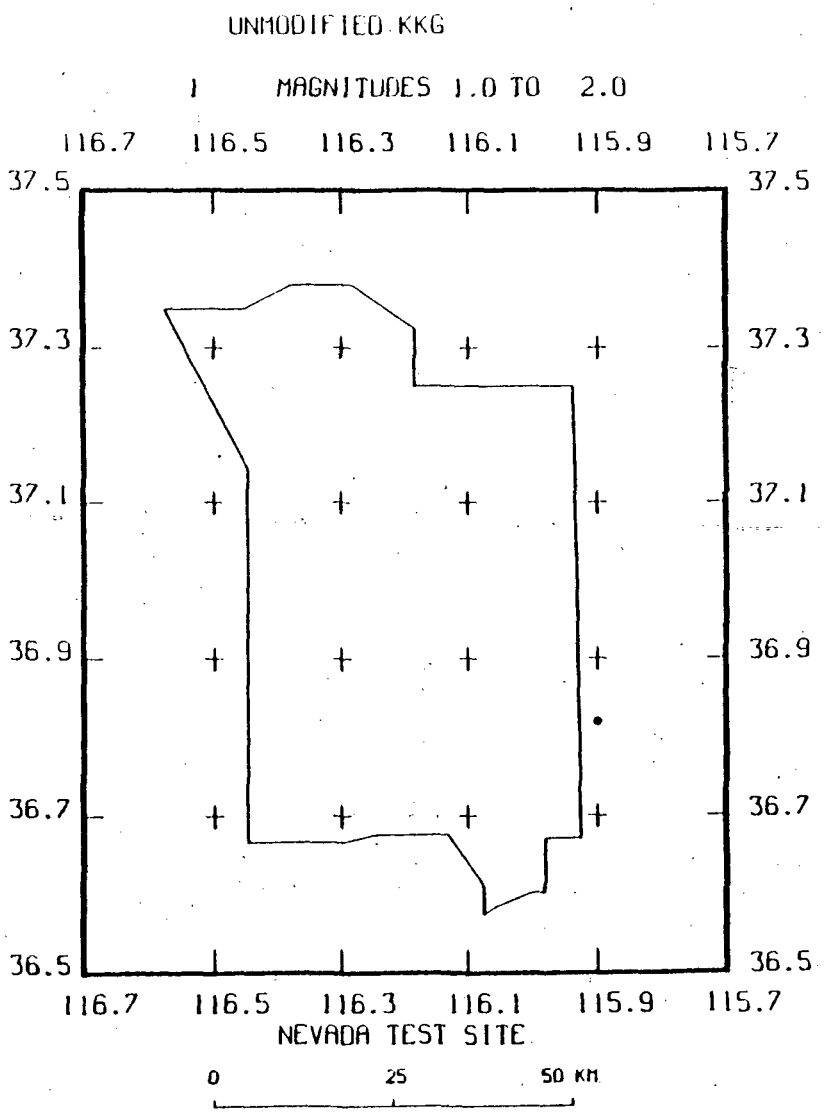

MODIFIED KKG
535 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

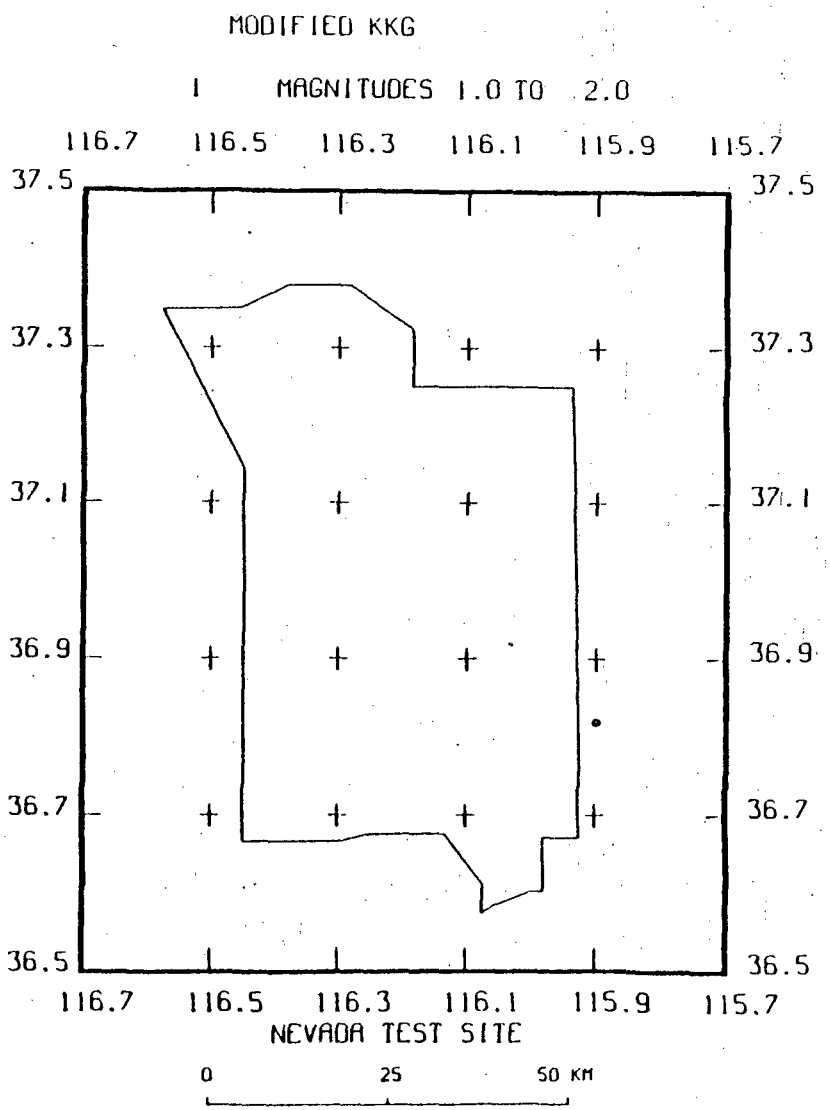

SOURCE-KKG
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

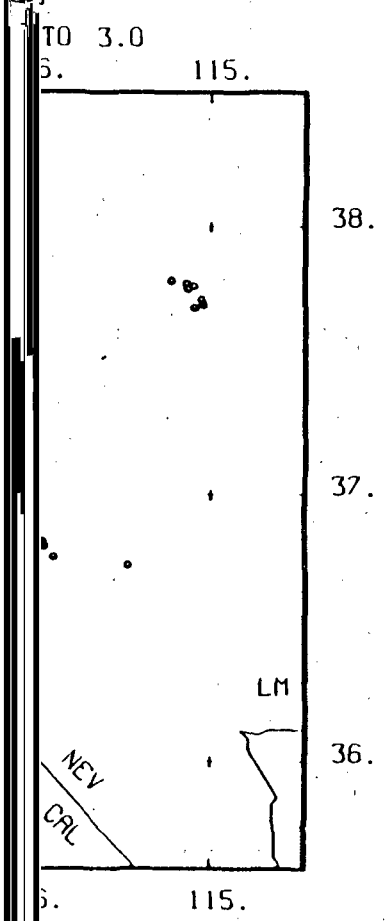

MODIFIED KKG
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

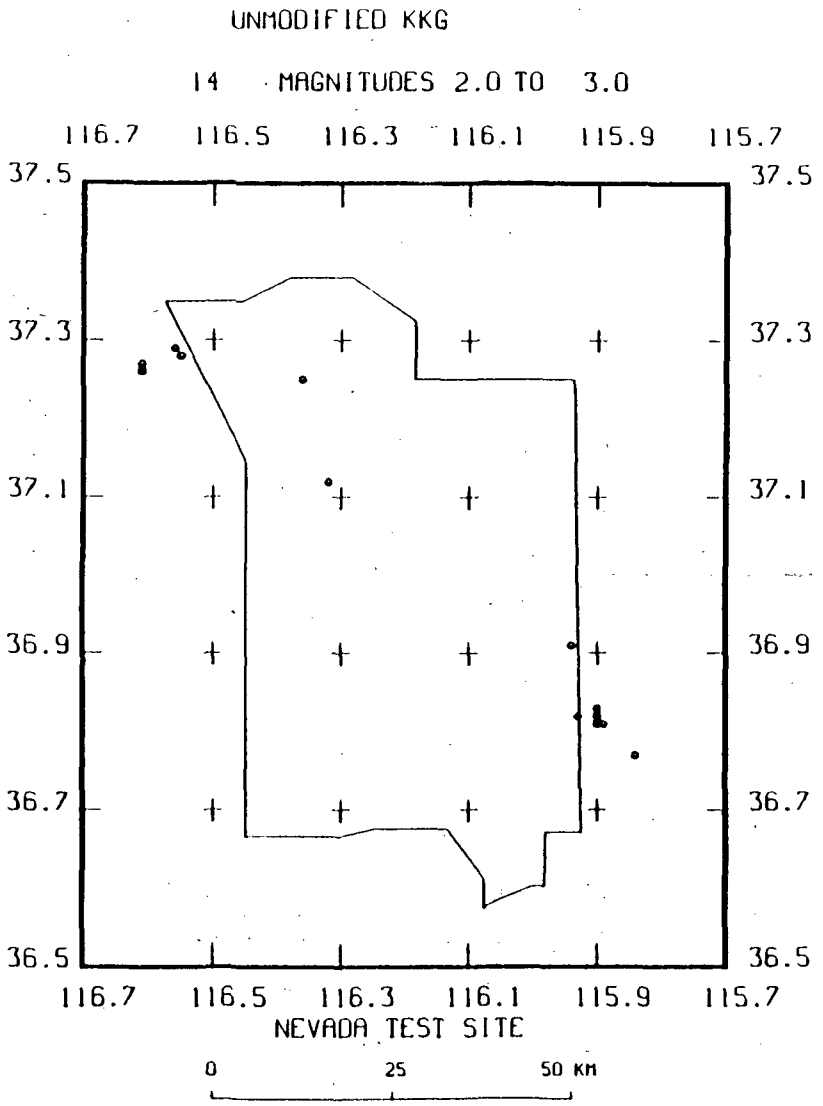

SOURCE-KKG
10 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

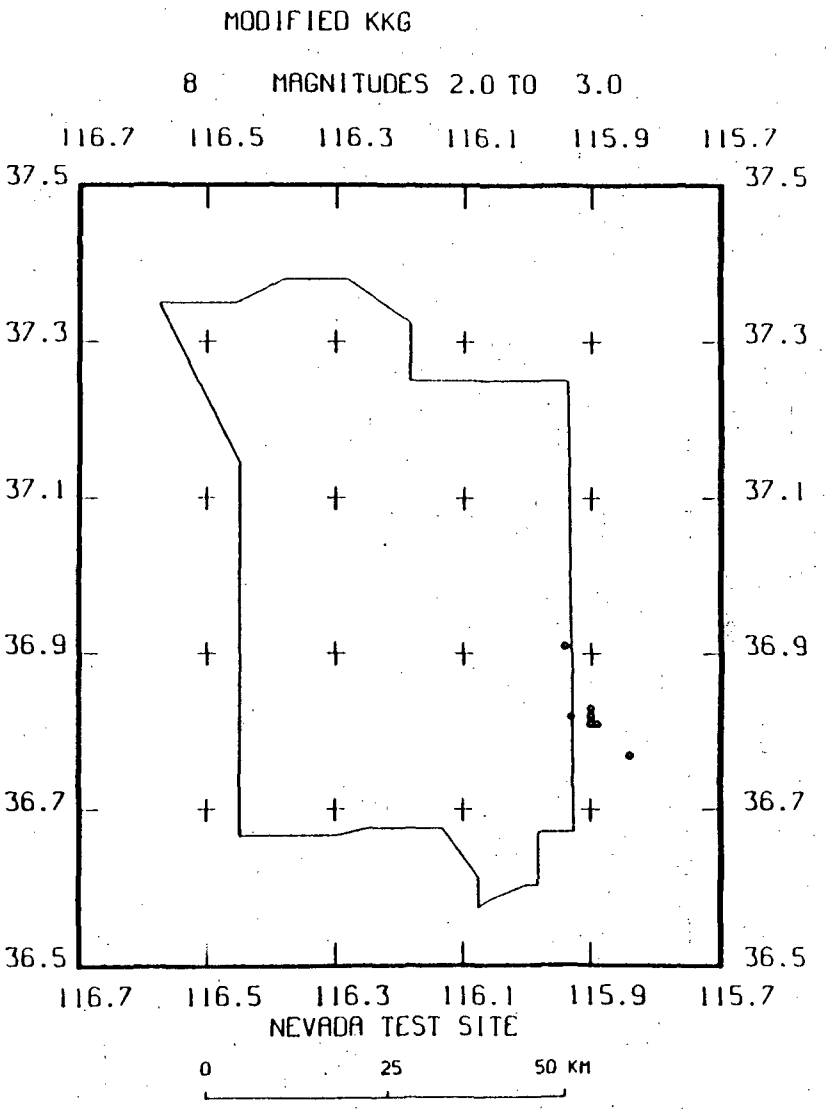

MODIFIED KKG
10 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

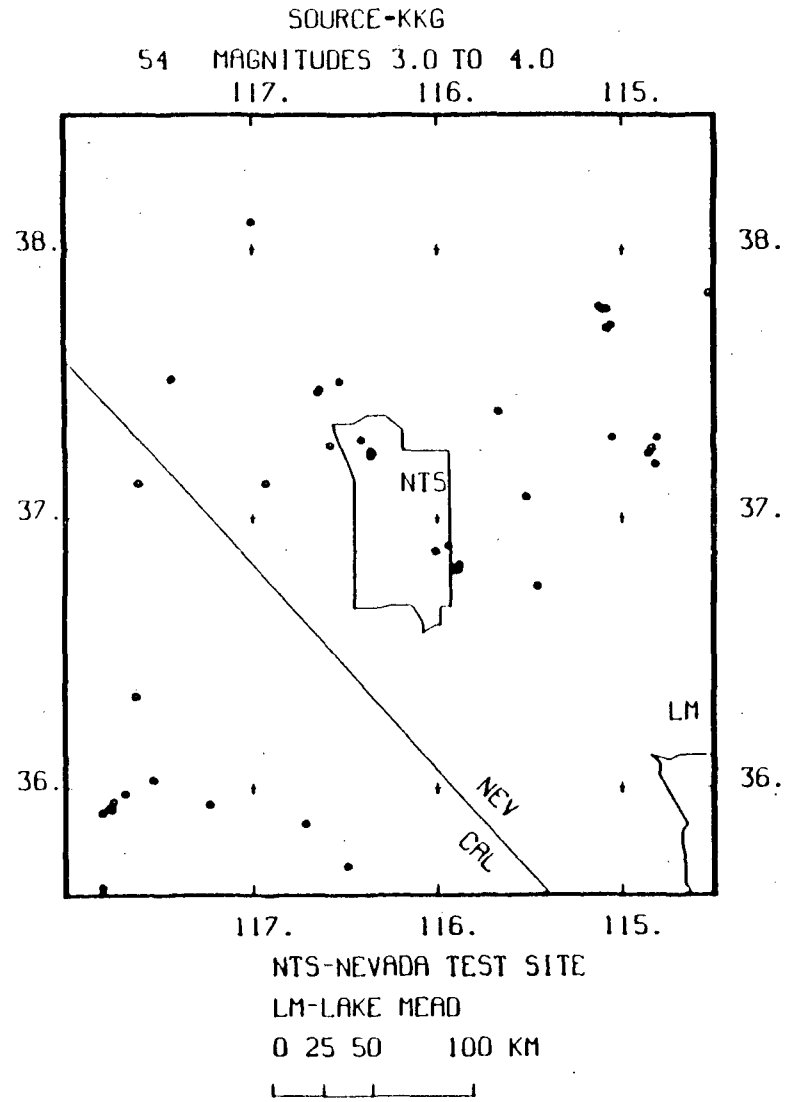

UNMODIFIED KKG
MAGNITUDES 1.0 TO 2.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

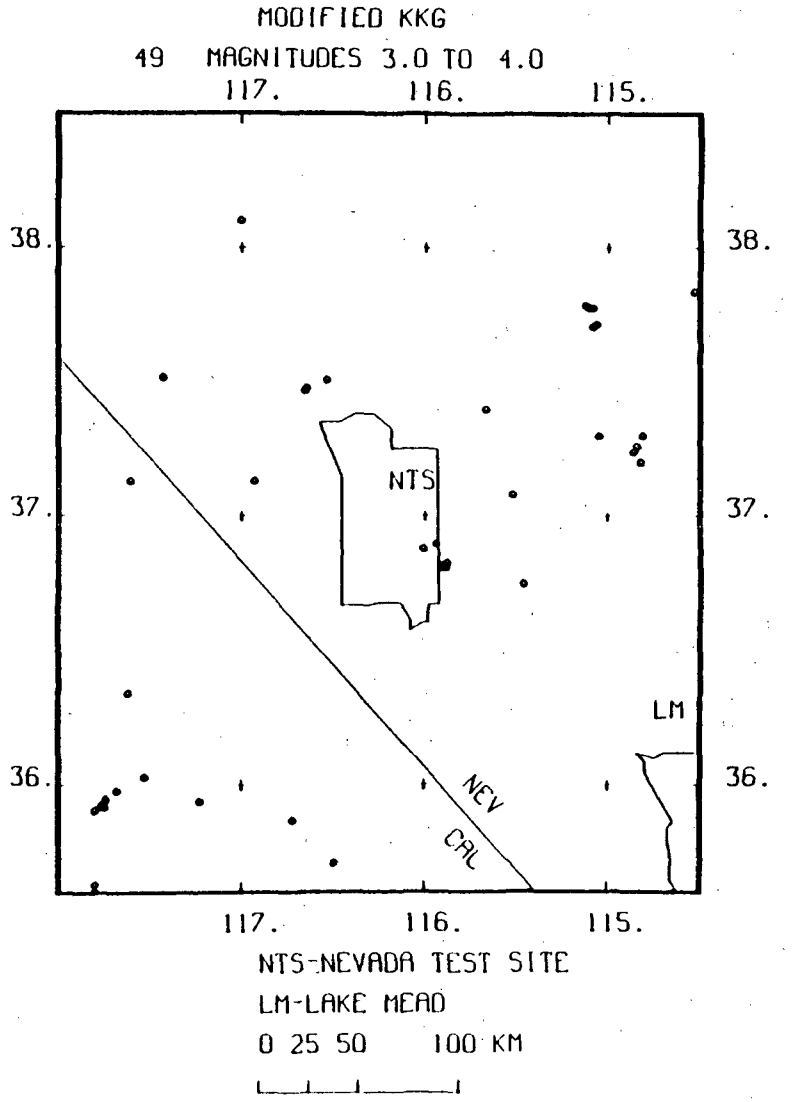

MODIFIED KKG
MAGNITUDES 1.0 TO 2.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

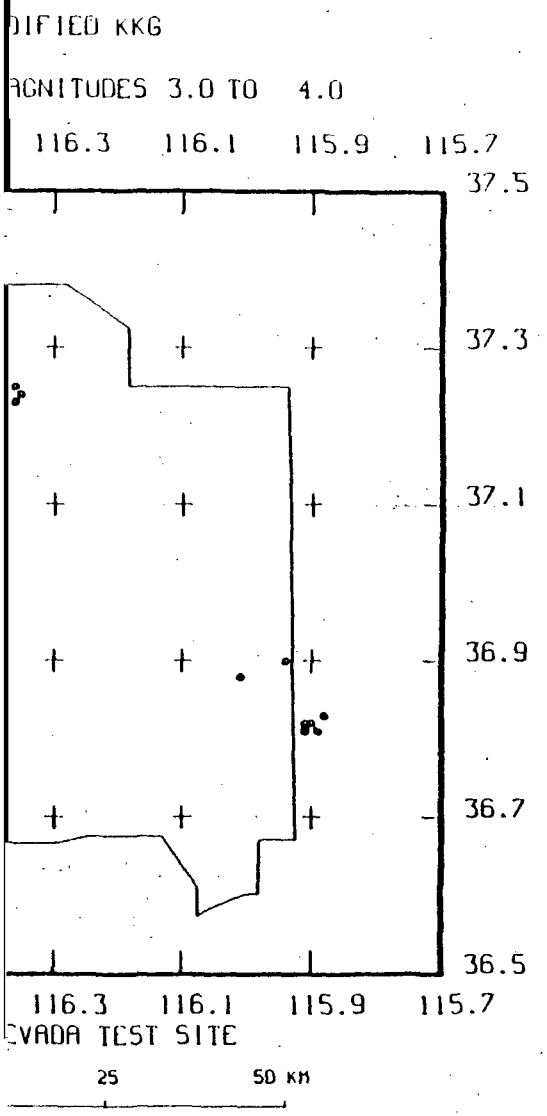

TO 3.0
6.
115.
38.
37.
LM
36.
NEV
CAL
6.
115.
EST SITE
00 KM

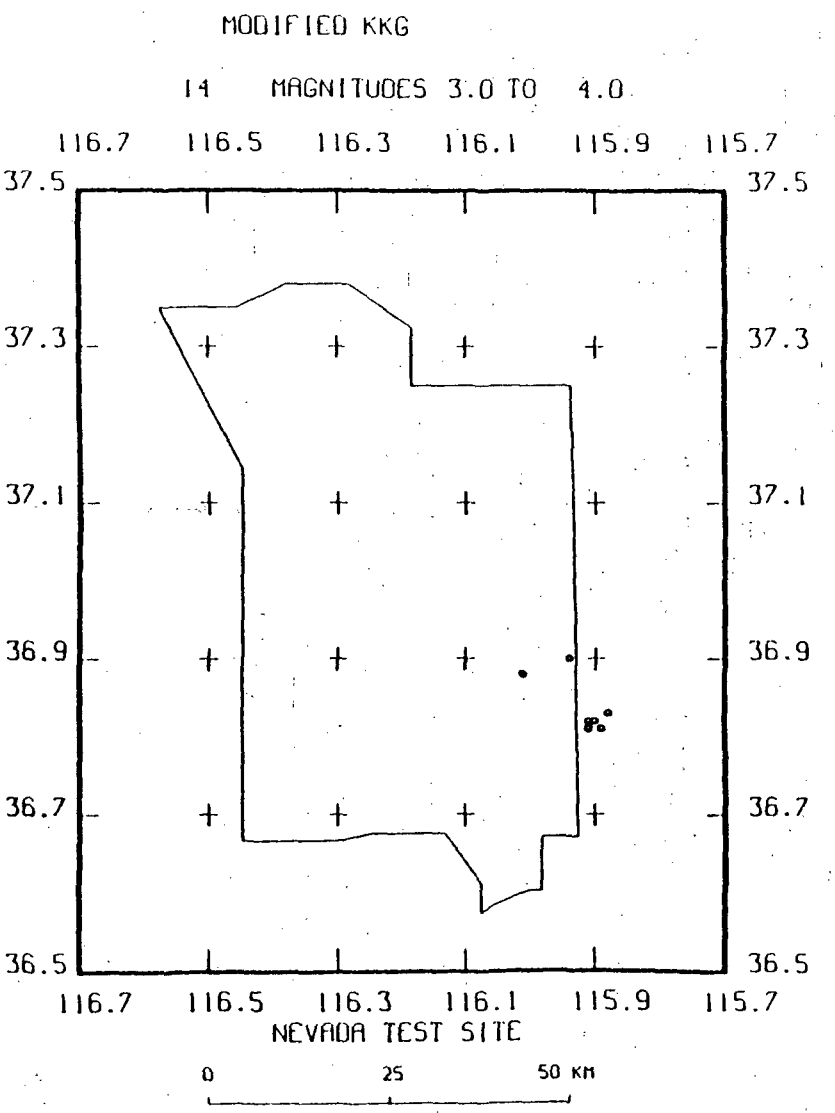

UNMODIFIED KKG
14 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

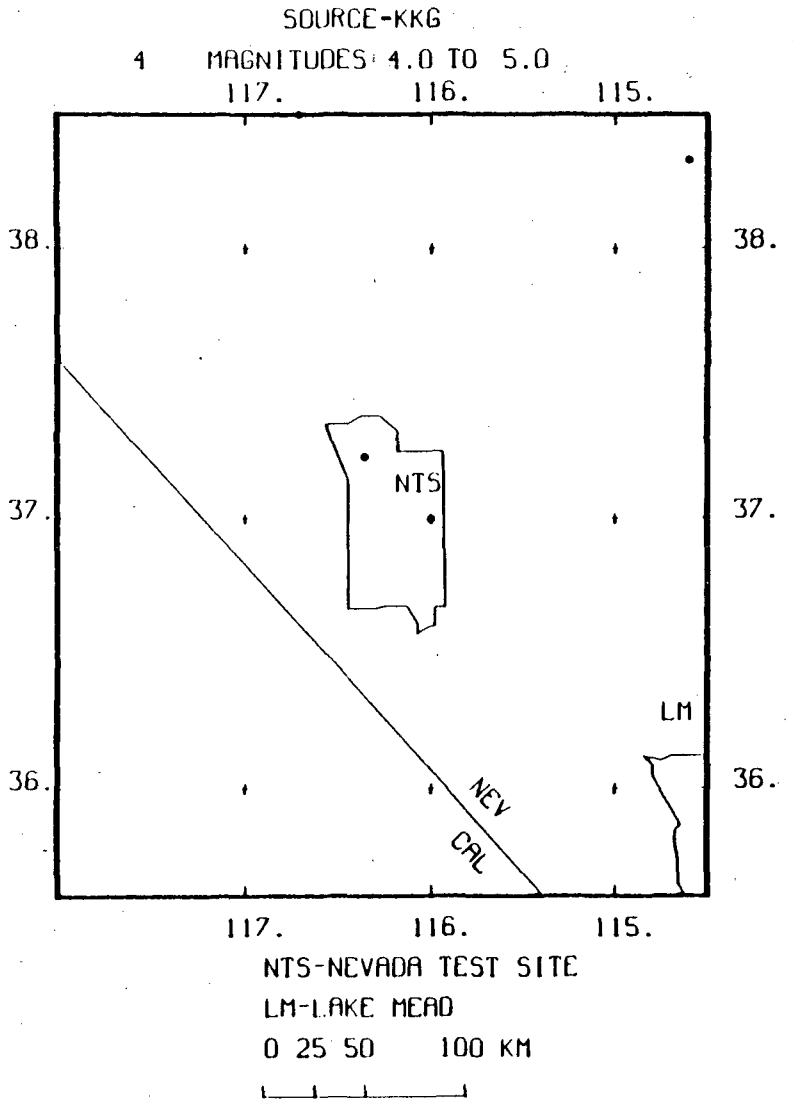

MODIFIED KKG
8 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

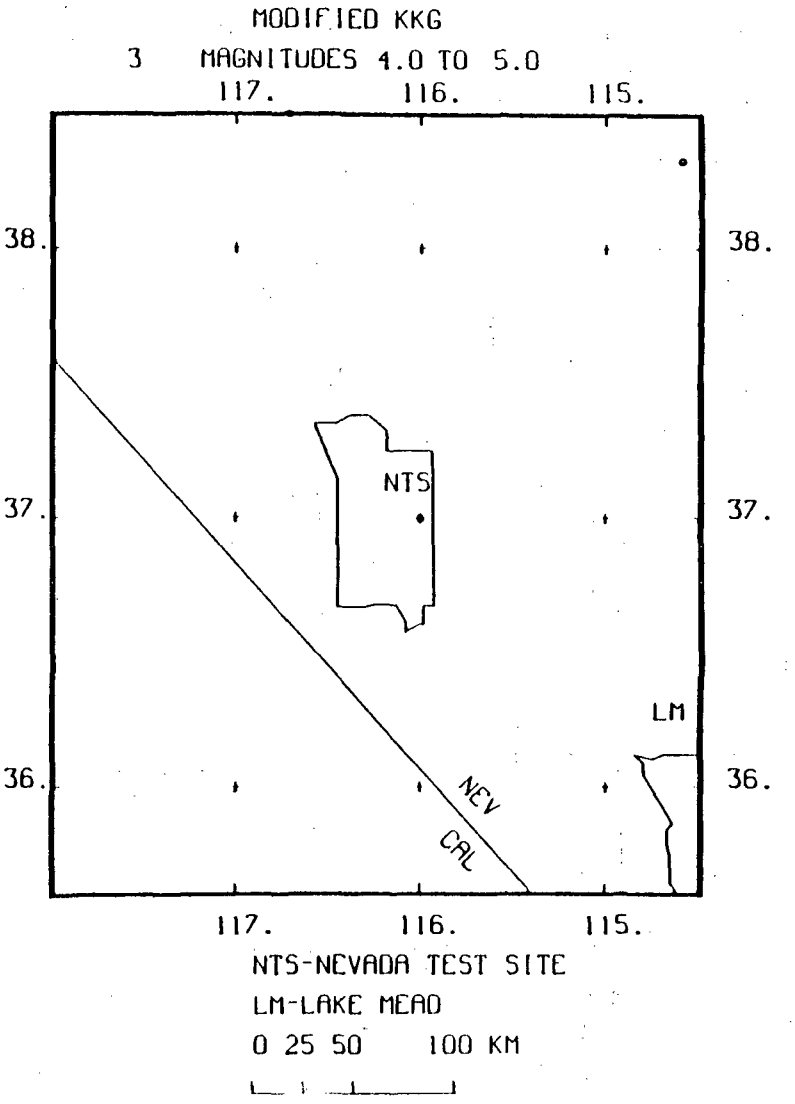

SOURCE-KKG
54 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

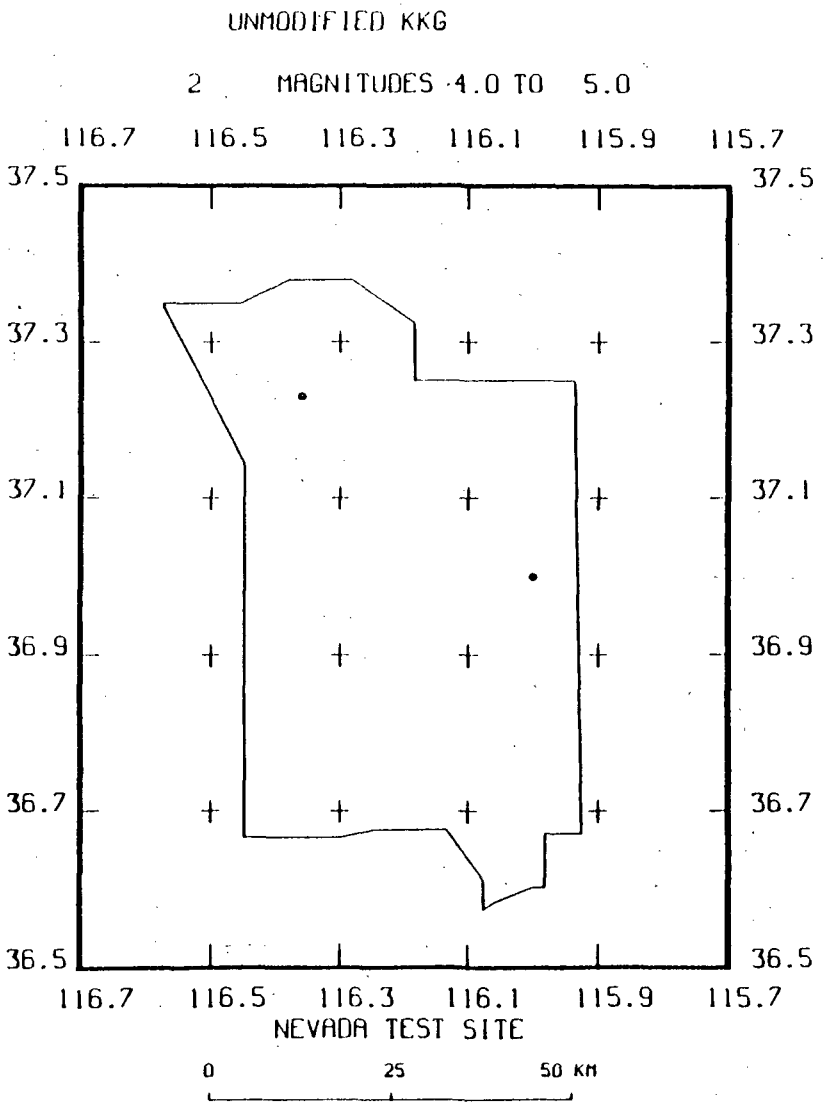

MODIFIED KKG
49 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

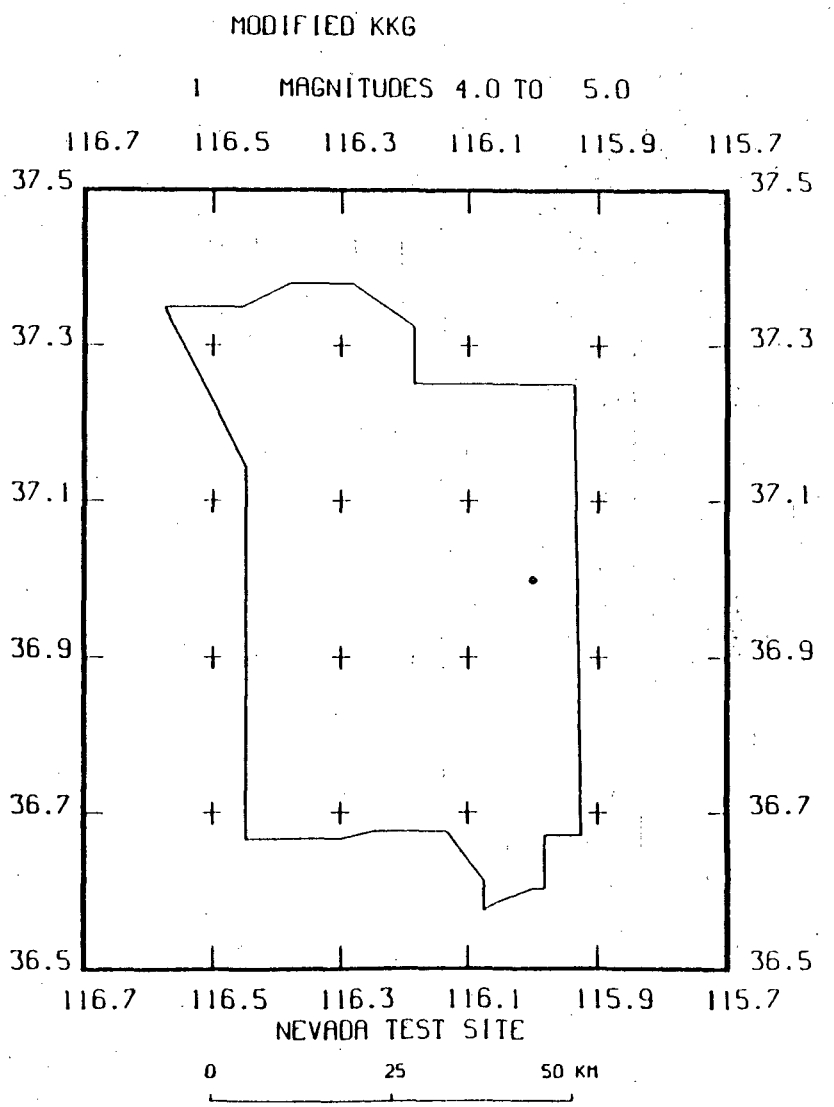

DIFIED KKG
AGNITUDES 3.0 TO 4.0
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
VADA TEST SITE
25
50 KM

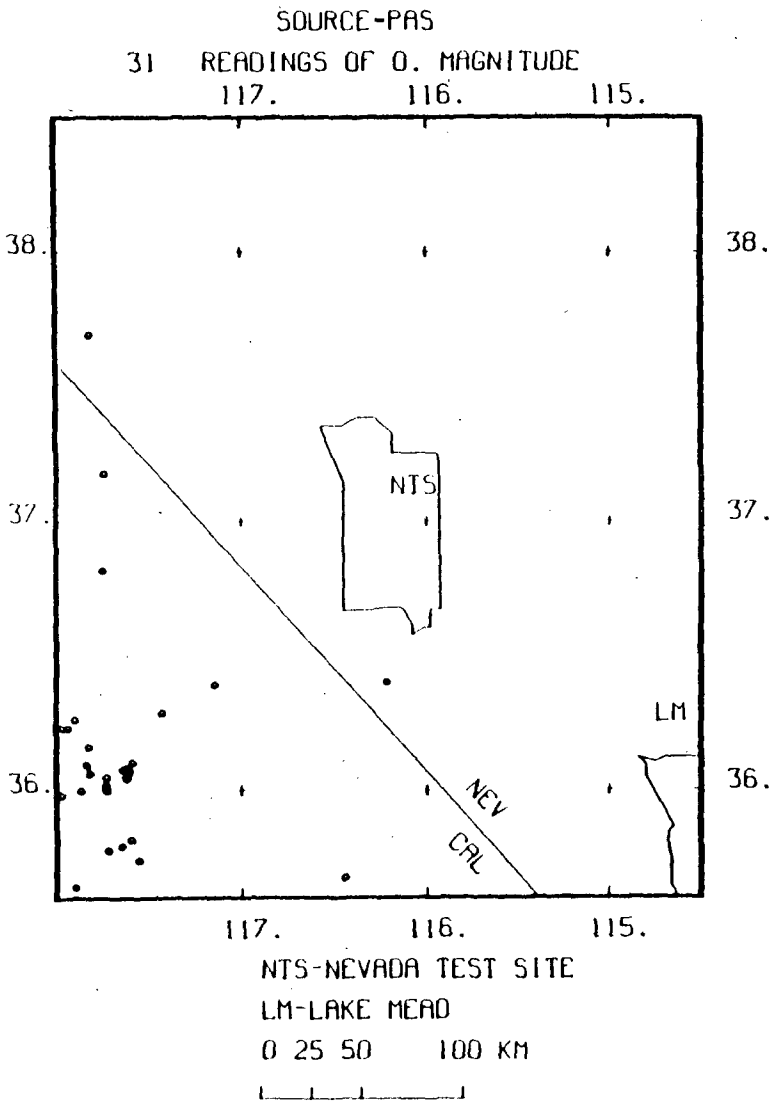

MODIFIED KKG
14 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

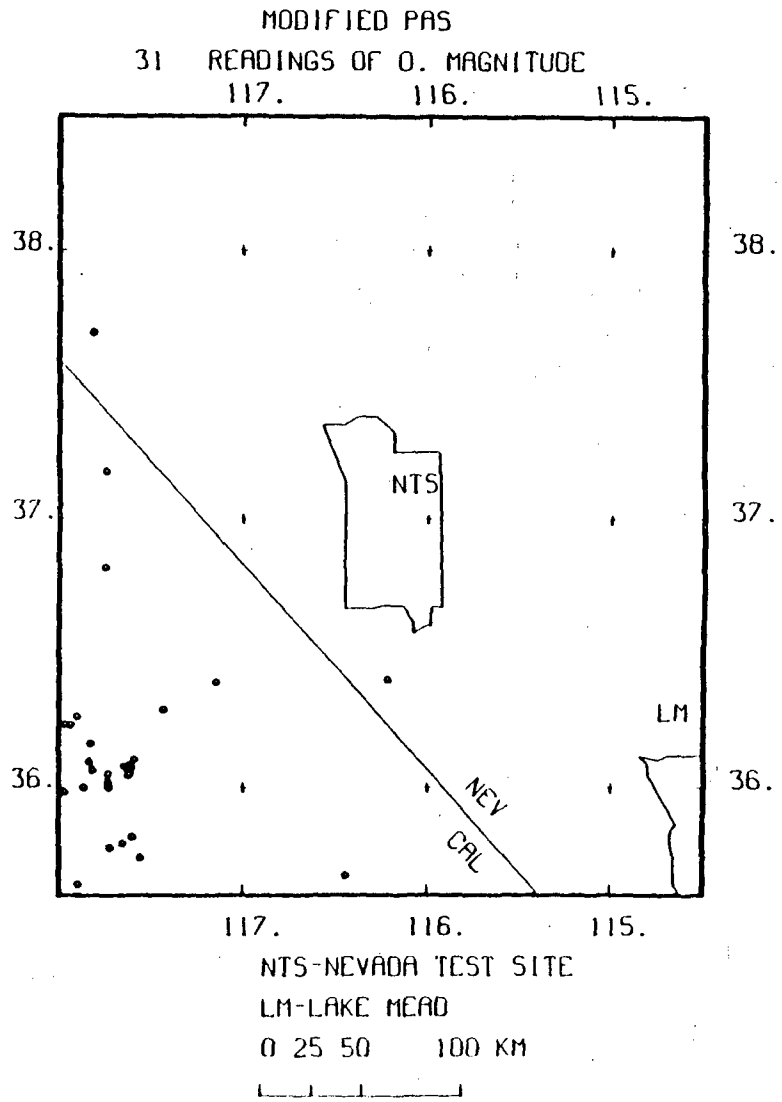

SOURCE-KKG
4 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED KKG
3 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED KKG
2 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

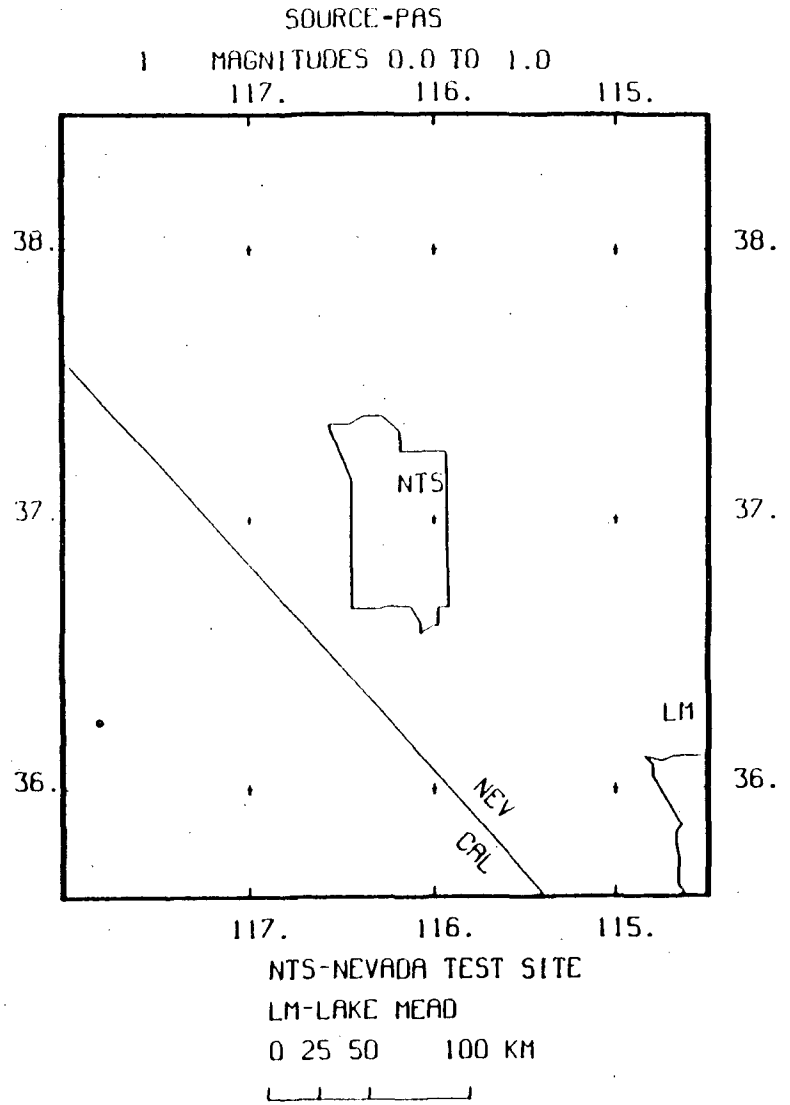

MODIFIED KKG
1 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

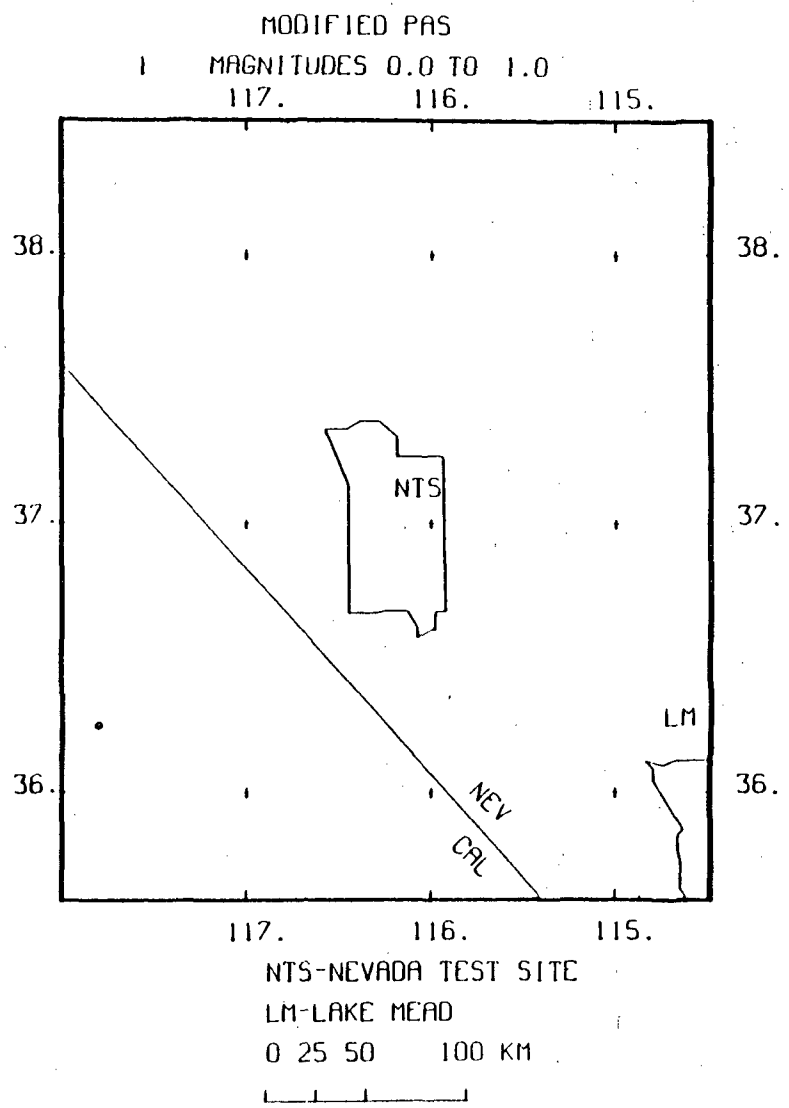

SOURCE-PAS
31 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

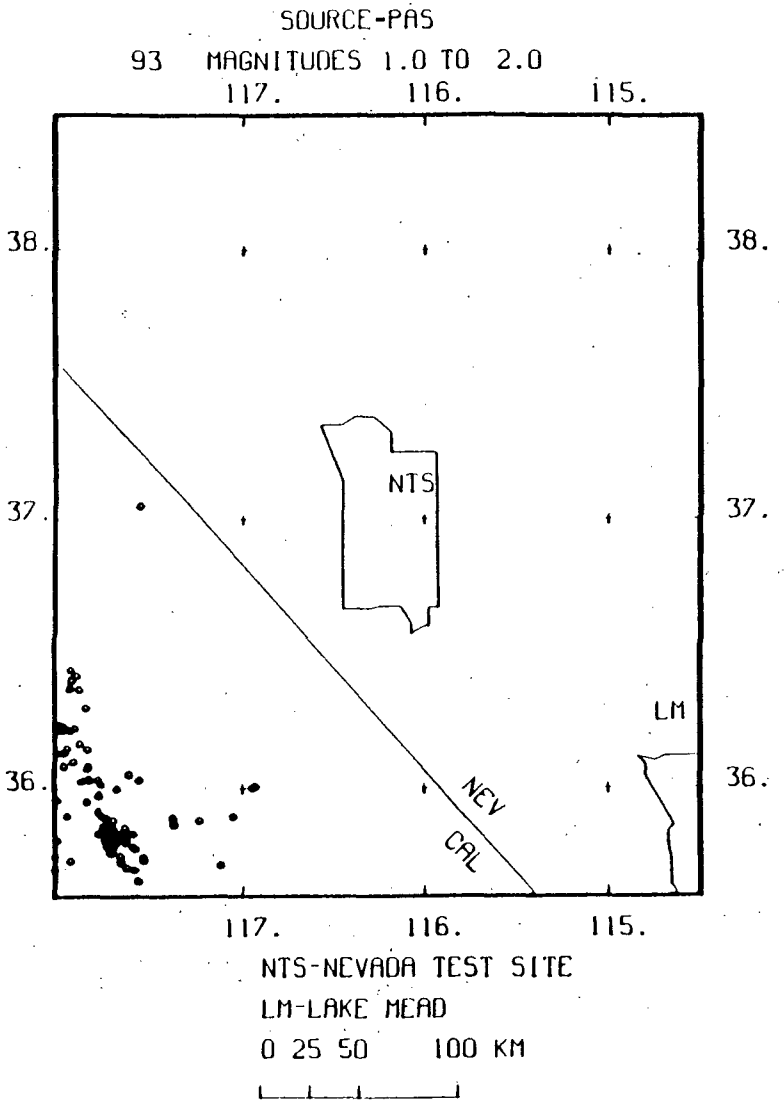

MODIFIED PAS
31 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

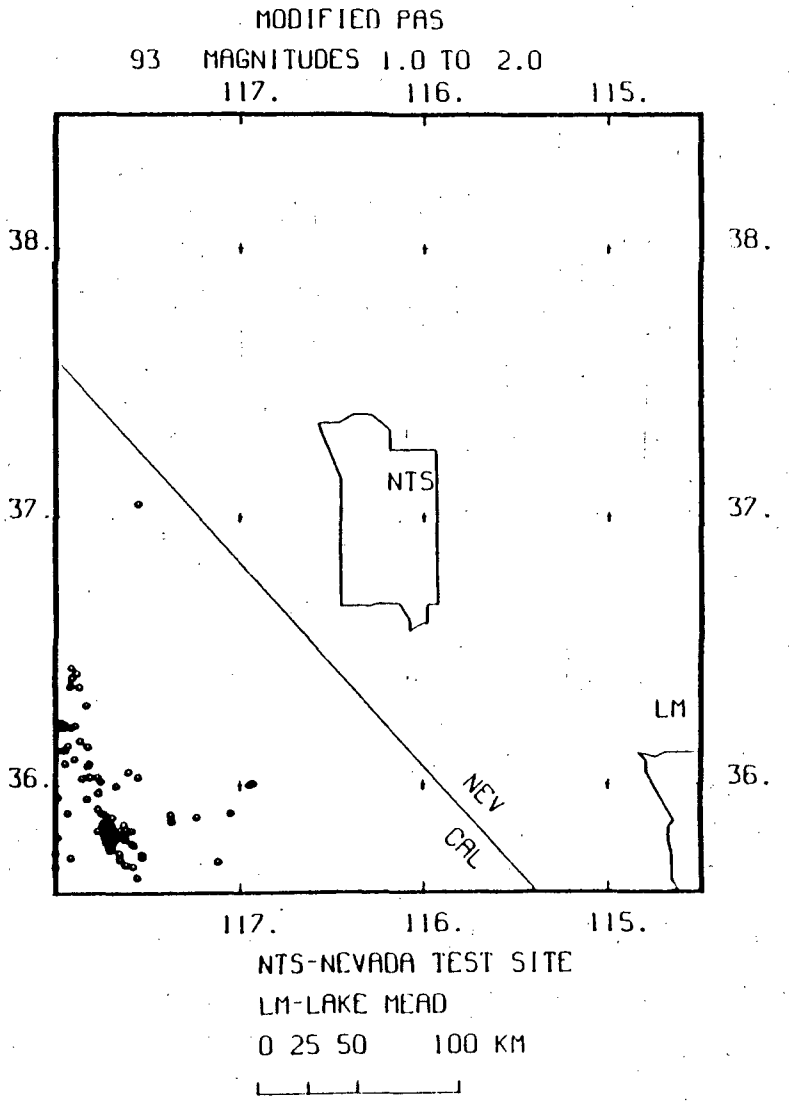
APPENDIX L

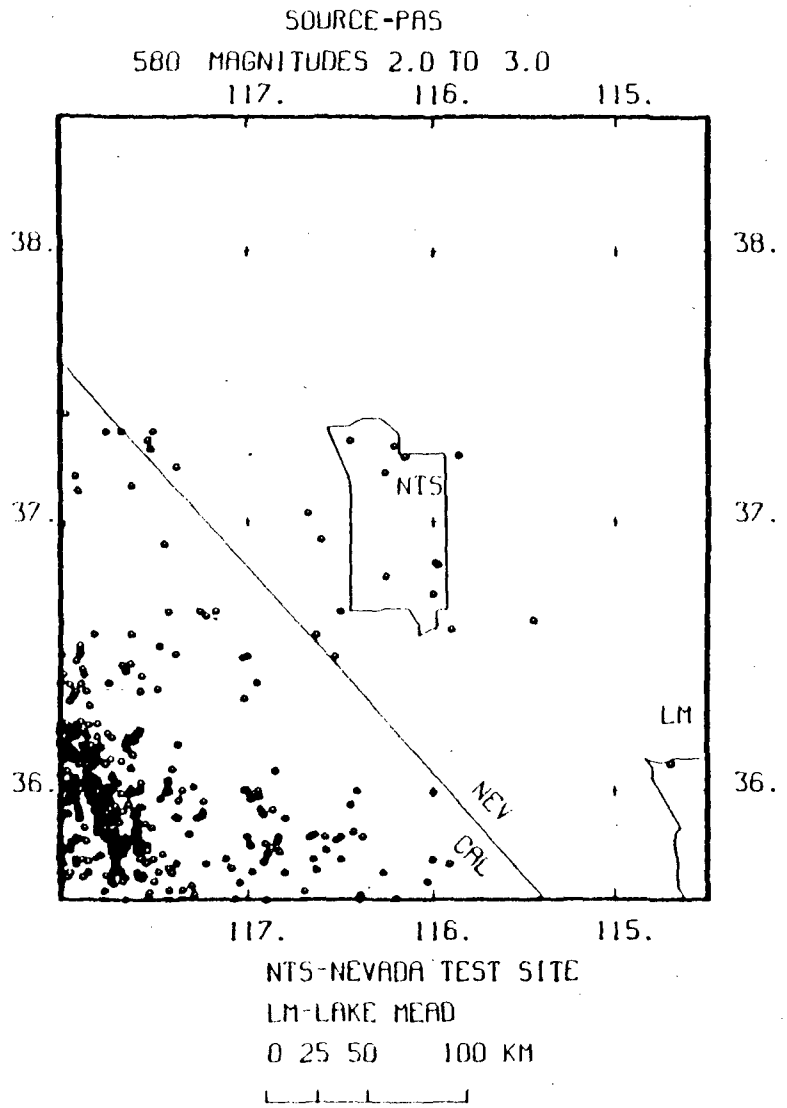
SOURCE - PAS

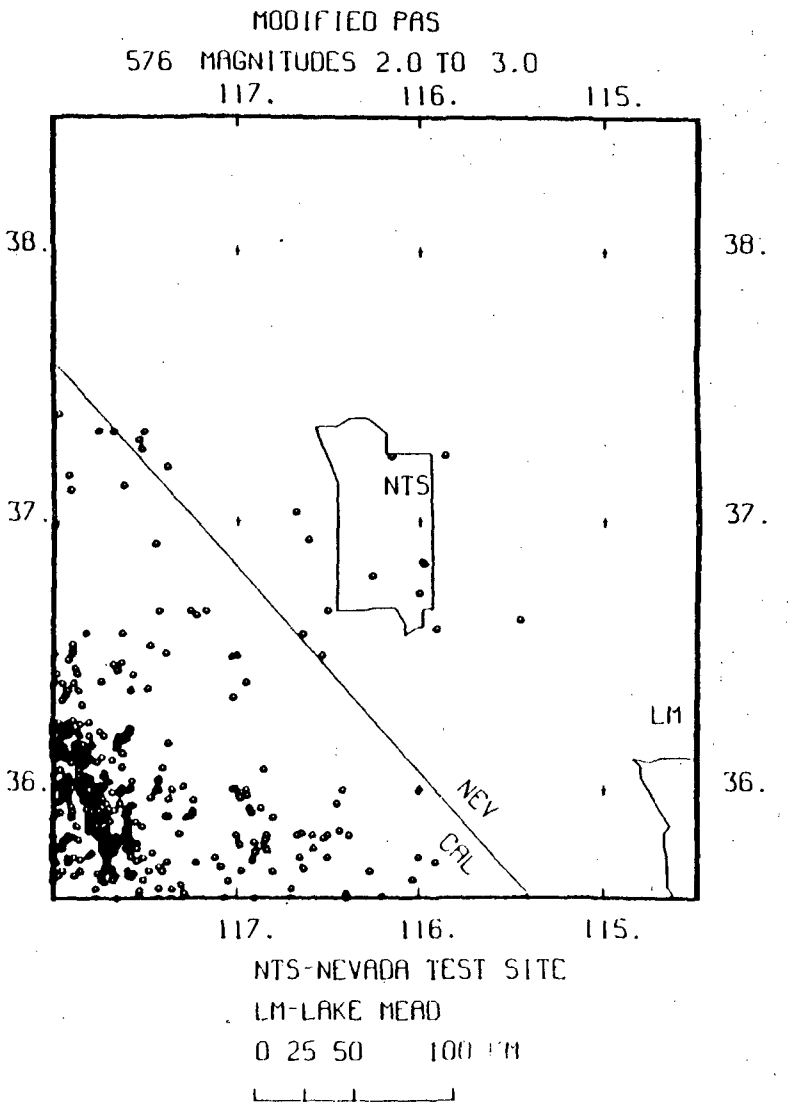

SOURCE-PAS
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

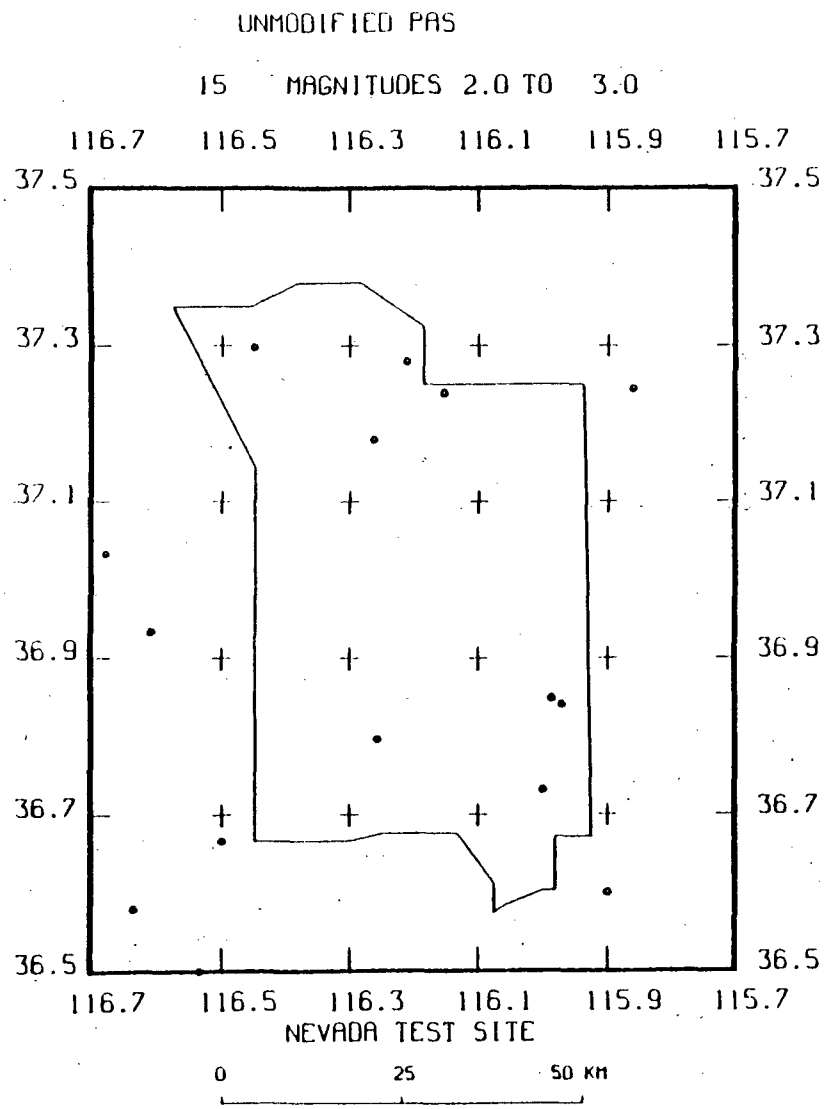

MODIFIED PAS
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

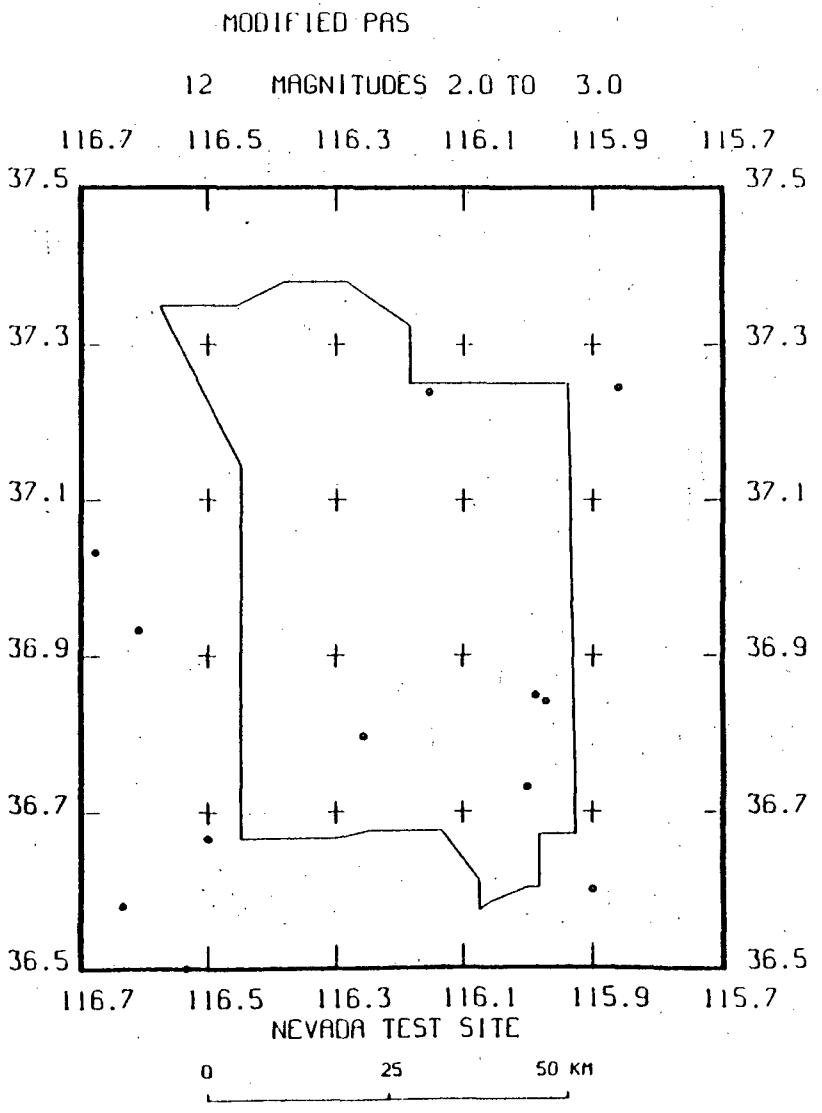

SOURCE-PAS
93 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

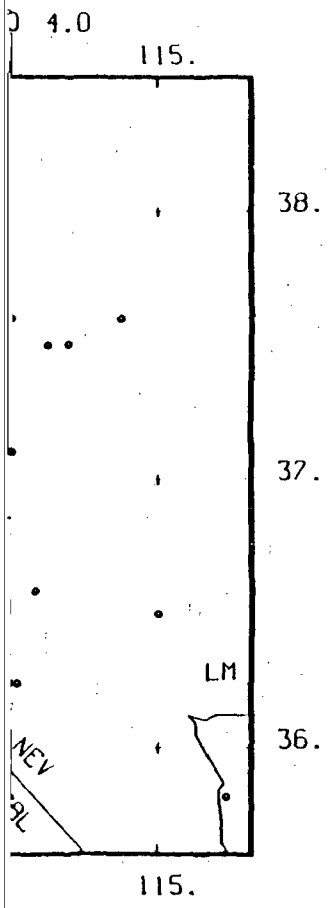

MODIFIED PAS
93 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


SOURCE-PAS
580 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED PAS
576 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

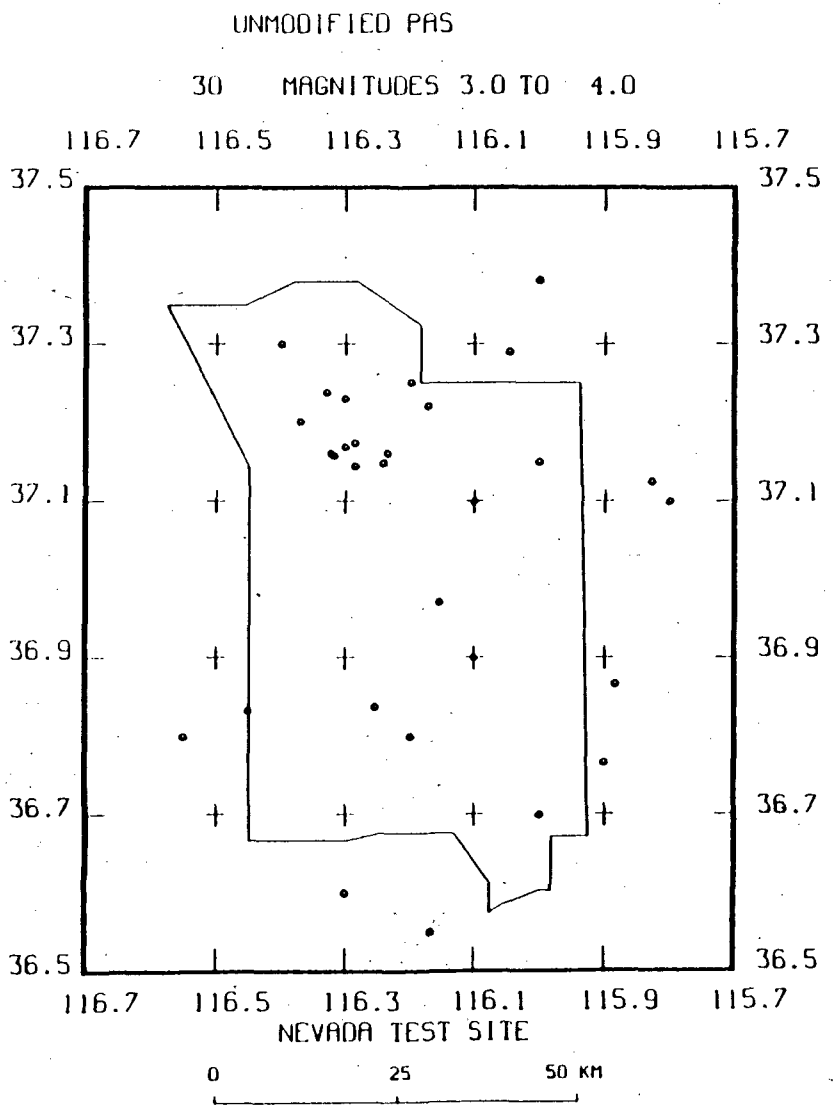

UNMODIFIED PAS
15 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

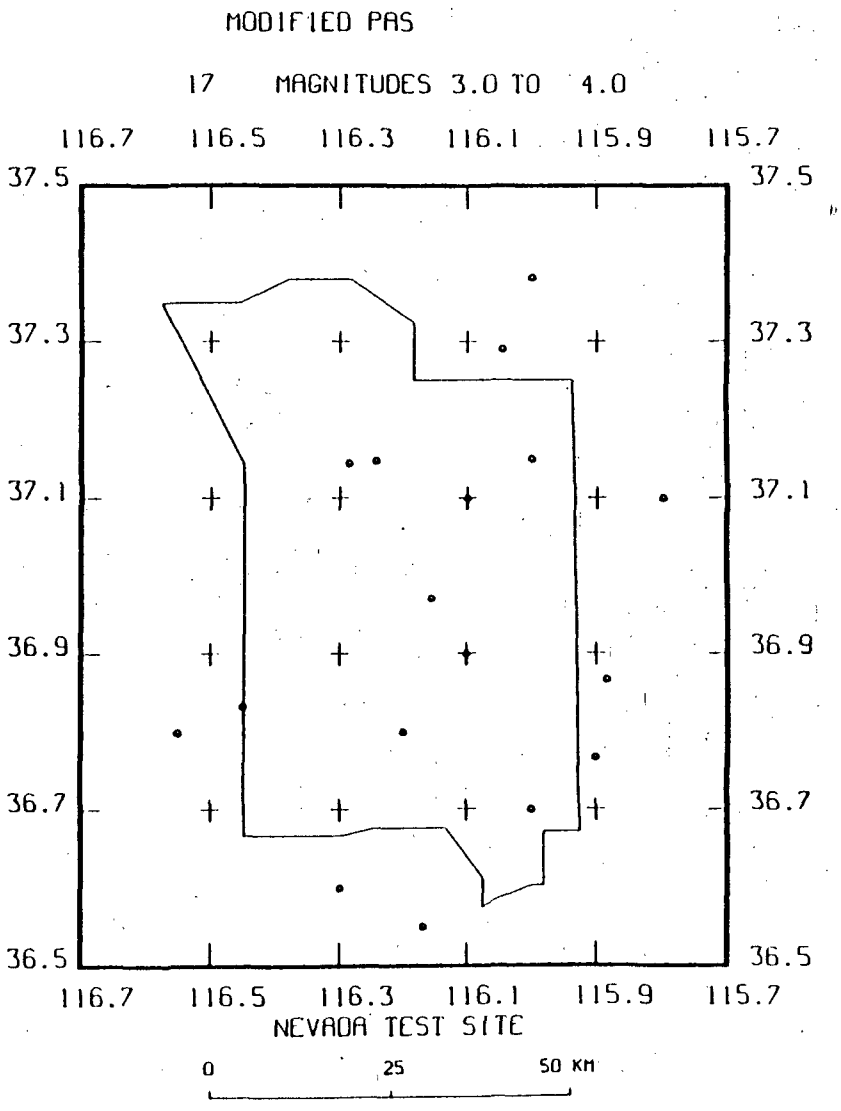

MODIFIED PAS
12 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

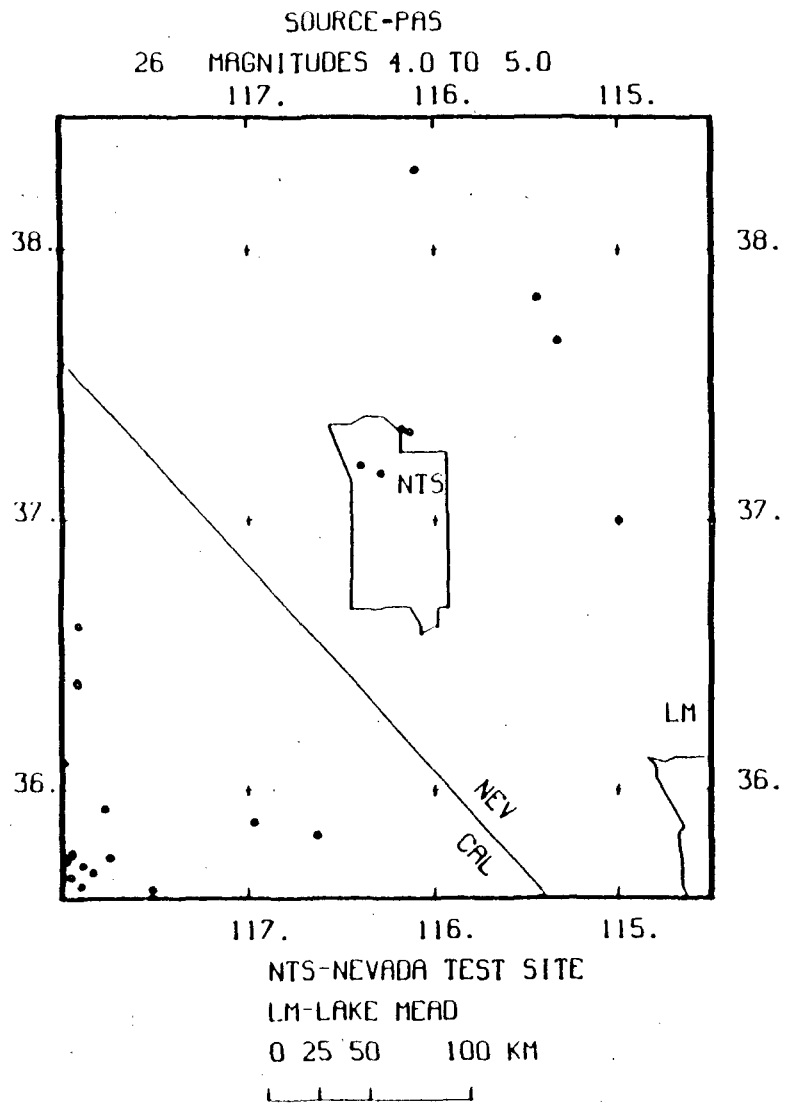


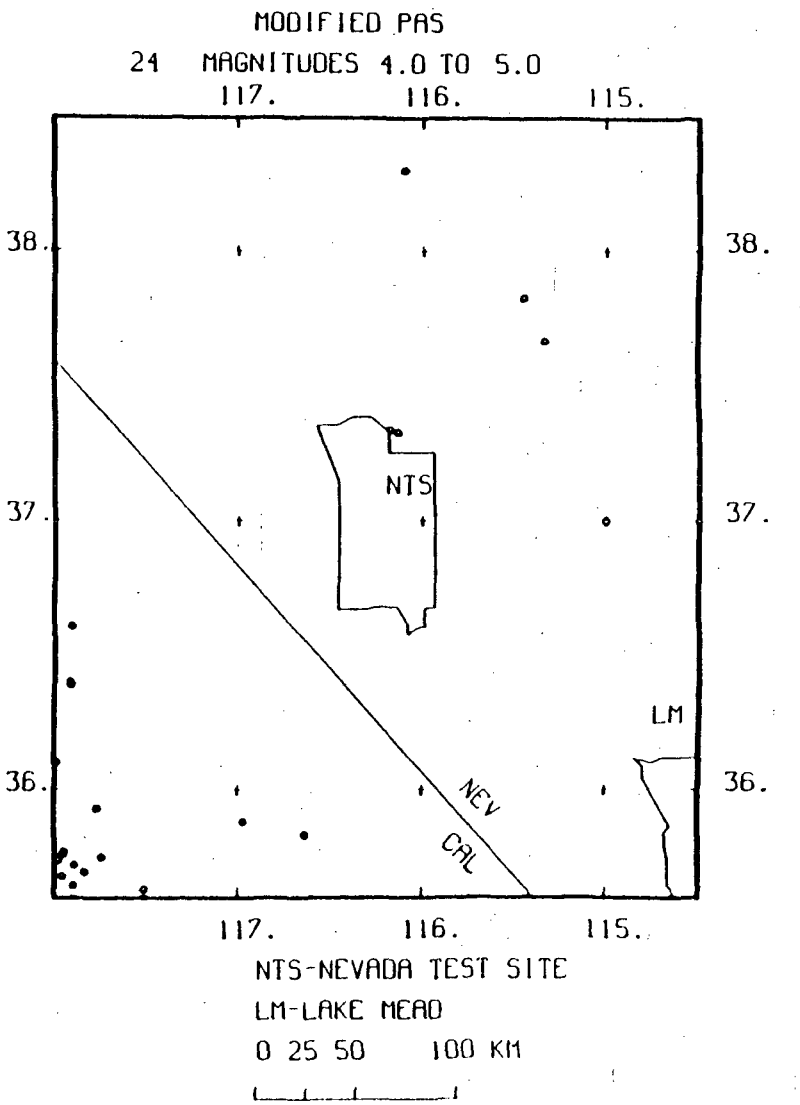
ST SITE

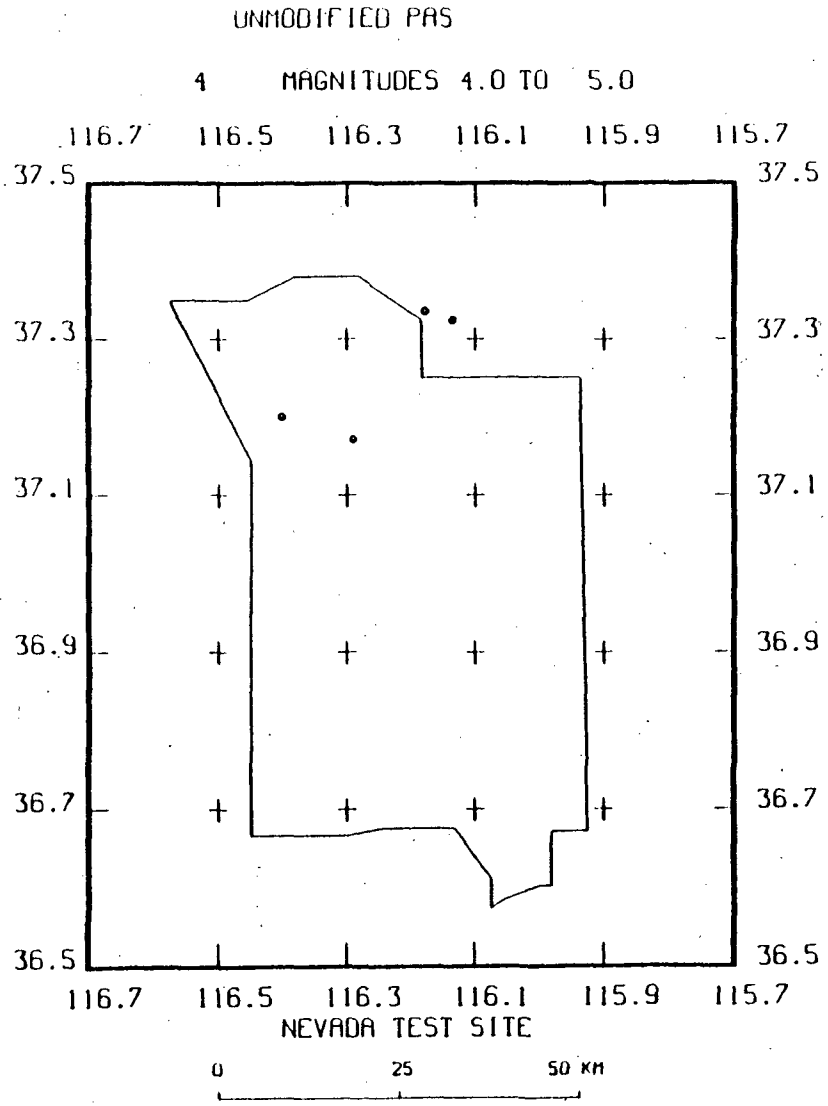
0 KM

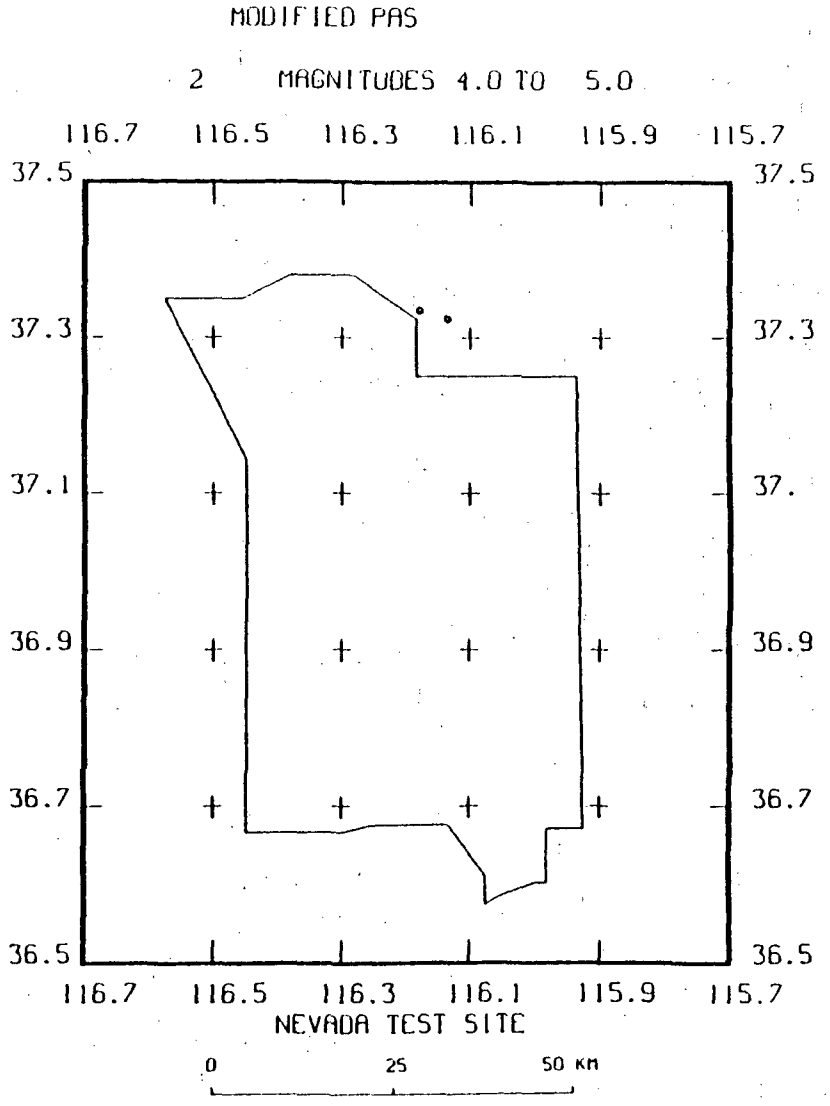

UNMODIFIED PAS
30 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM


MODIFIED PAS
17 MAGNITUDES 3.0 TO 4.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM


SOURCE-PAS
26 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

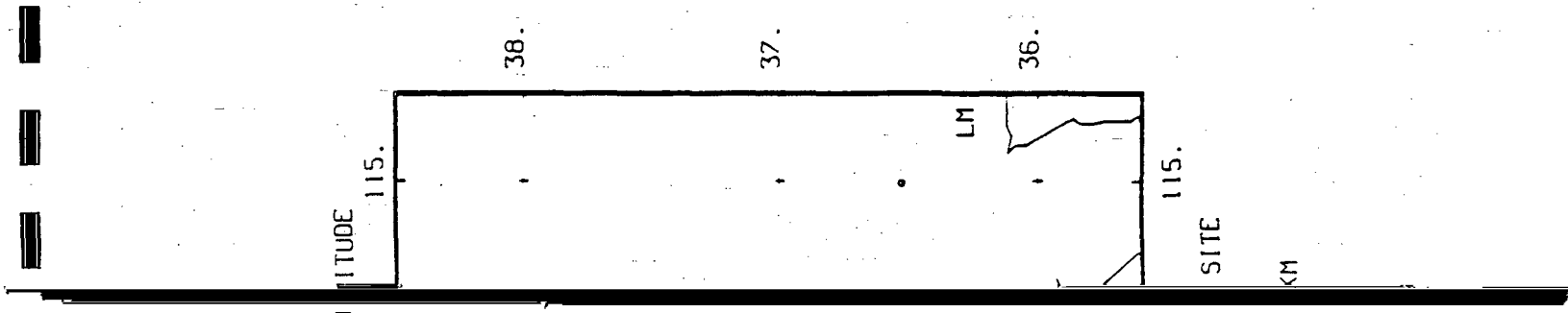

MODIFIED PAS
24 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

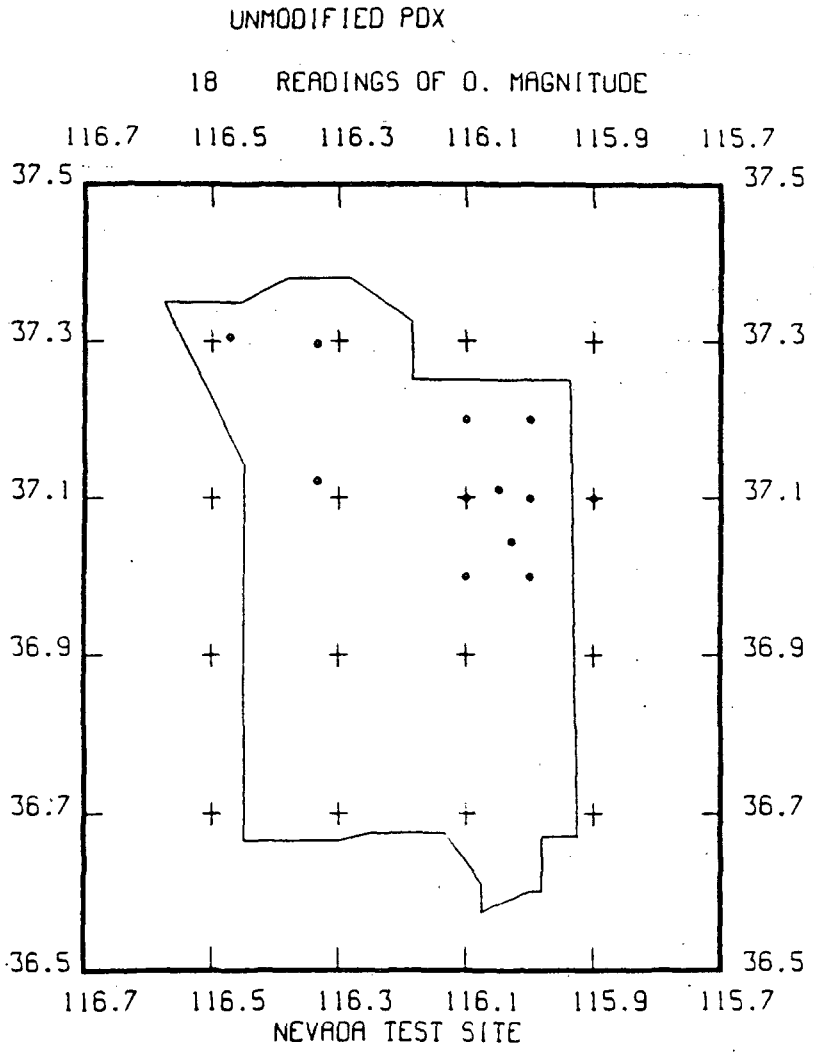

UNMODIFIED PAS
4 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

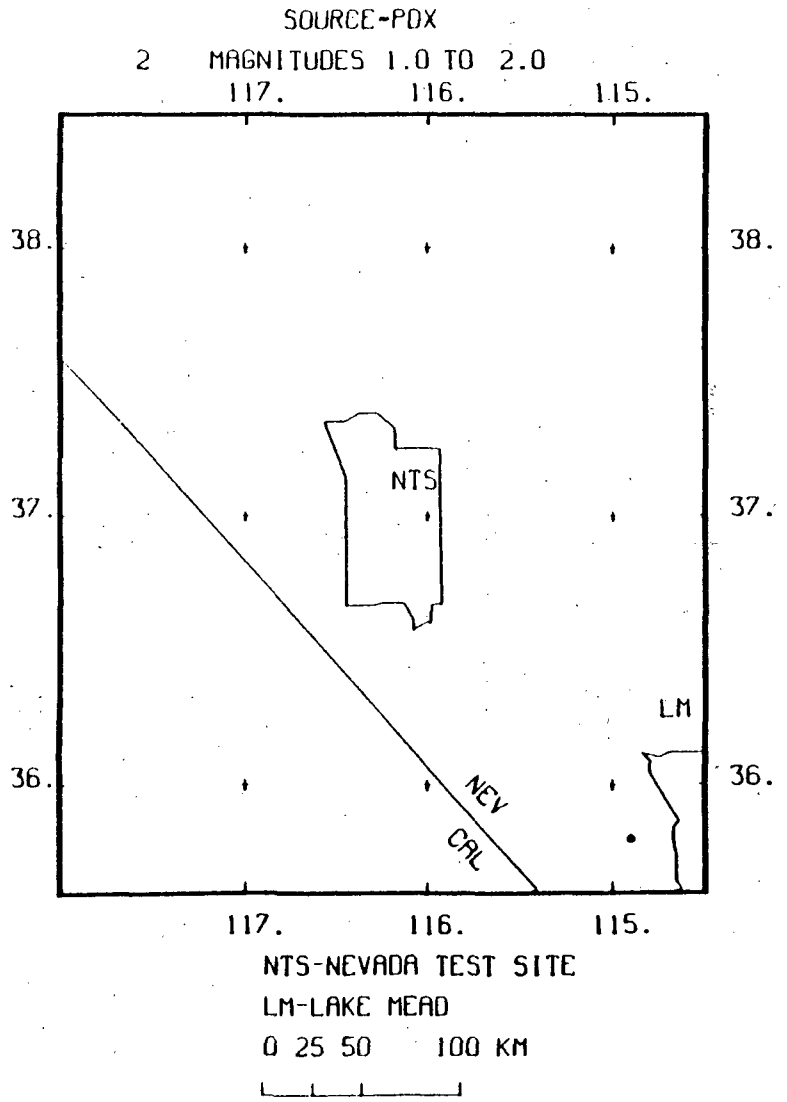

MODIFIED PAS
2 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

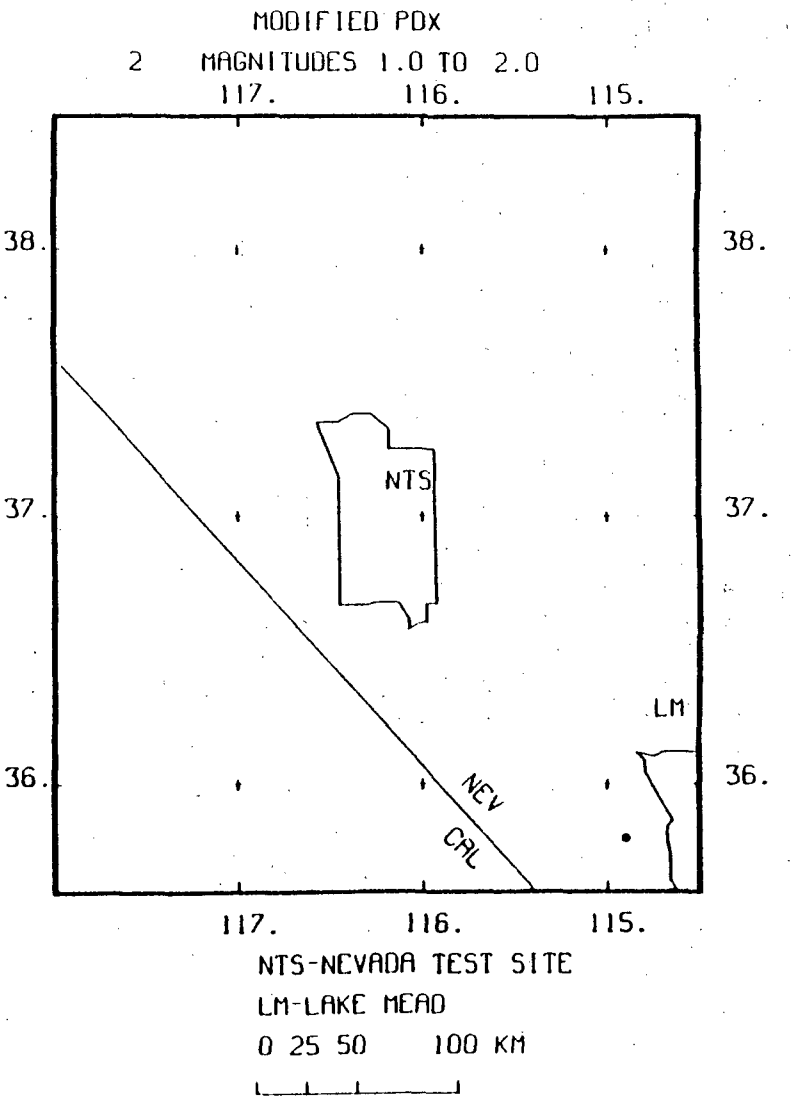
APPENDIX M

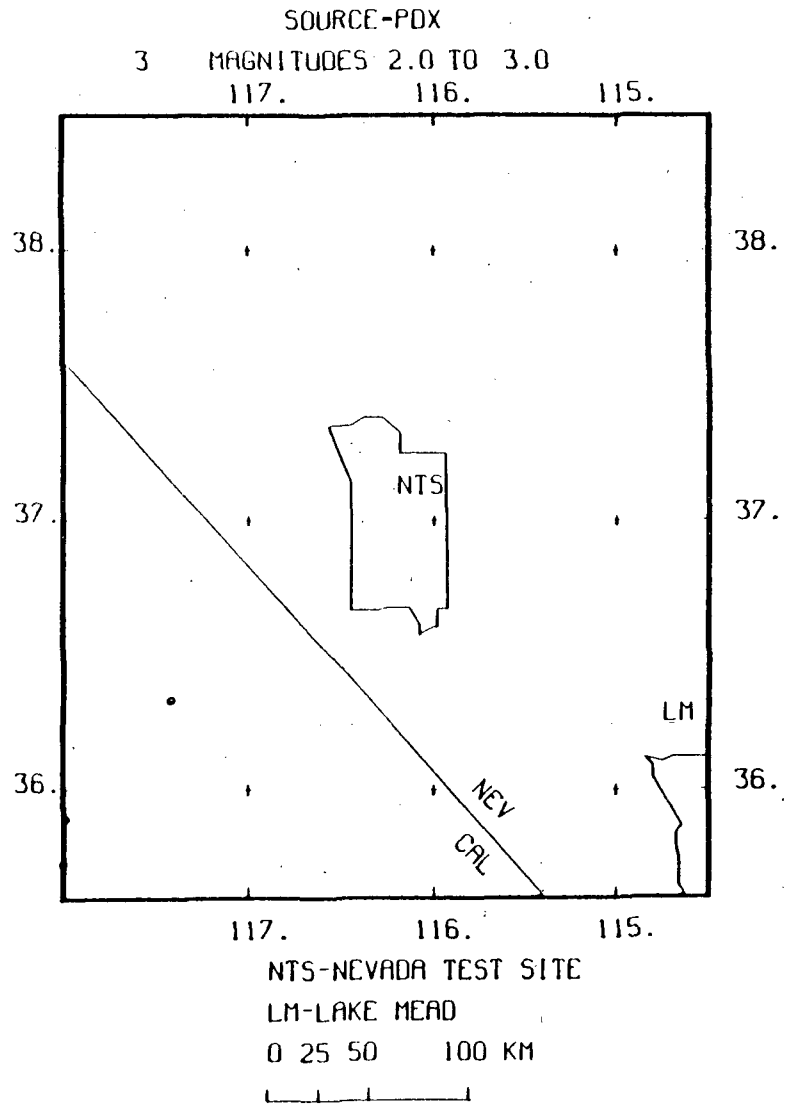
SOURCE - PDX

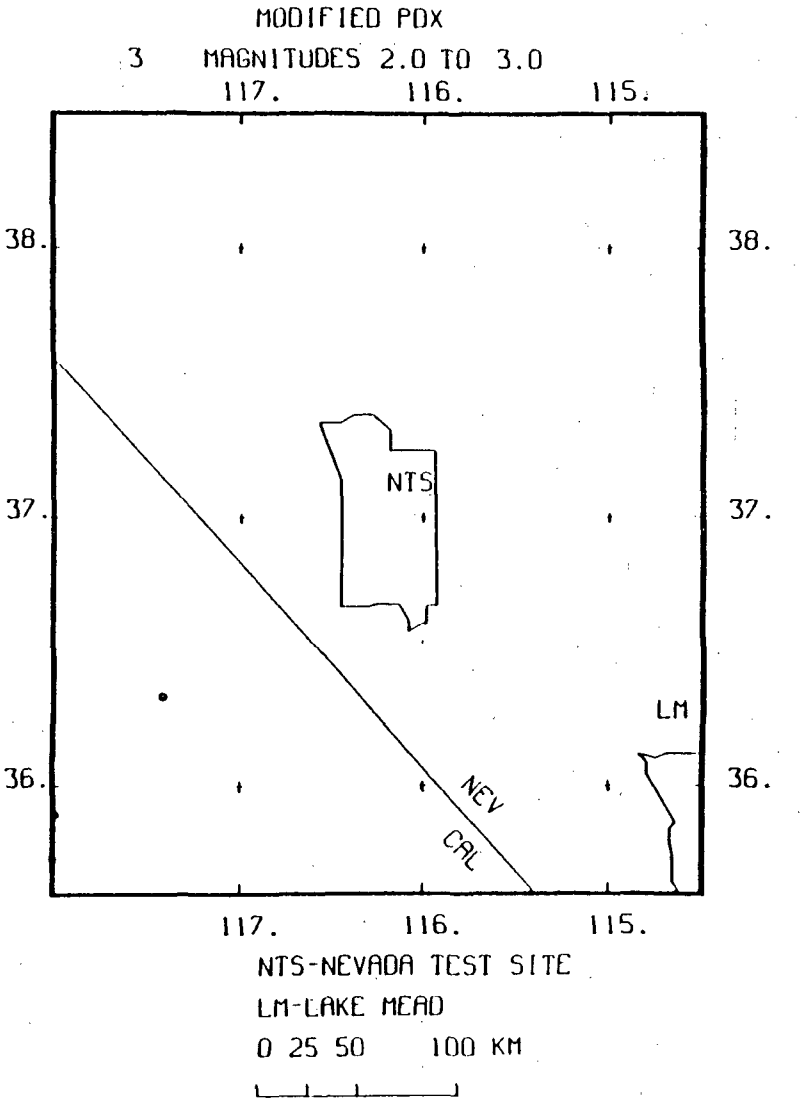

38.
37.
36.
LM
115.
115.
ITUDE
SITE
KM

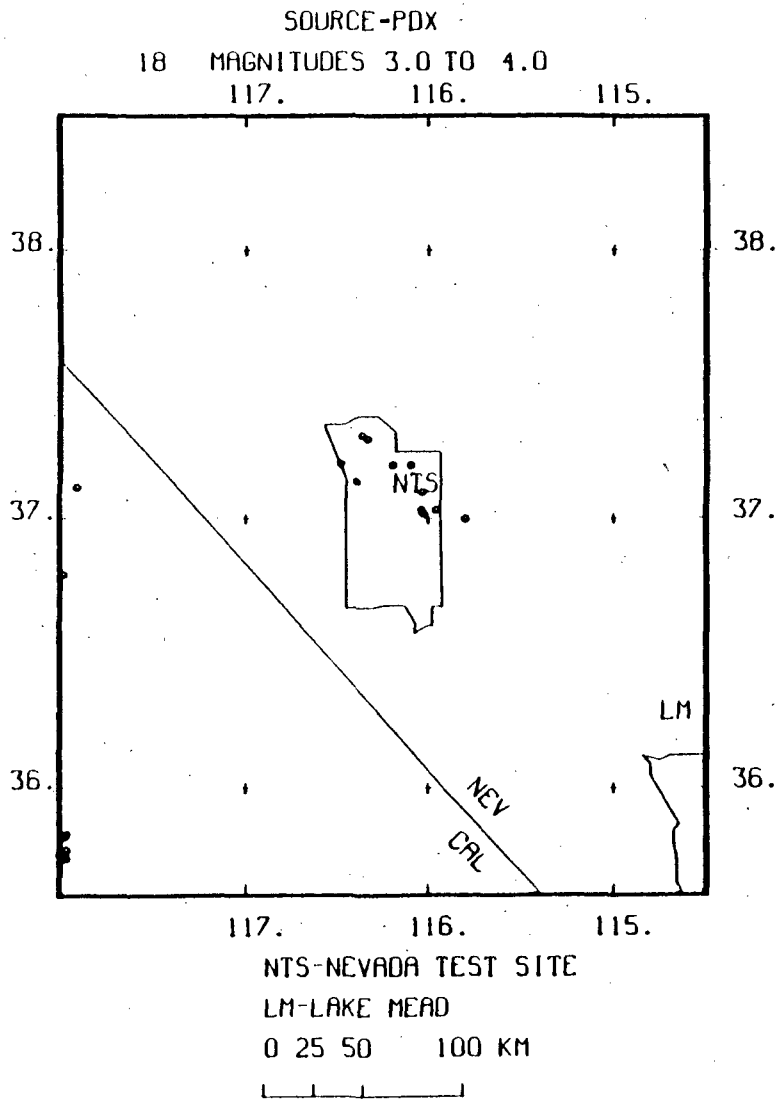

UNMODIFIED PDX
18 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE

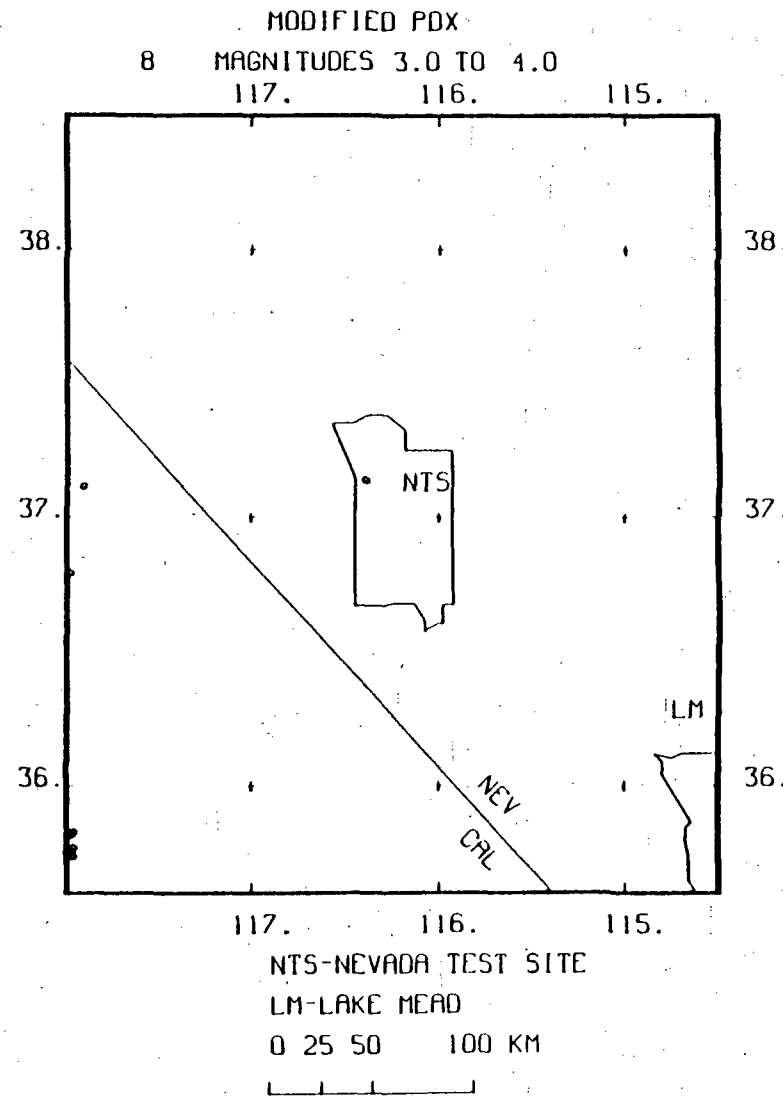

SOURCE-PDX
2 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

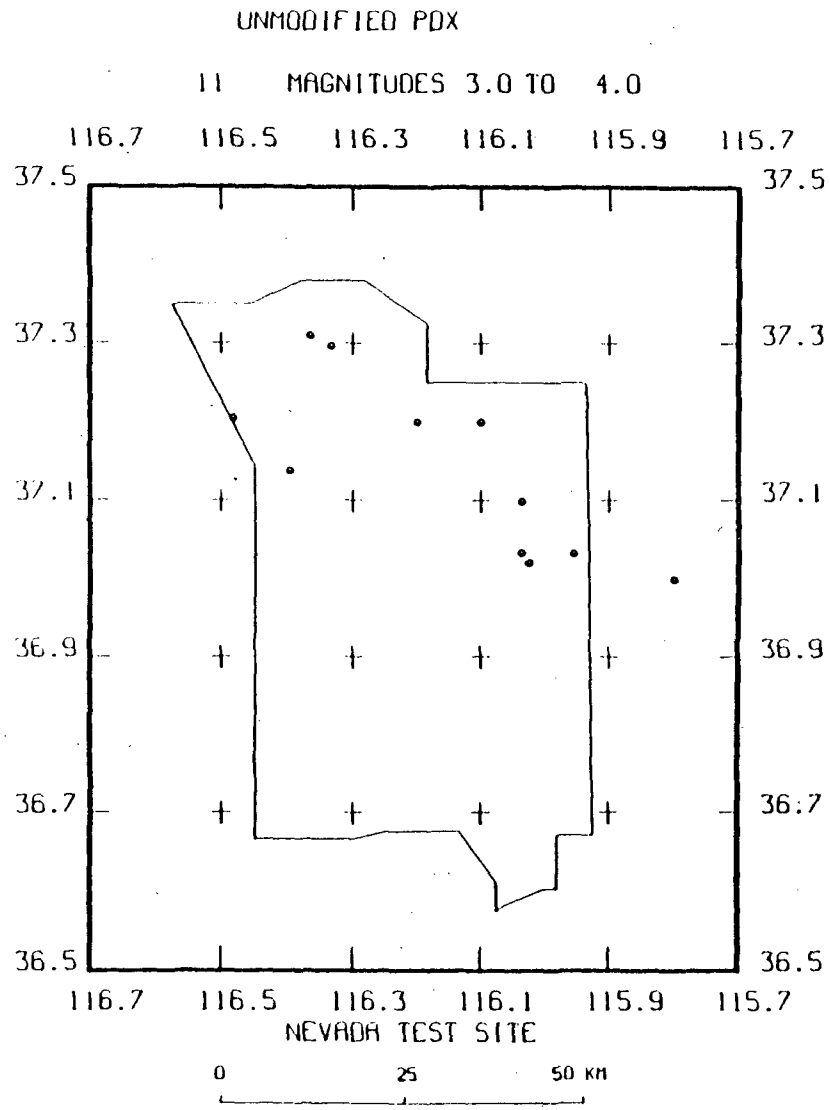

MODIFIED PDX
2 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

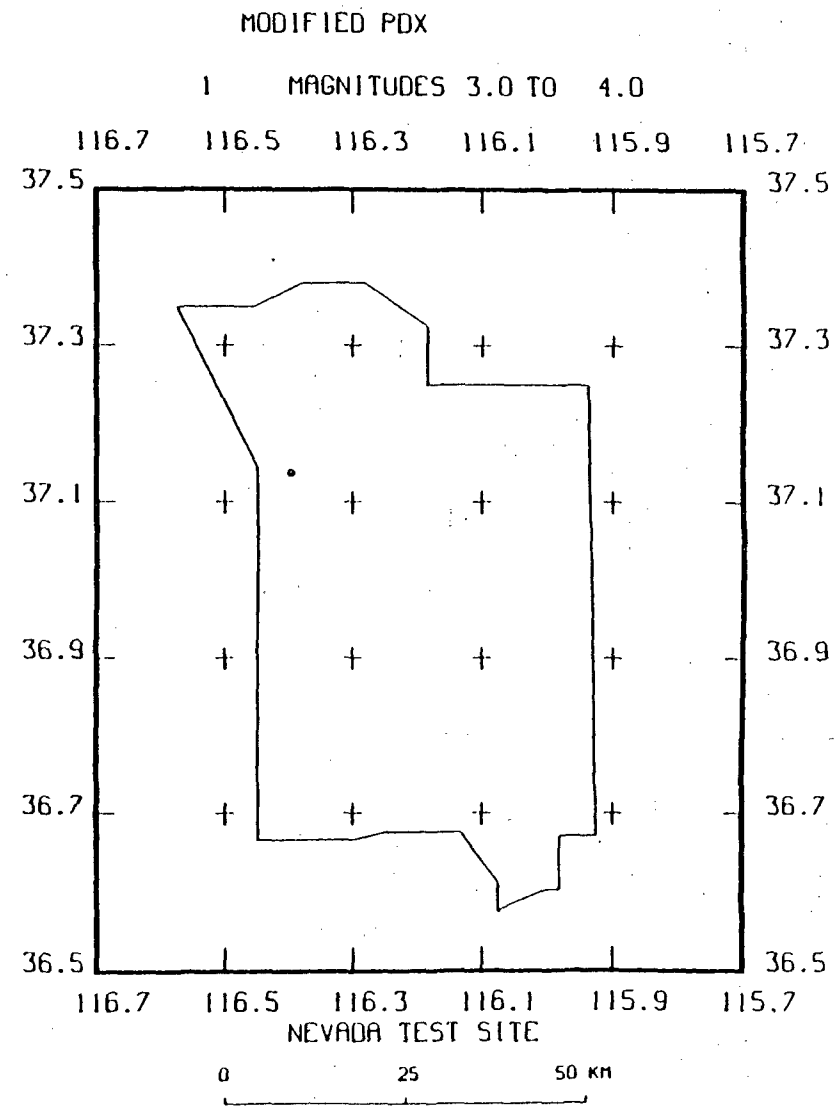

SOURCE-PDX
3 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

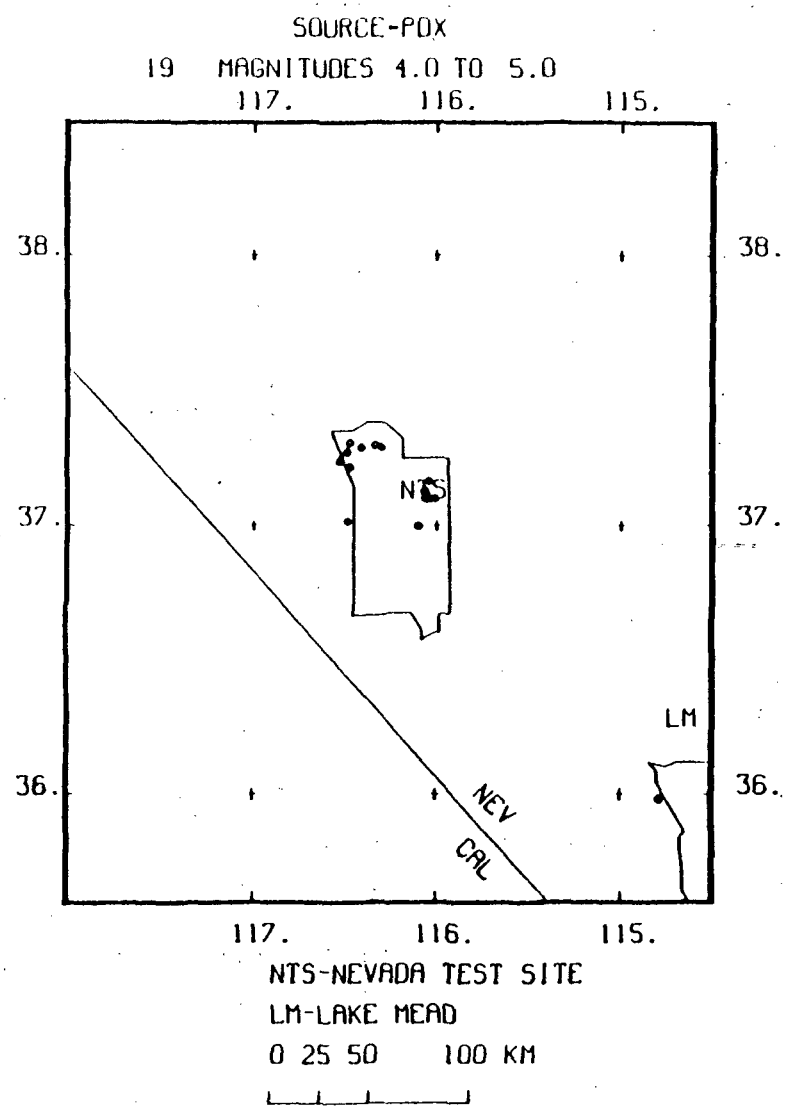

MODIFIED PDX
3 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

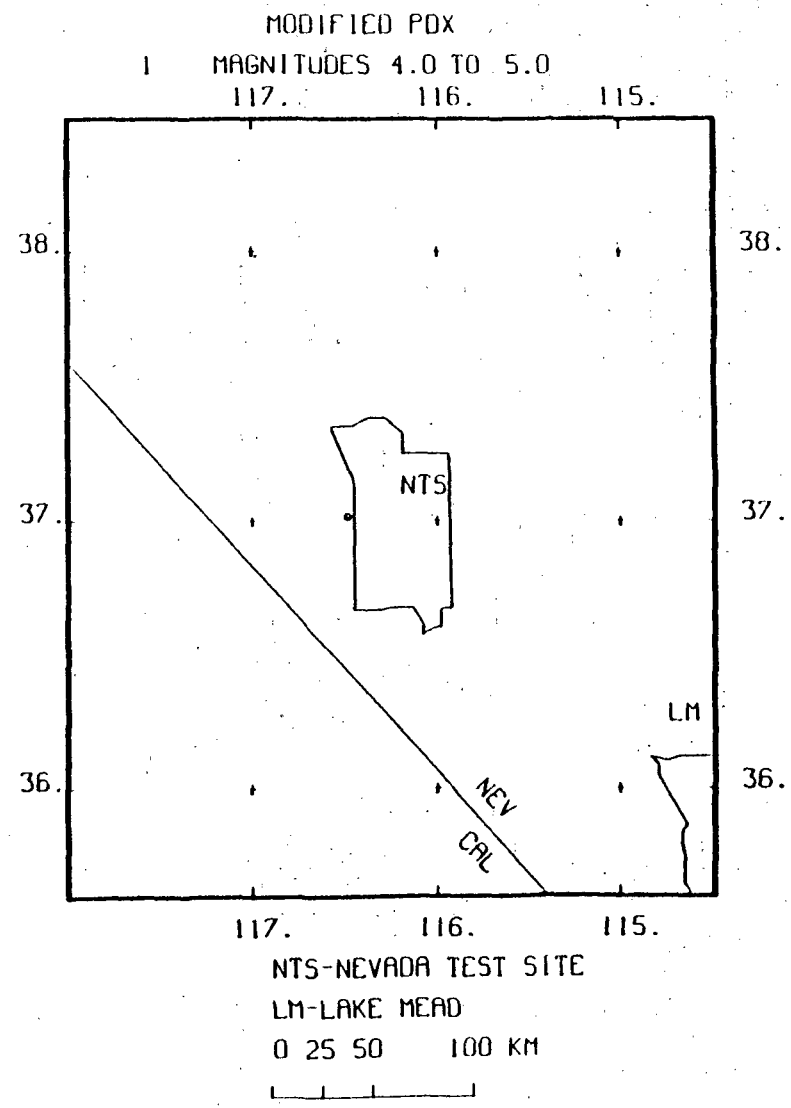

SOURCE-PDX
18 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

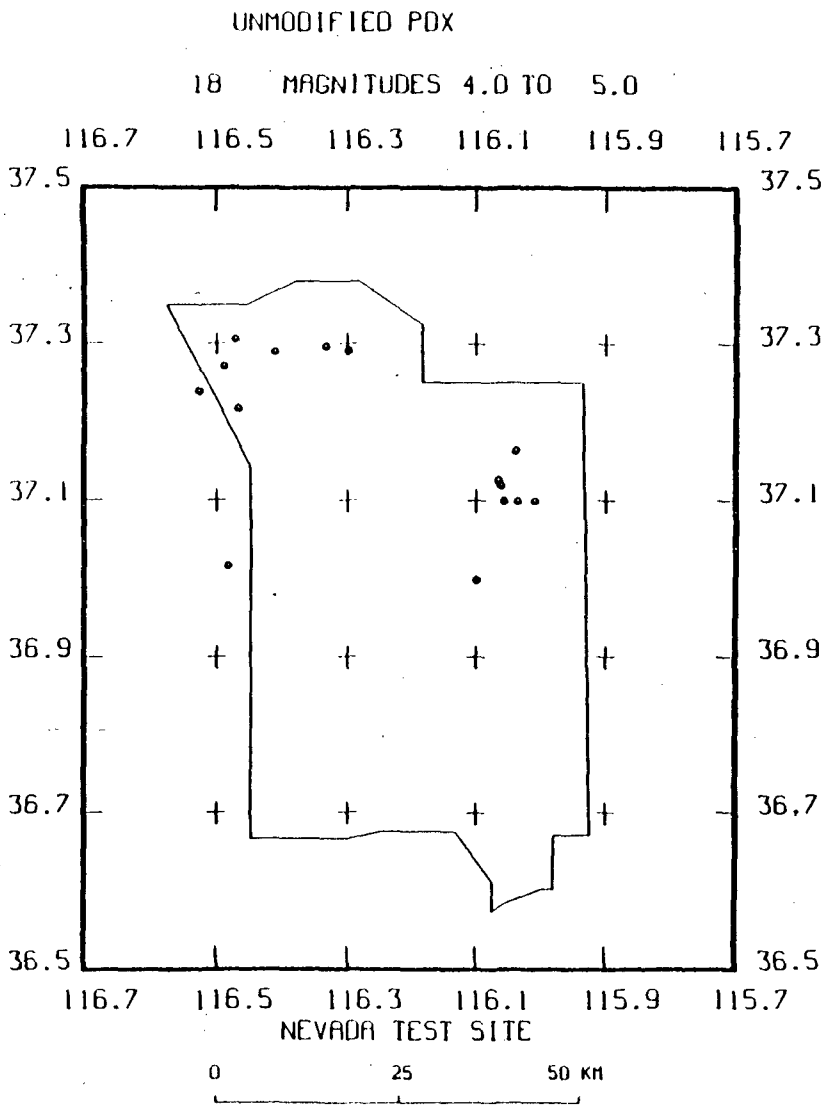

MODIFIED PDX
8 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

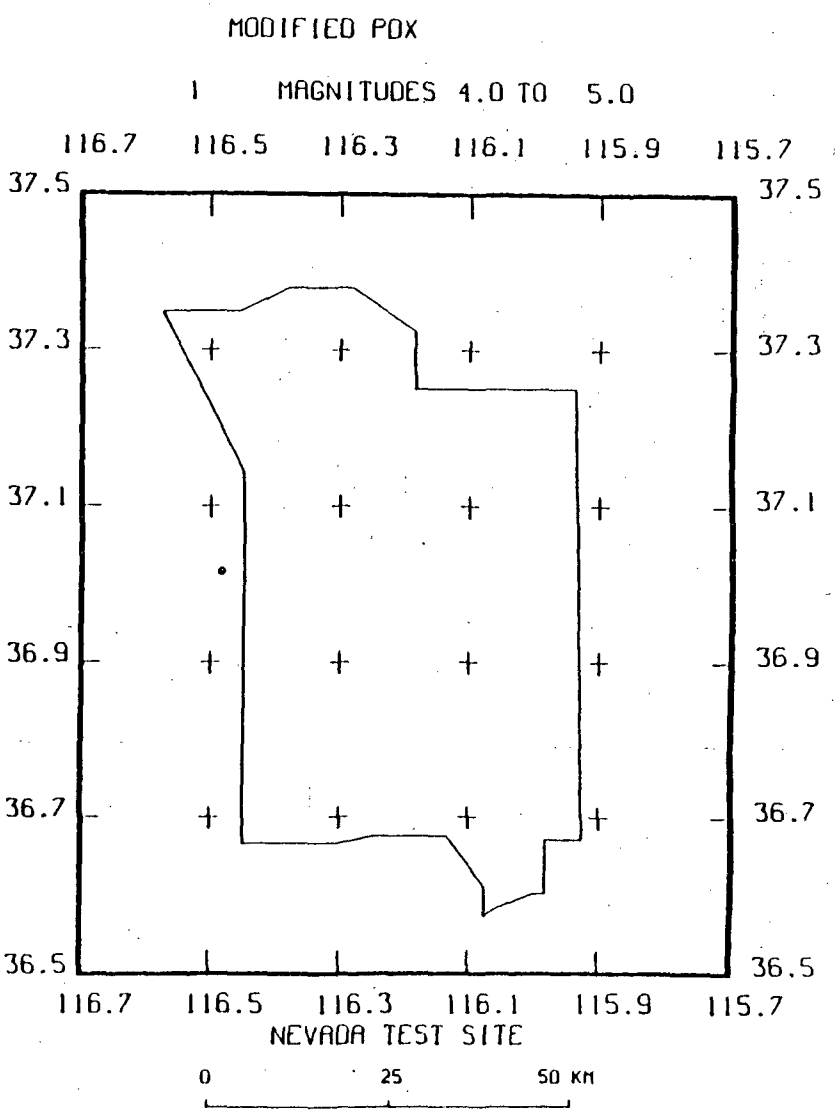

UNMODIFIED PDX
11 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

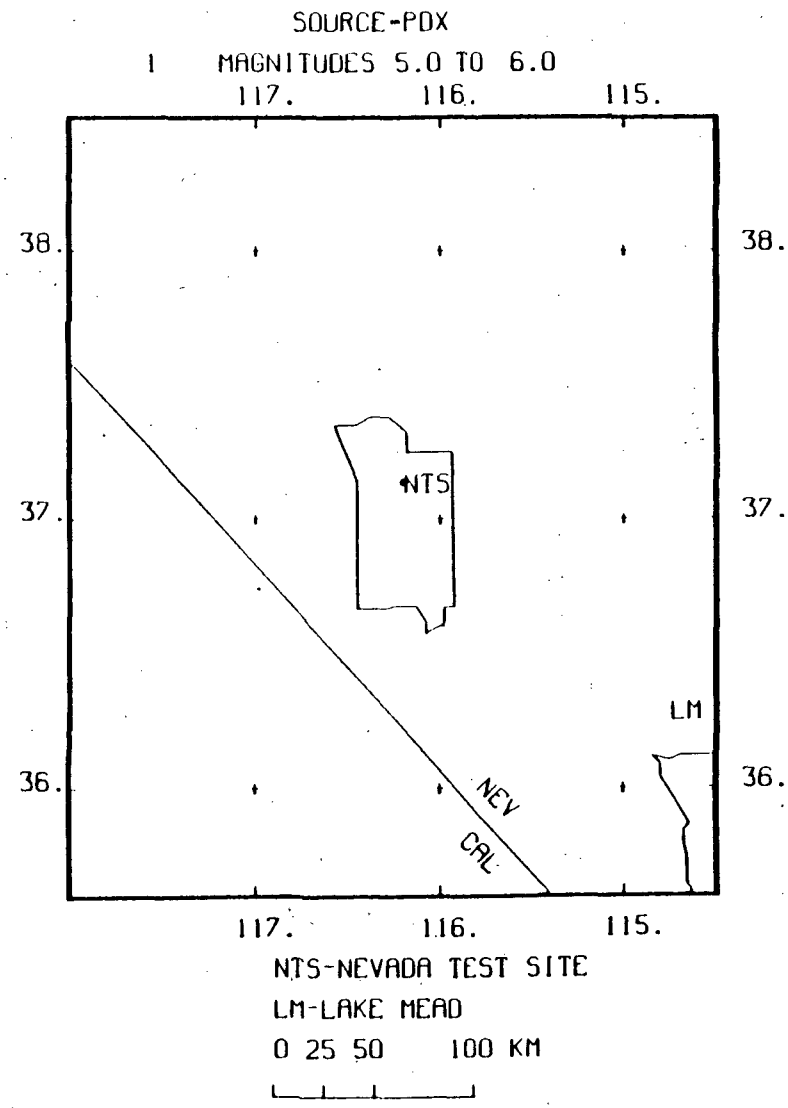

MODIFIED PDX
1 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

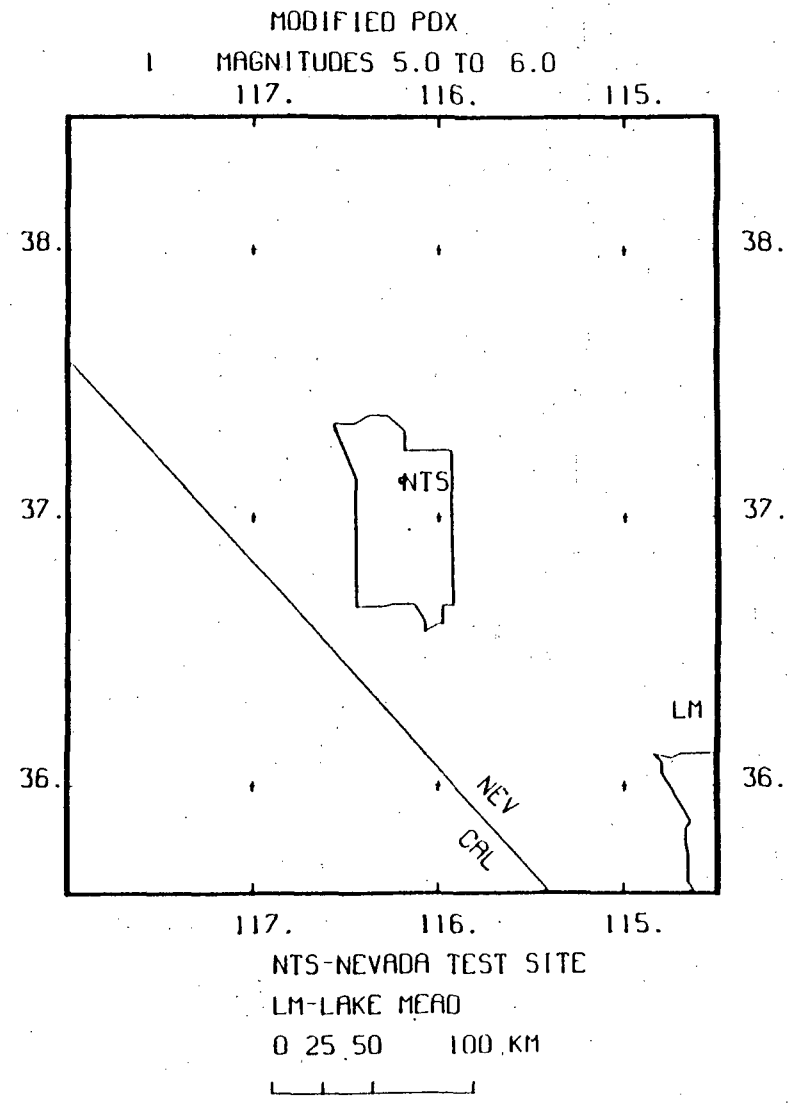

SOURCE-PDX
19 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

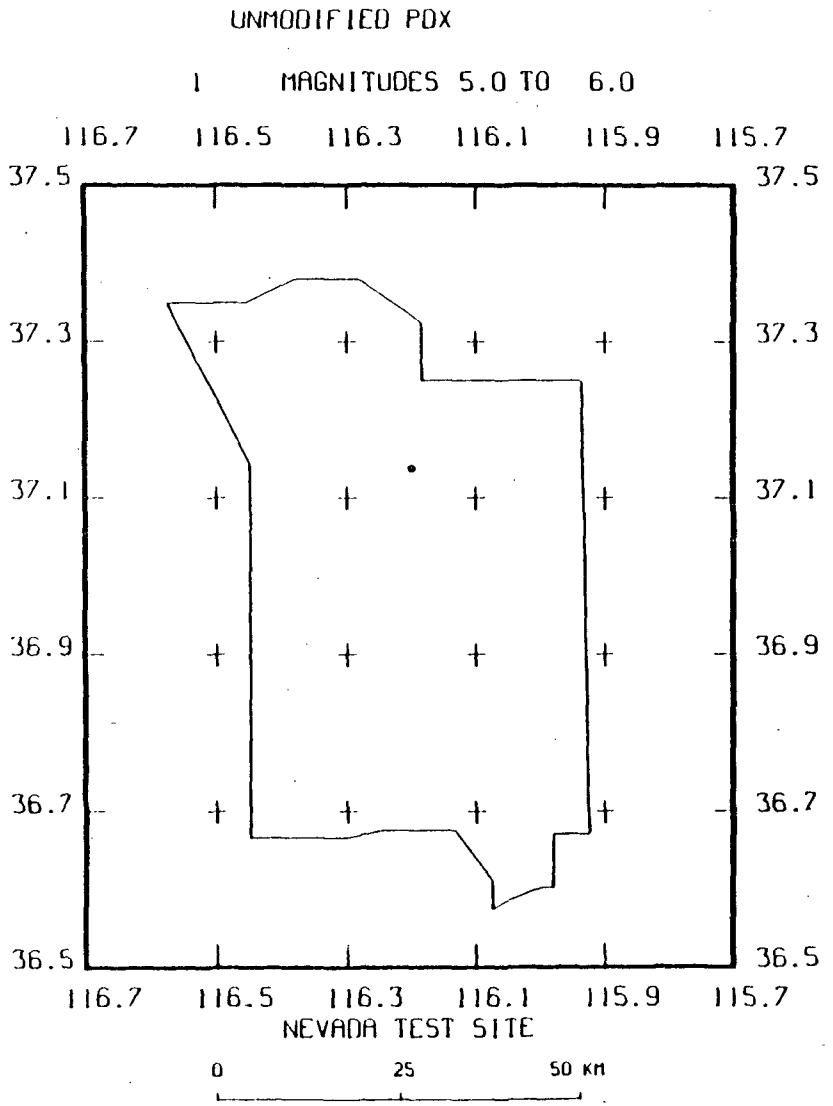

MODIFIED PDX
1 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

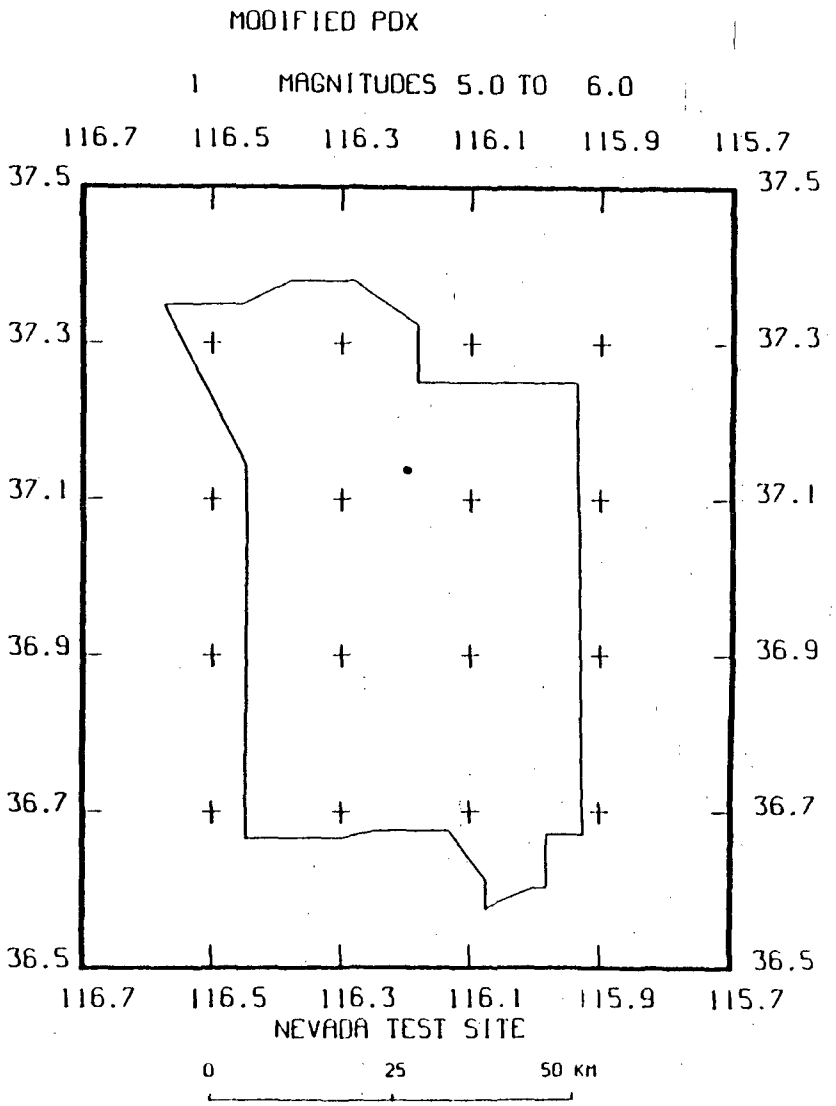

UNMODIFIED PDX
18 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM


MODIFIED PDX
1 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM


SOURCE-PDX
1 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

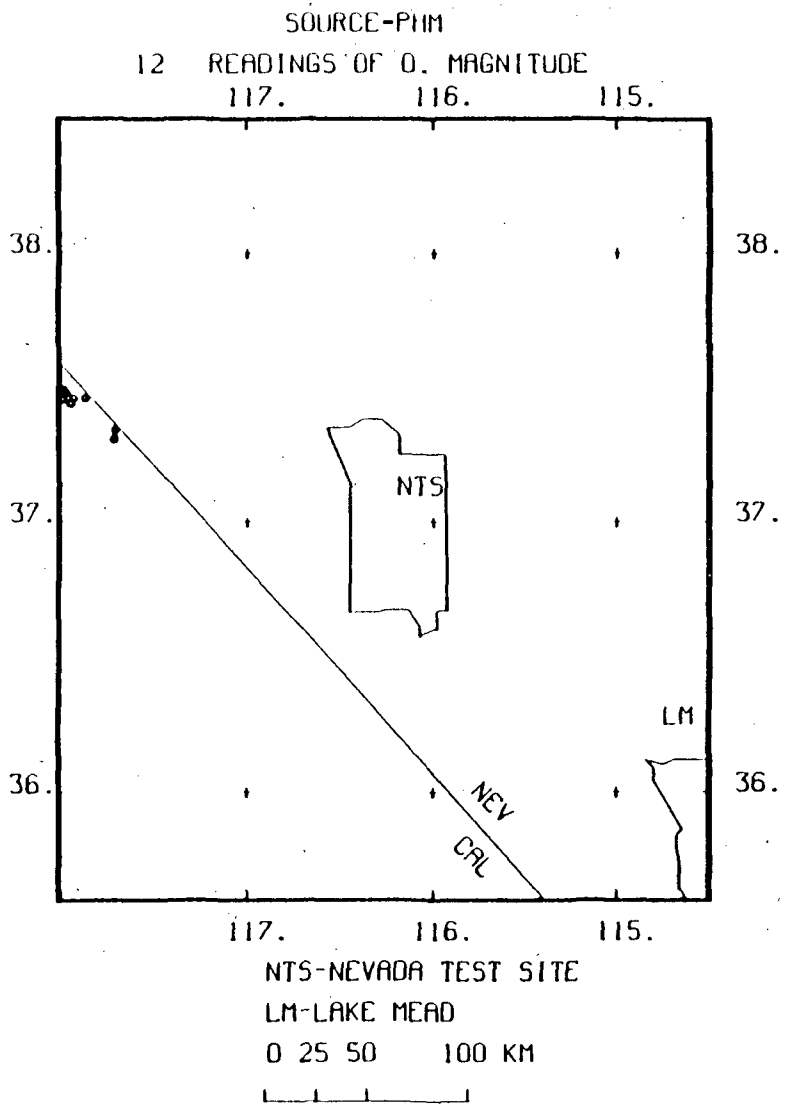

MODIFIED PDX
1 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

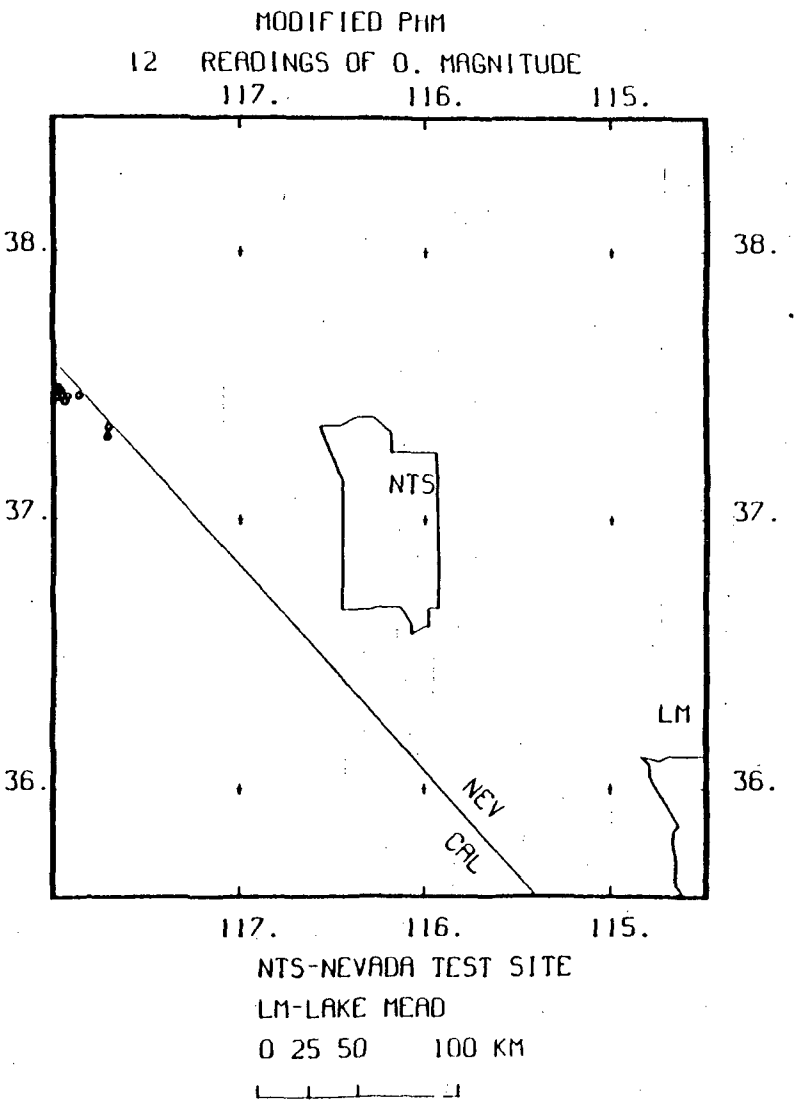

UNMODIFIED PDX
1 MAGNITUDES 5.0 TO 6.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

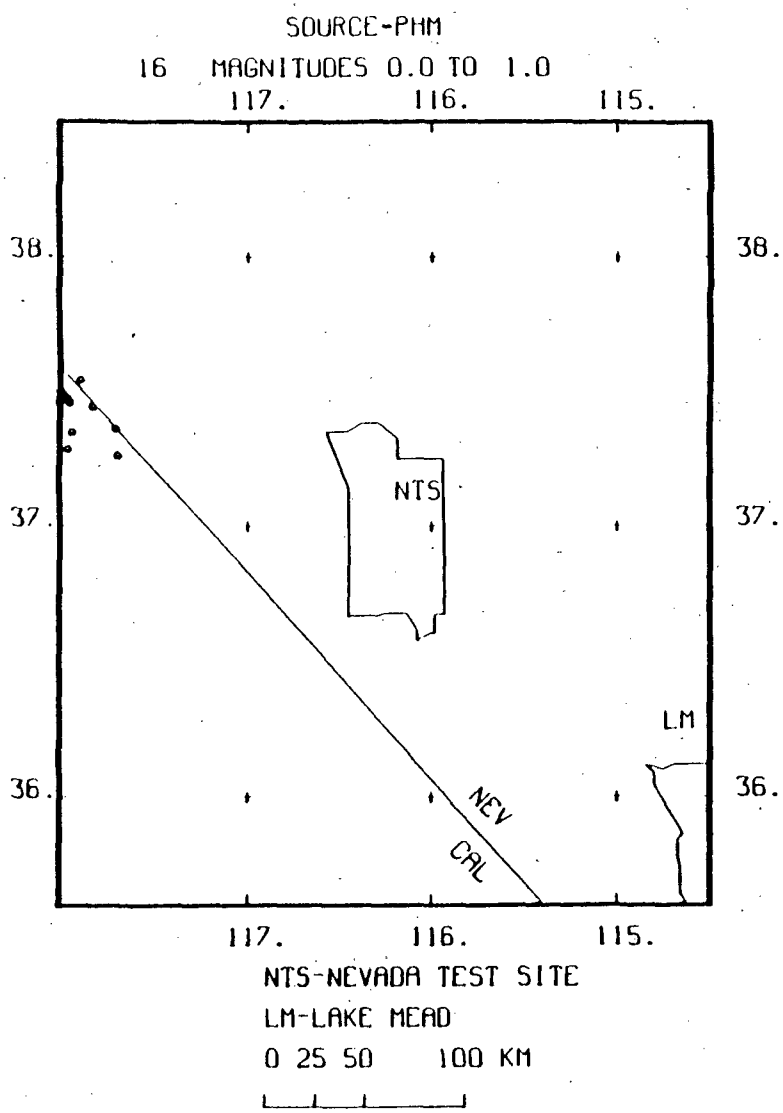

MODIFIED PDX
1 MAGNITUDES 5.0 TO 6.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

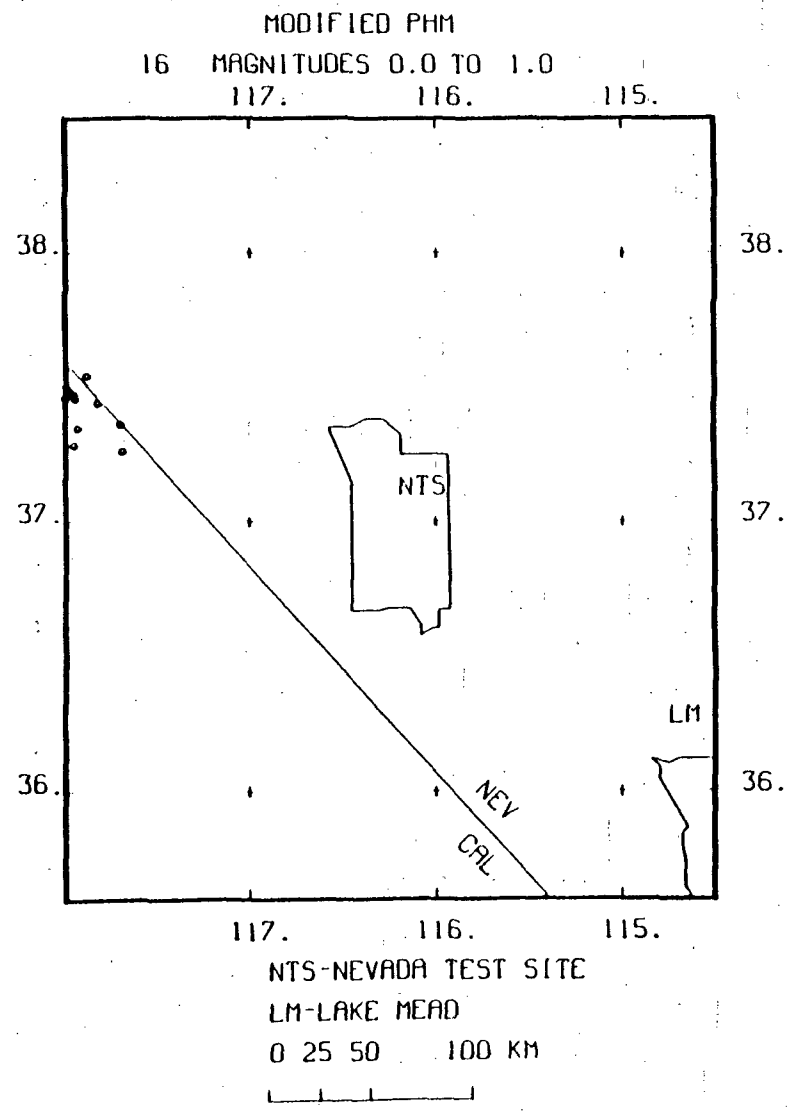
APPENDIX N

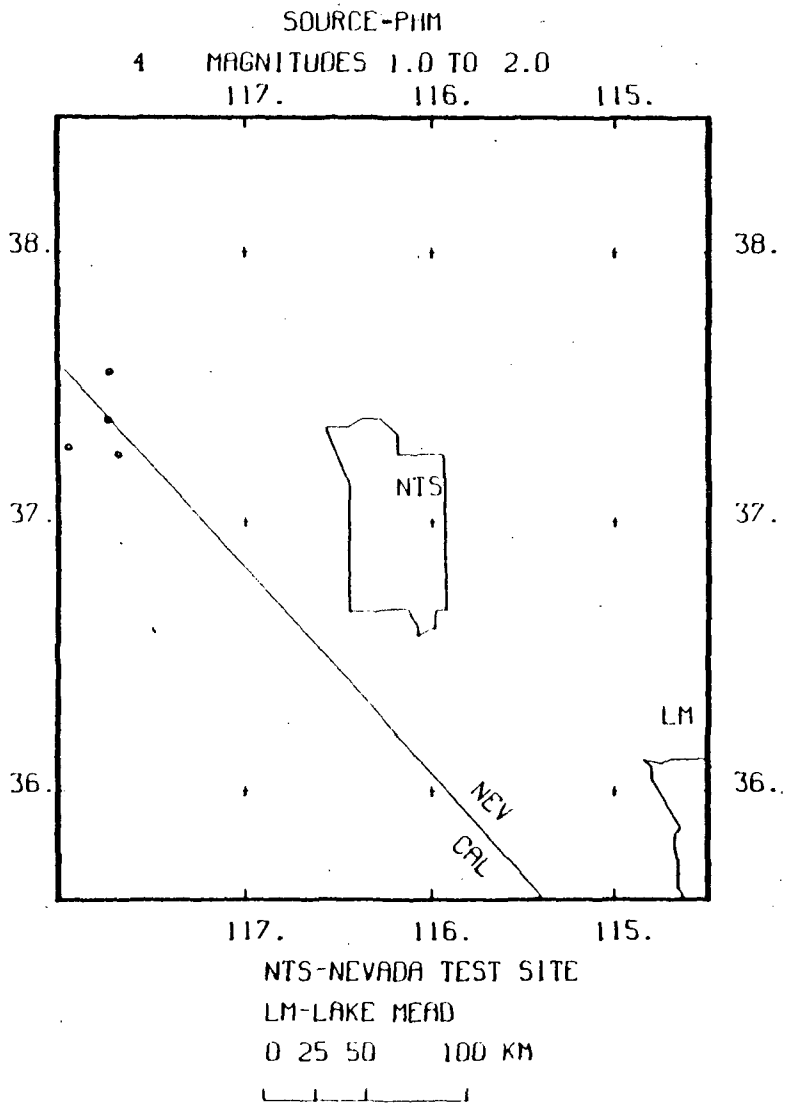
SOURCE - PHM

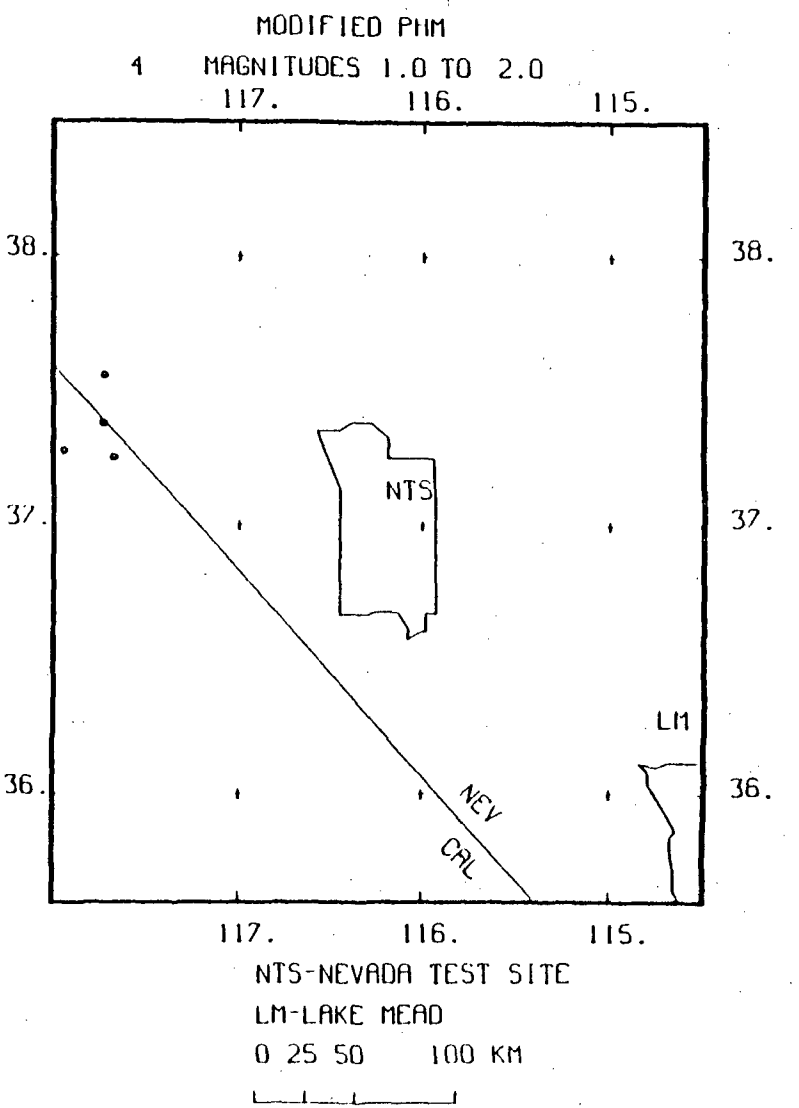

SOURCE-PHM
12 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

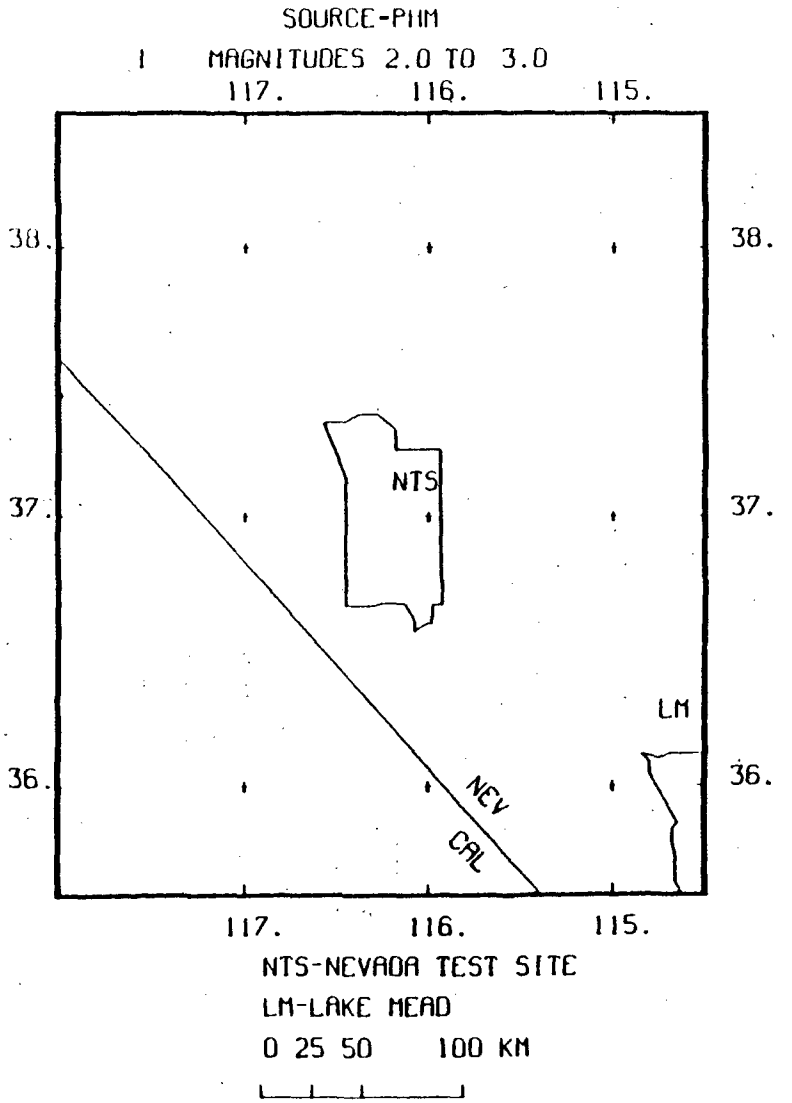

MODIFIED PHM
12 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

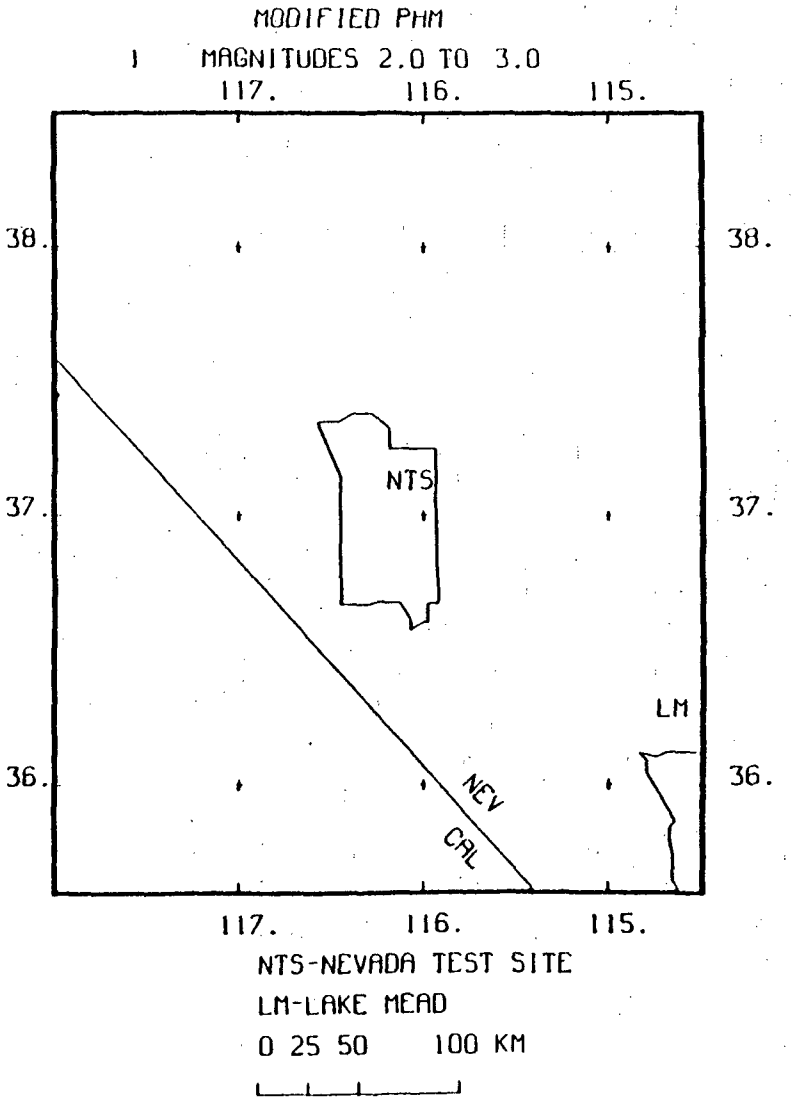

SOURCE-PHM
16 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED PHM
16 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


SOURCE-PHM
4 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

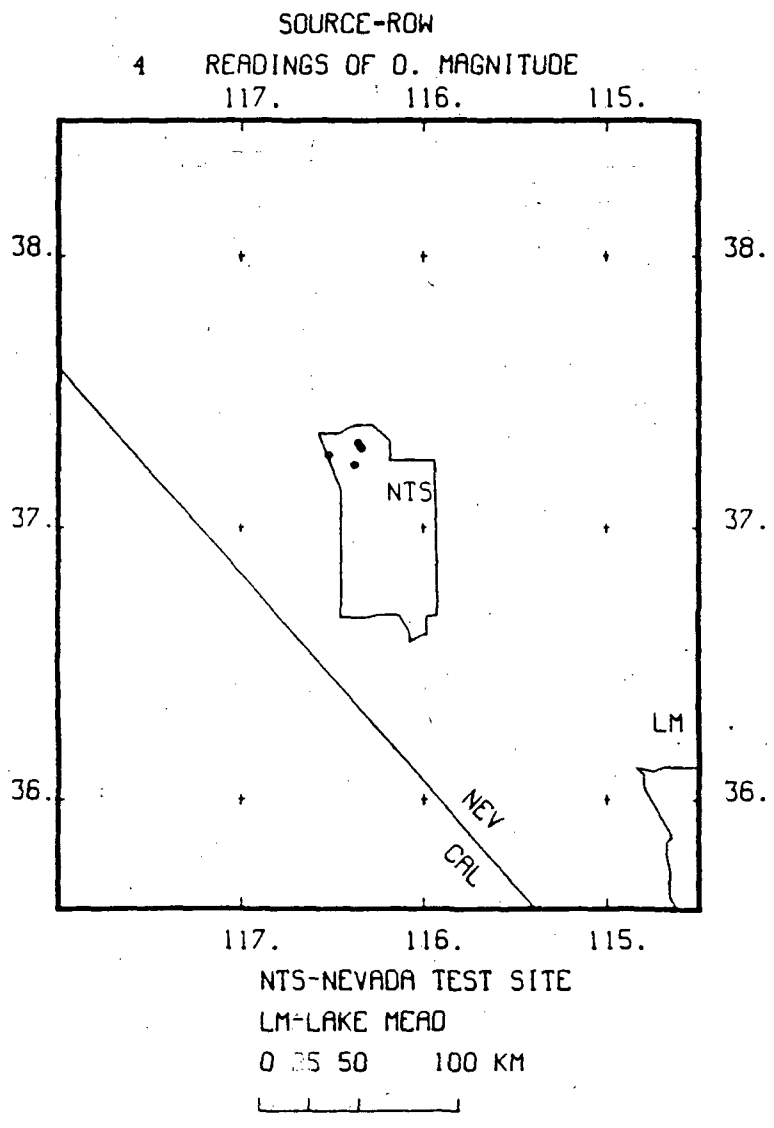

MODIFIED PHM
4 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

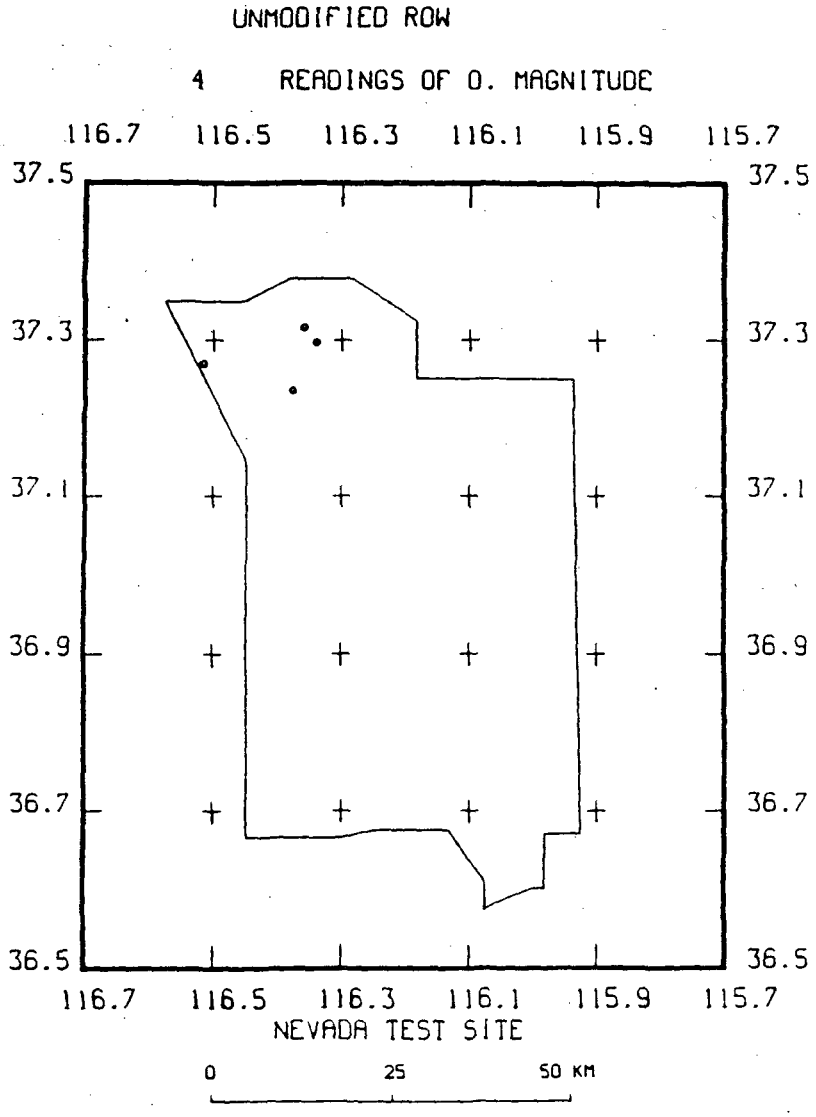

SOURCE-PHM
MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

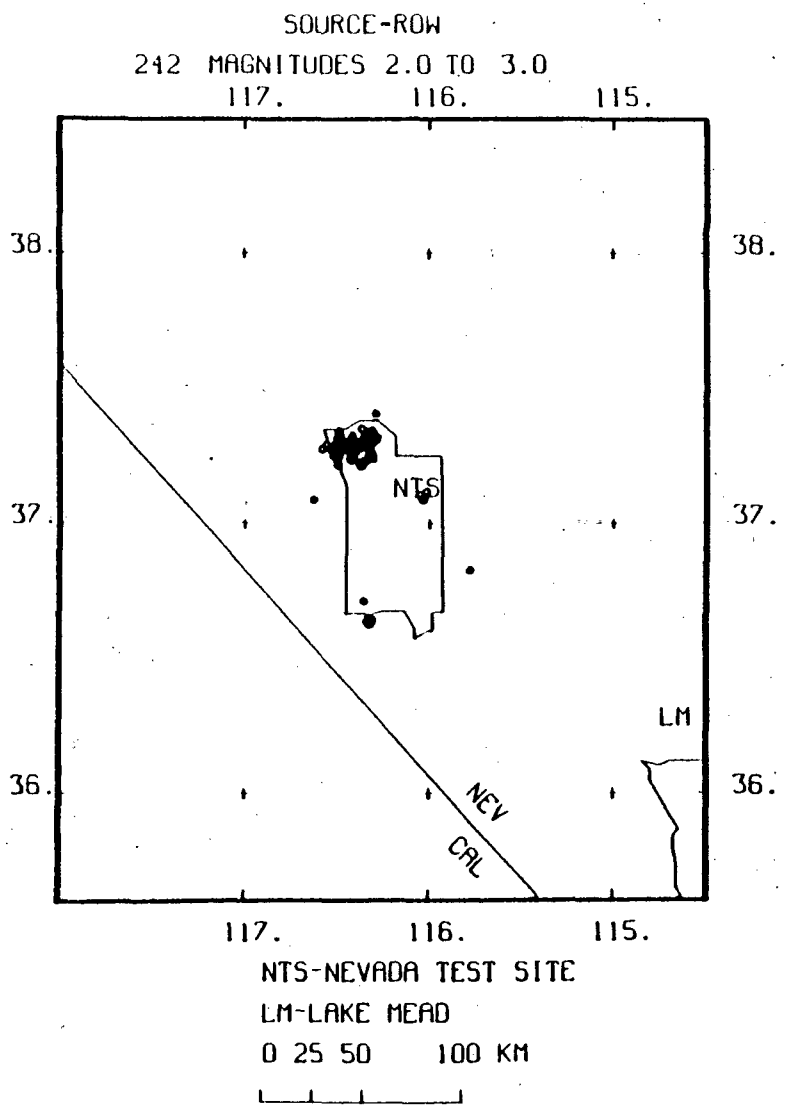

MODIFIED PHM
MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

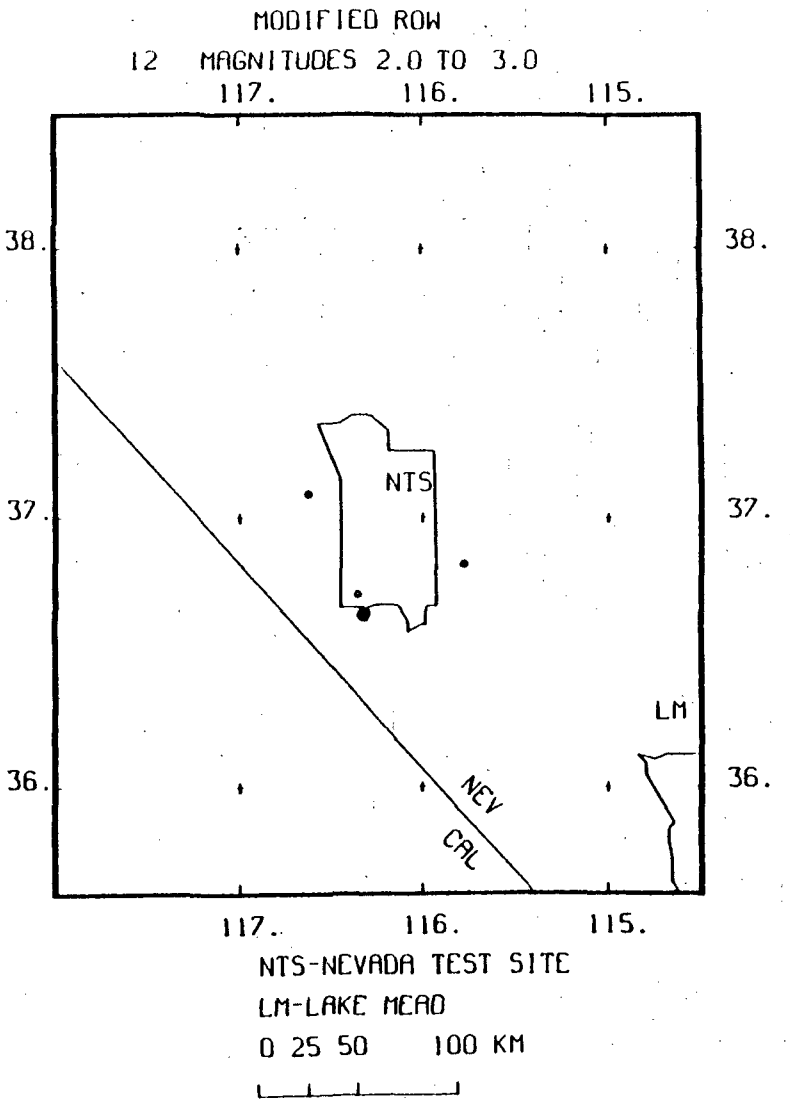
APPENDIX O

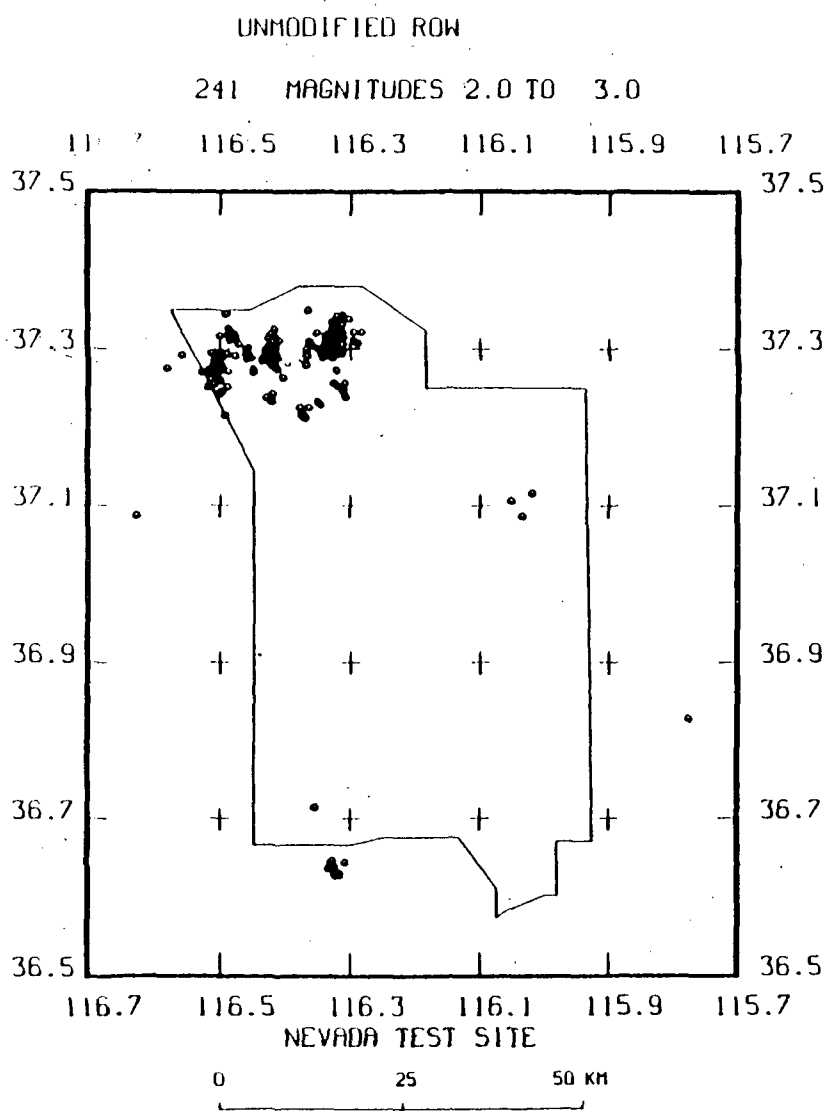
SOURCE - ROW

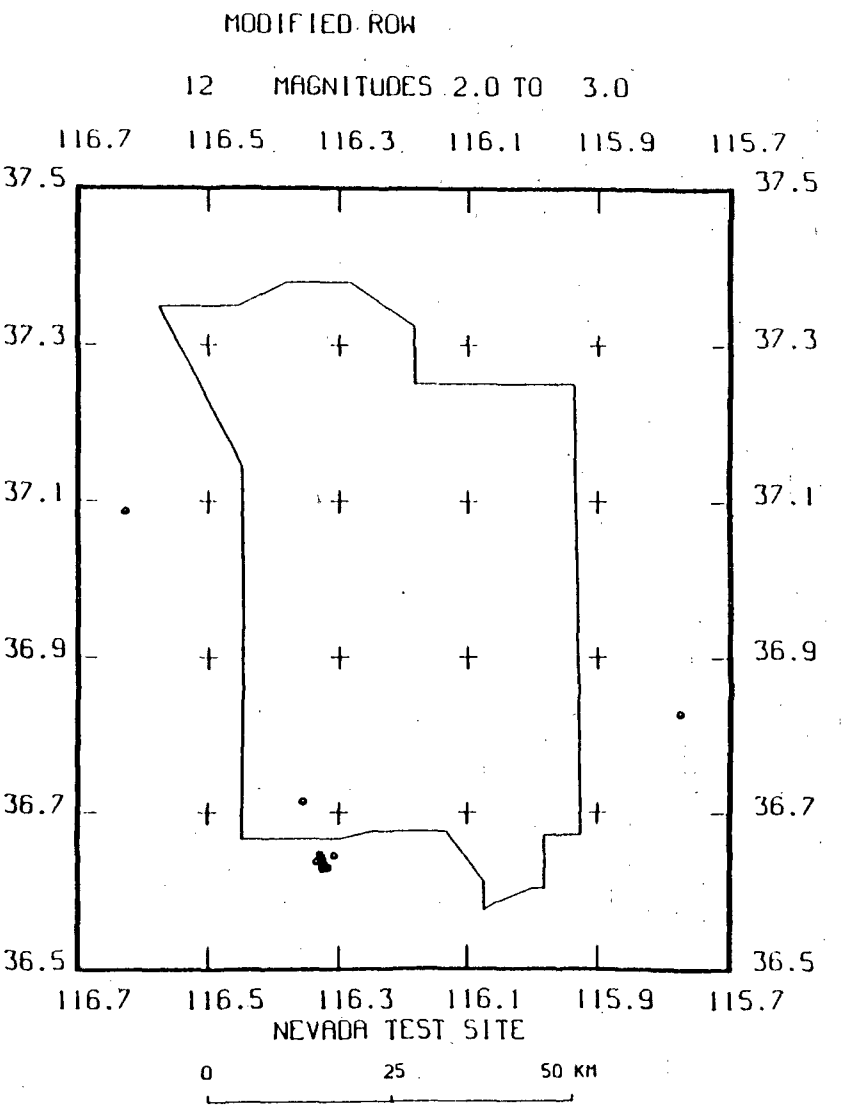

SOURCE-ROW
4 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

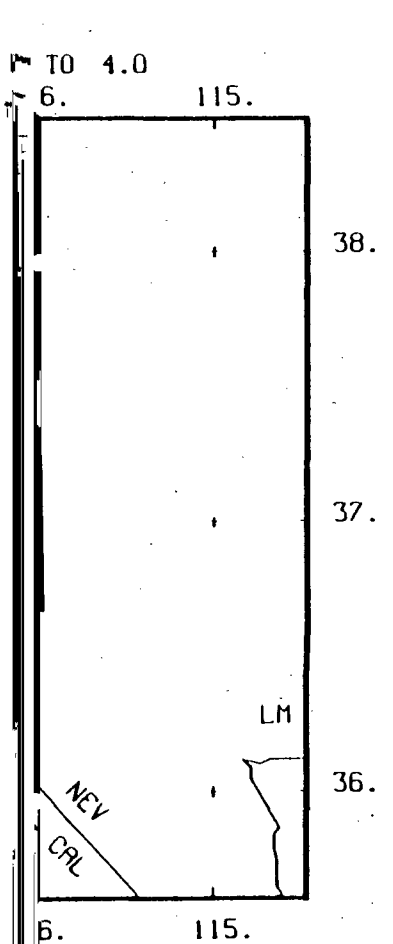

UNMODIFIED ROW
4 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

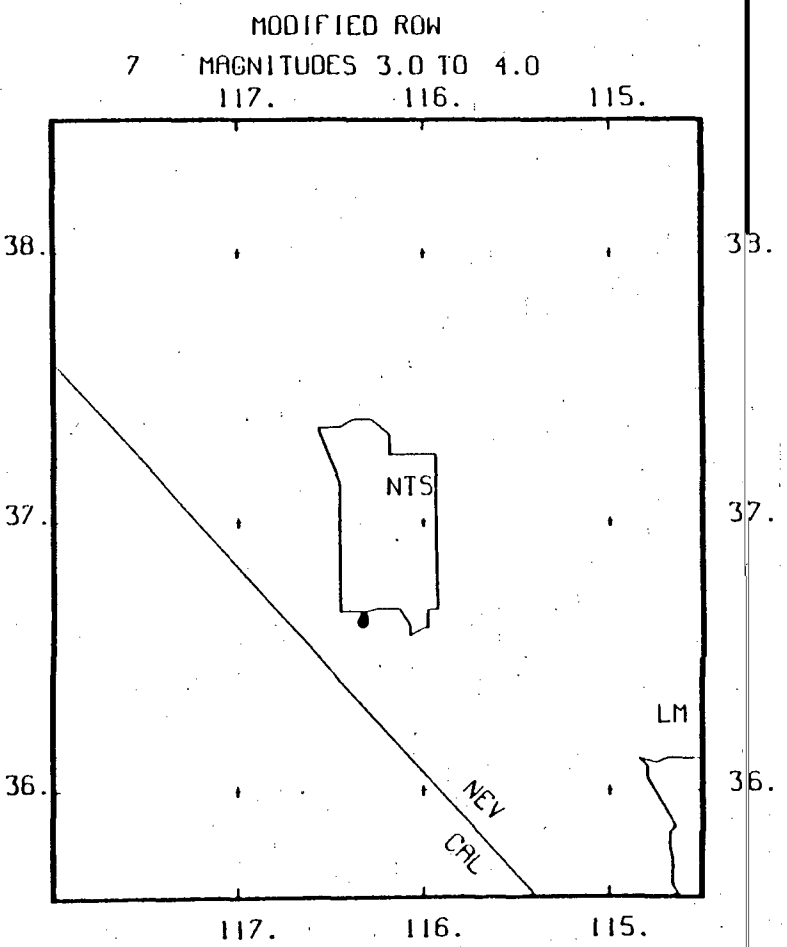

SOURCE-ROW
242 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED ROW
12 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED ROW
241 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

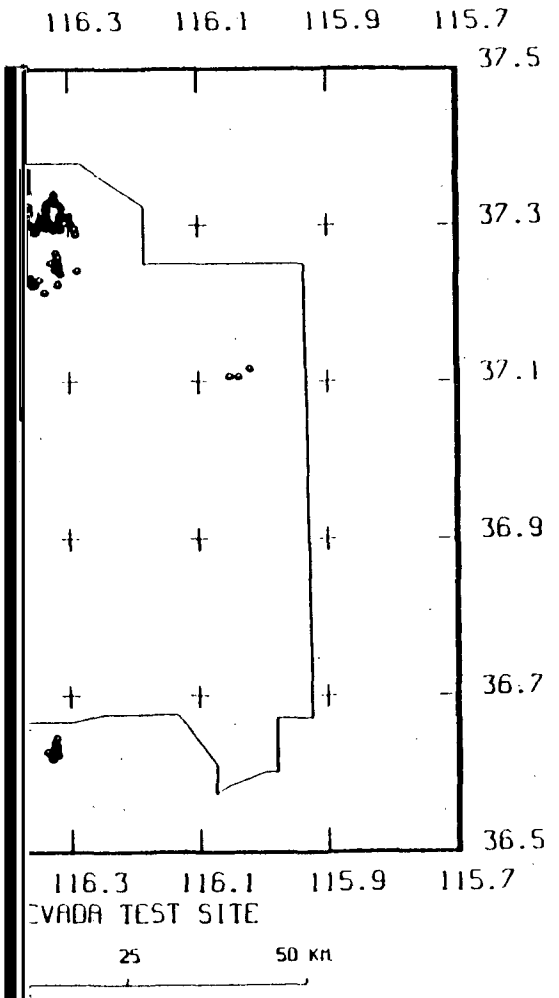

MODIFIED ROW
12 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


TO 4.0
6.
115.
38.
37.
36.
LM
NEV
CAL
6.
115.
TEST SITE
100 KM


MODIFIED ROW
7 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
117.
116.
115.
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

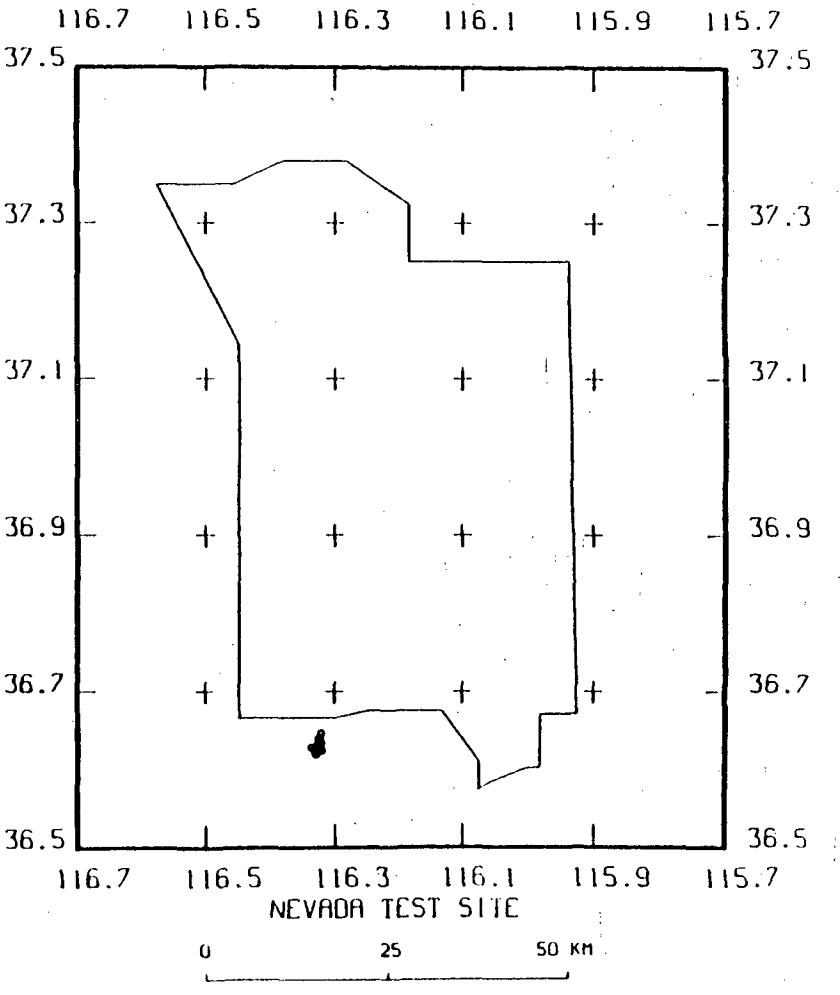
IFIED ROW

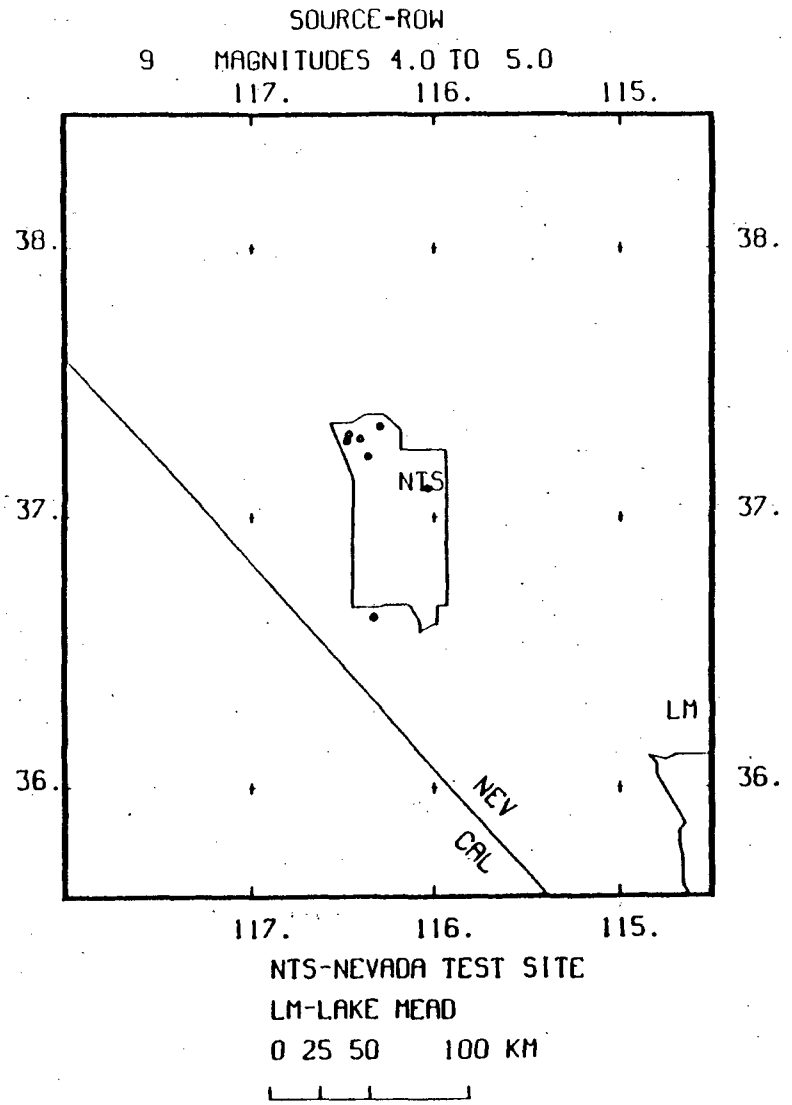
GNITUDES 3.0 TO 4.0

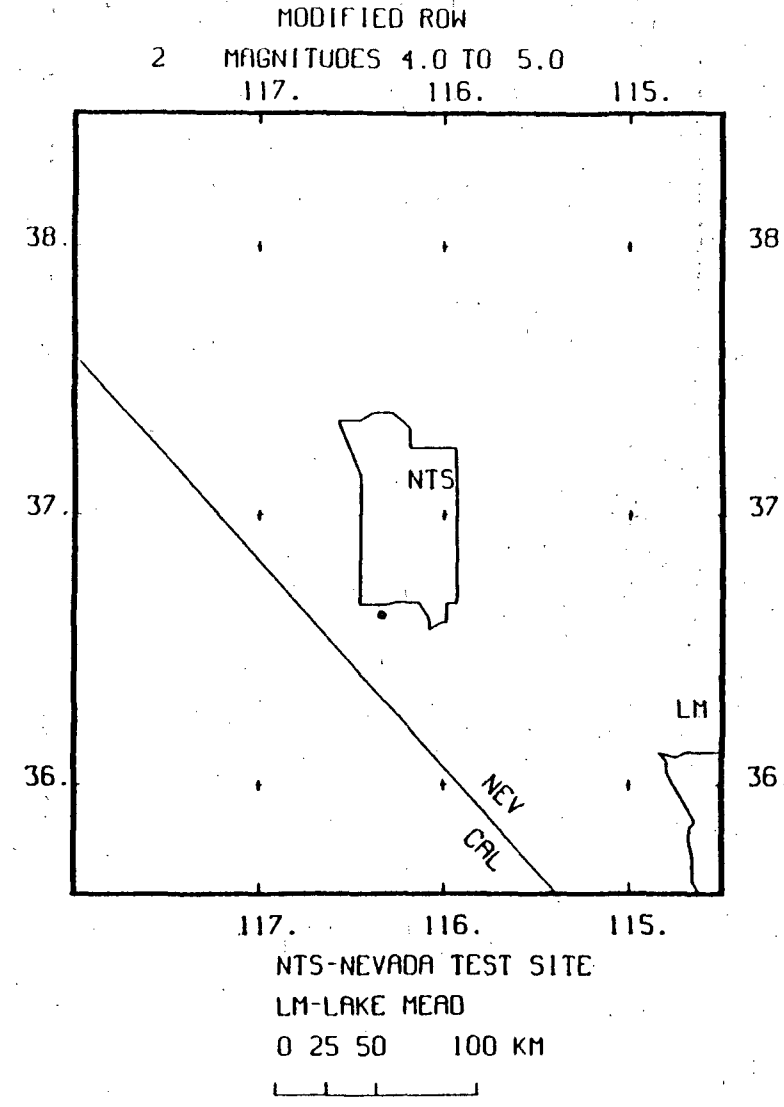


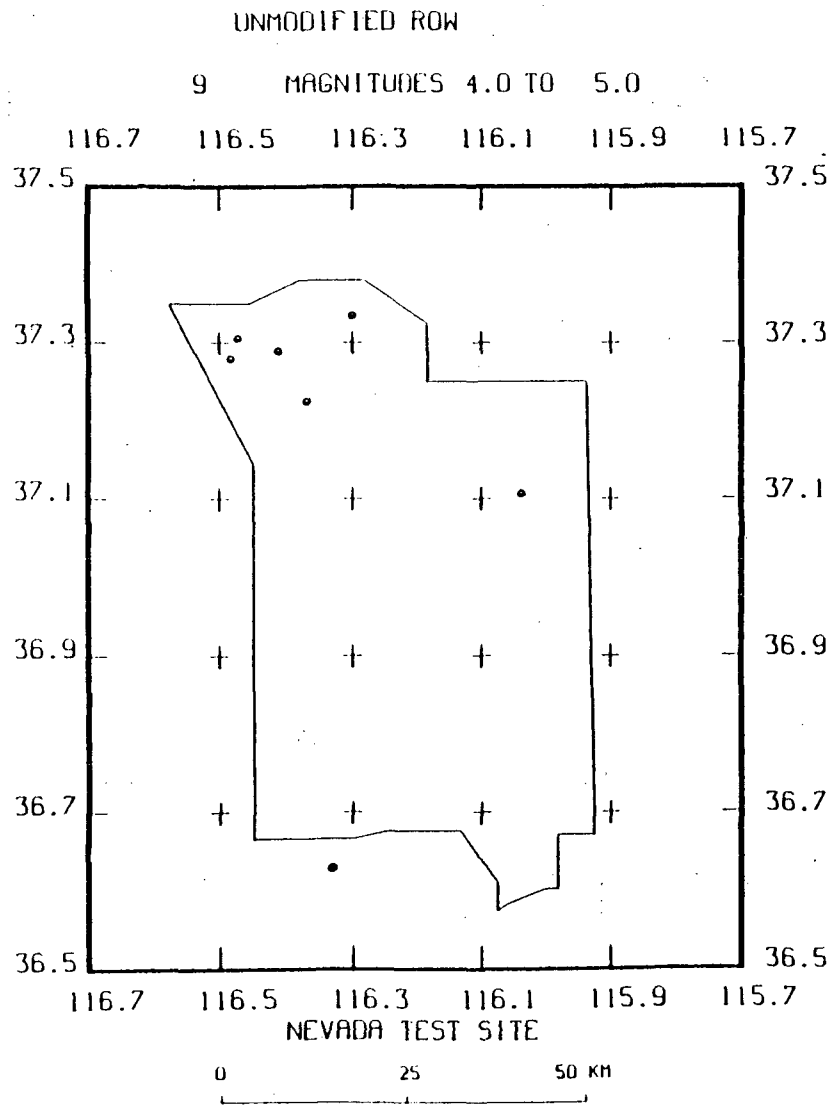
MODIFIED ROW

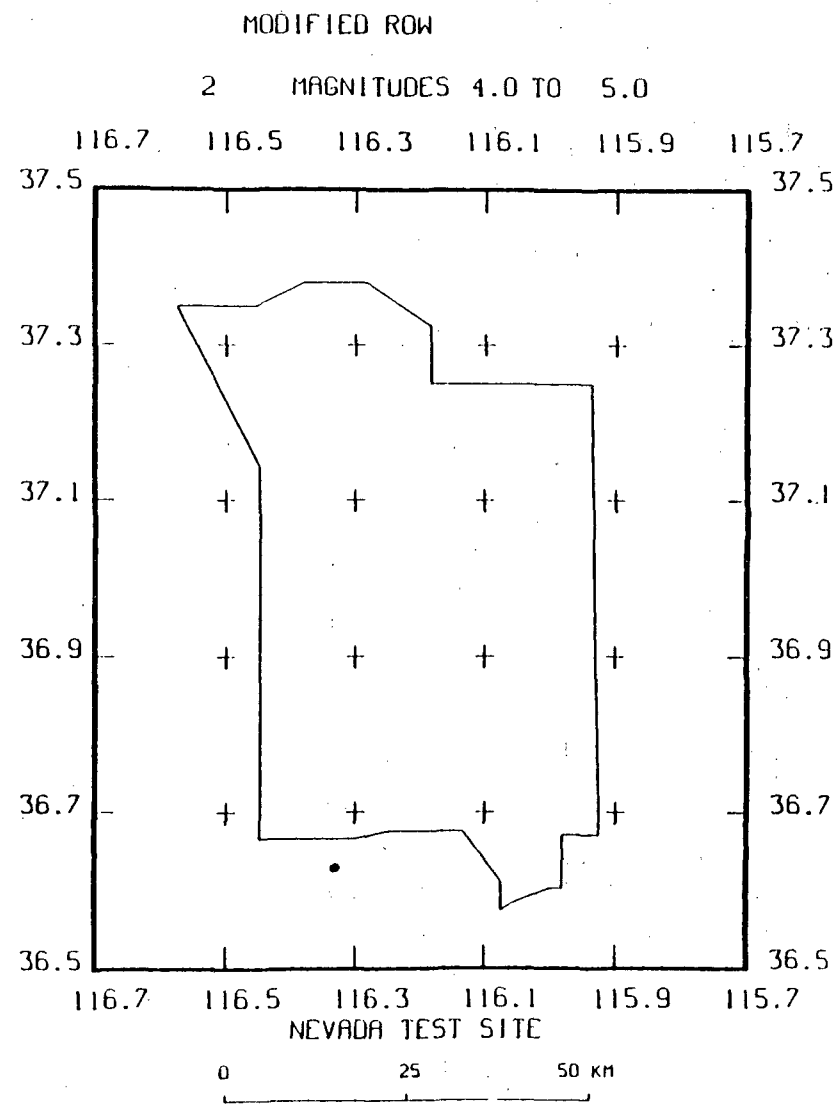
7 MAGNITUDES 3.0 TO 4.0




SOURCE-ROW
9 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

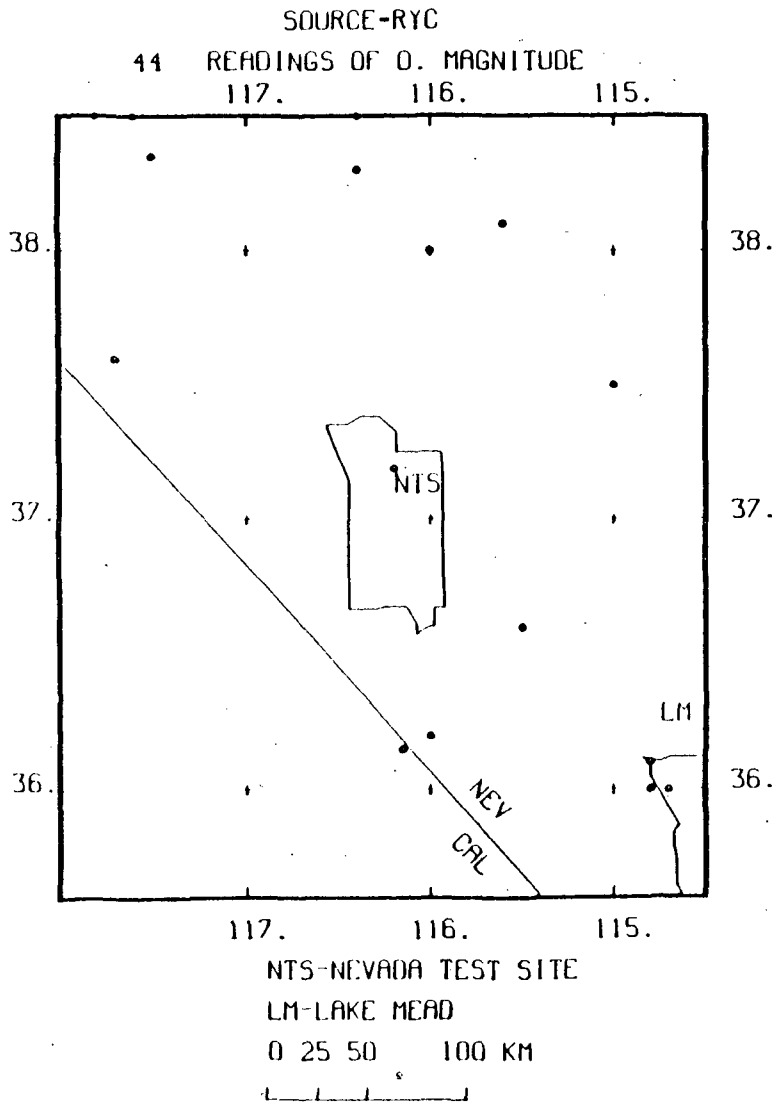

MODIFIED ROW
2 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

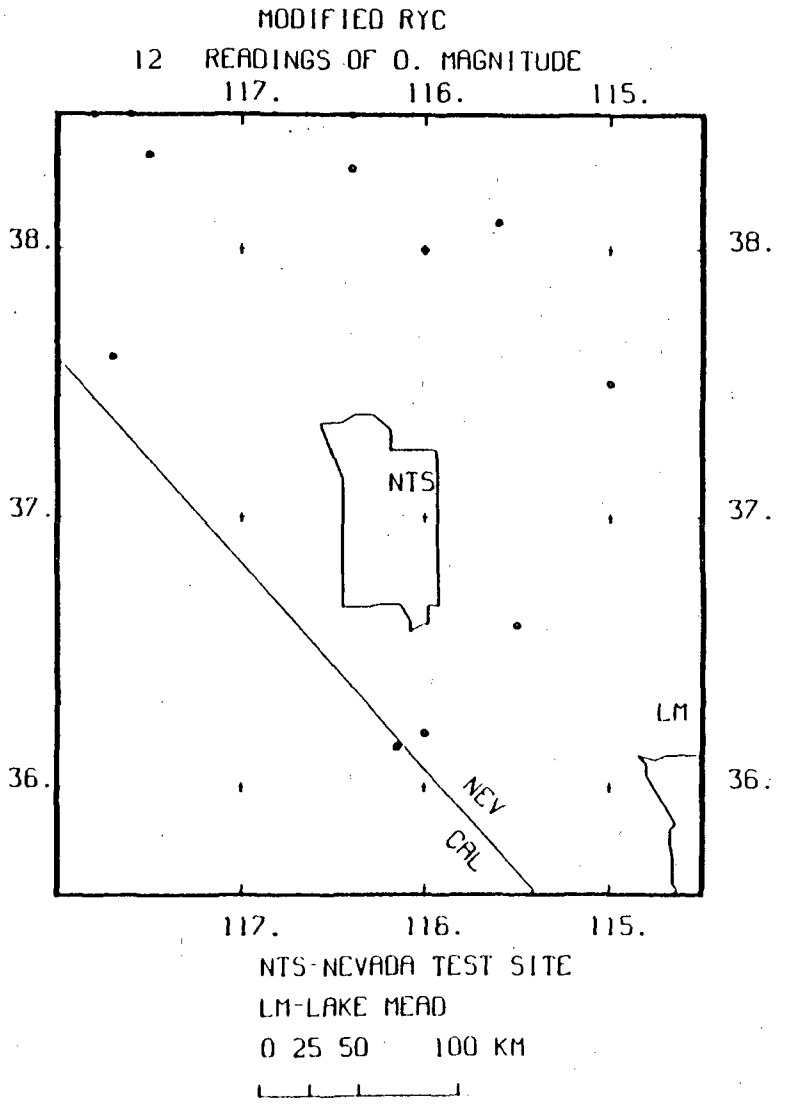

UNMODIFIED ROW
9 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

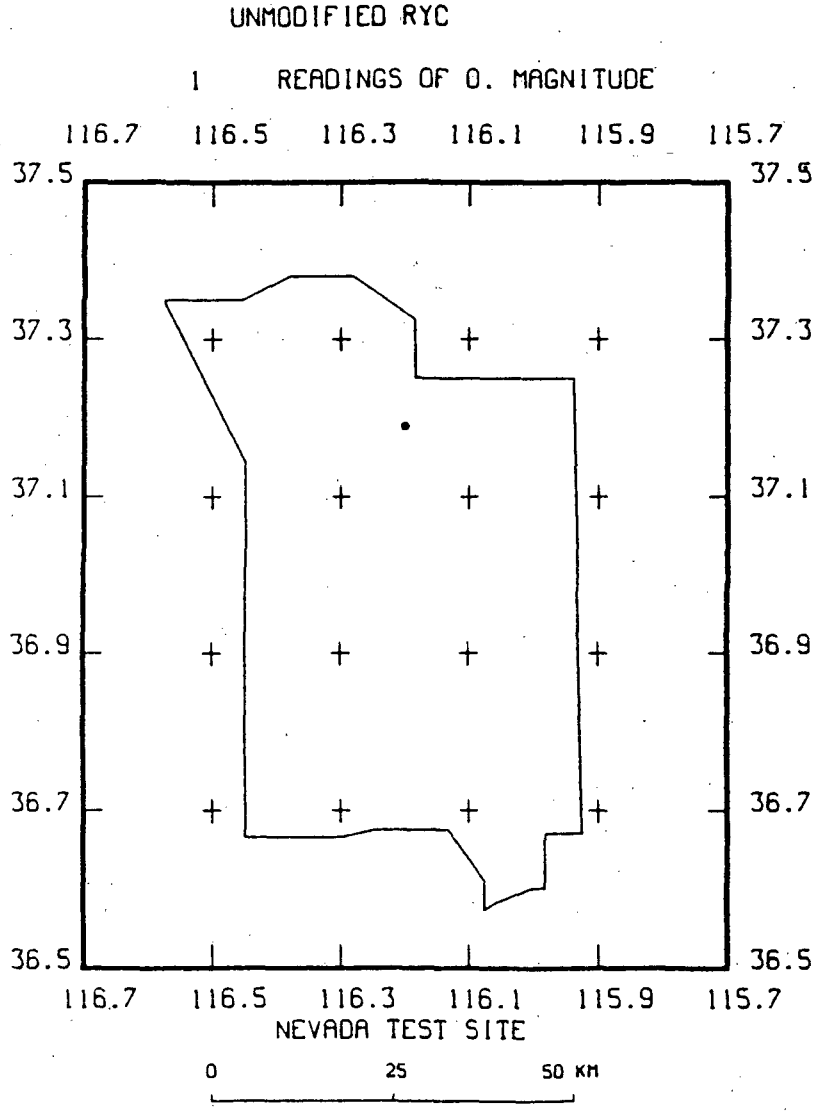

MODIFIED ROW
2 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

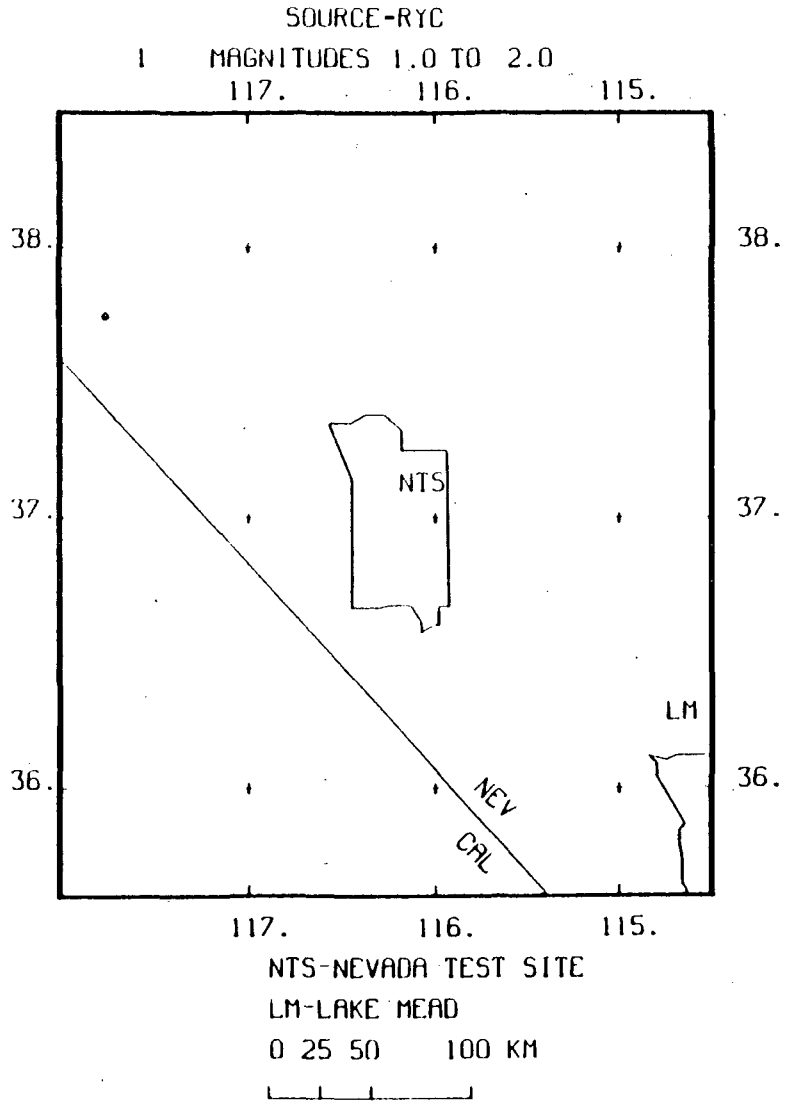
APPENDIX P

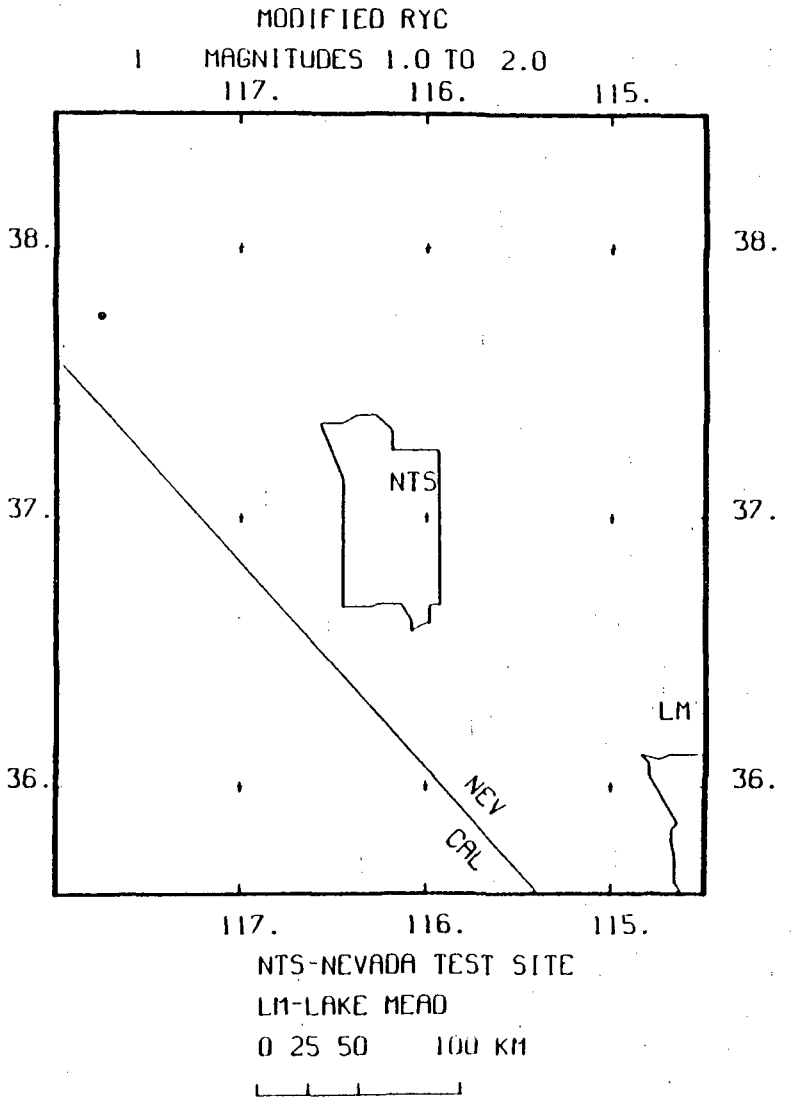
SOURCE - RYC

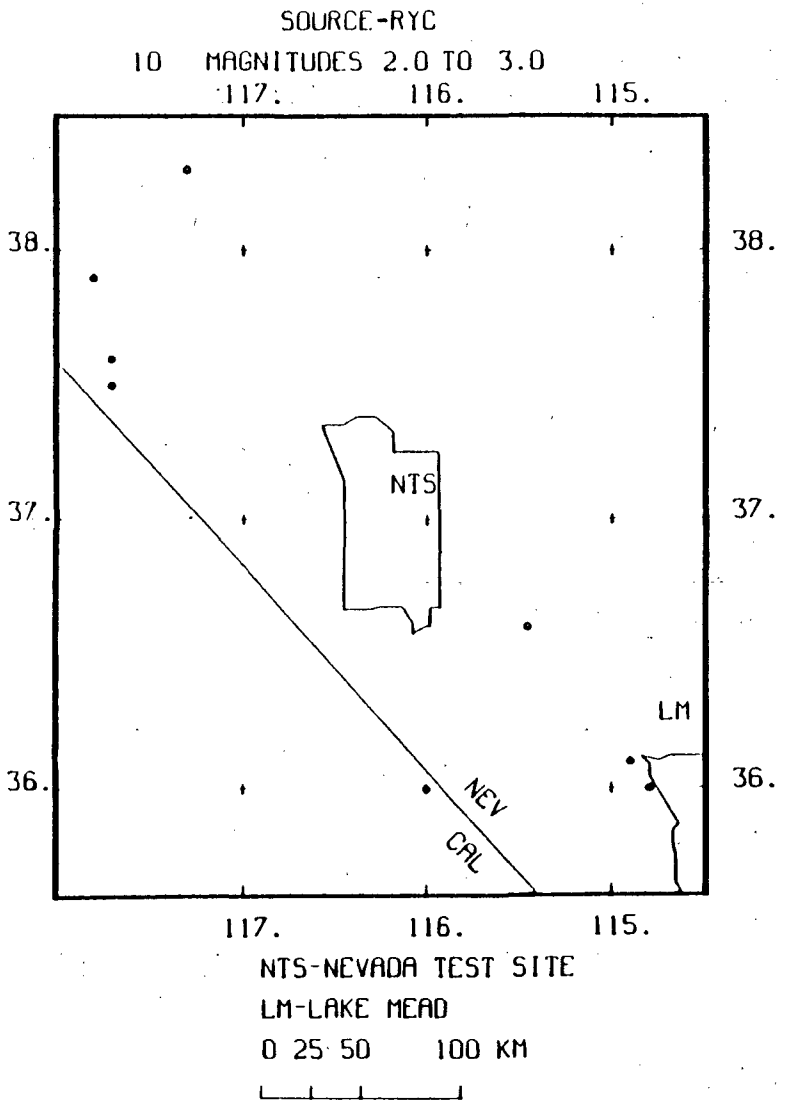

SOURCE-RYC
44 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

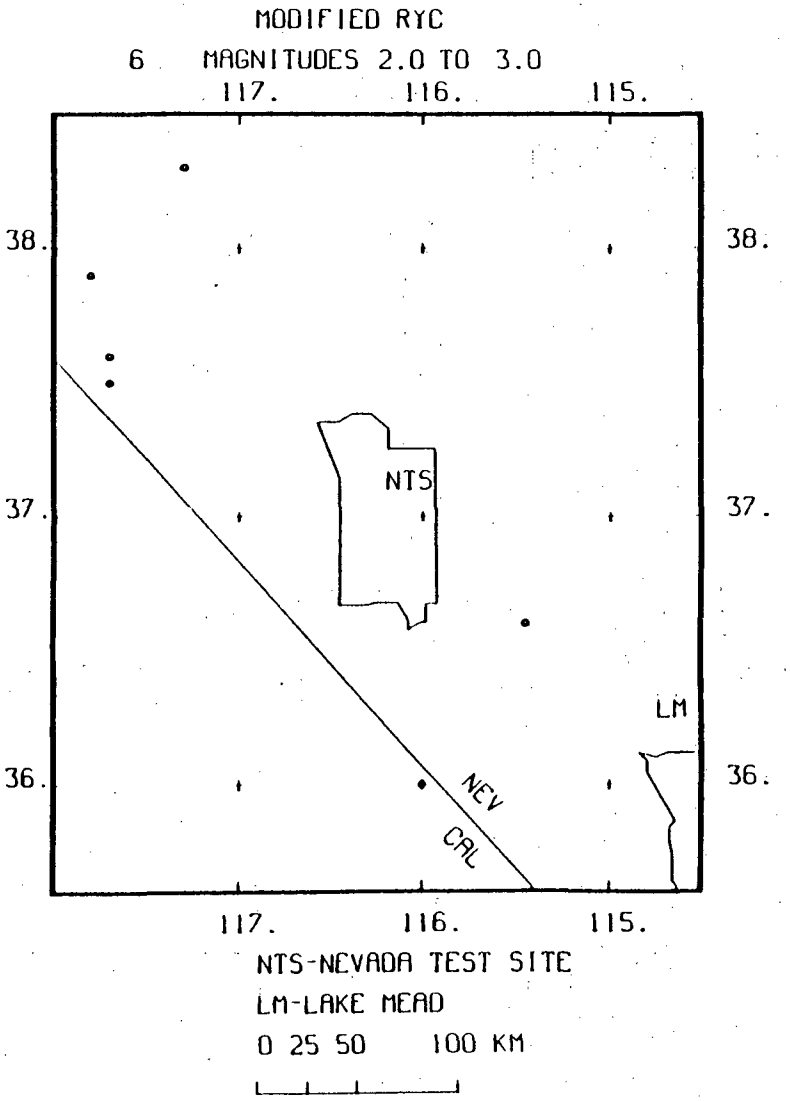

MODIFIED RYC
12 READINGS OF 0. MAGNITUDE
117. 116. 115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

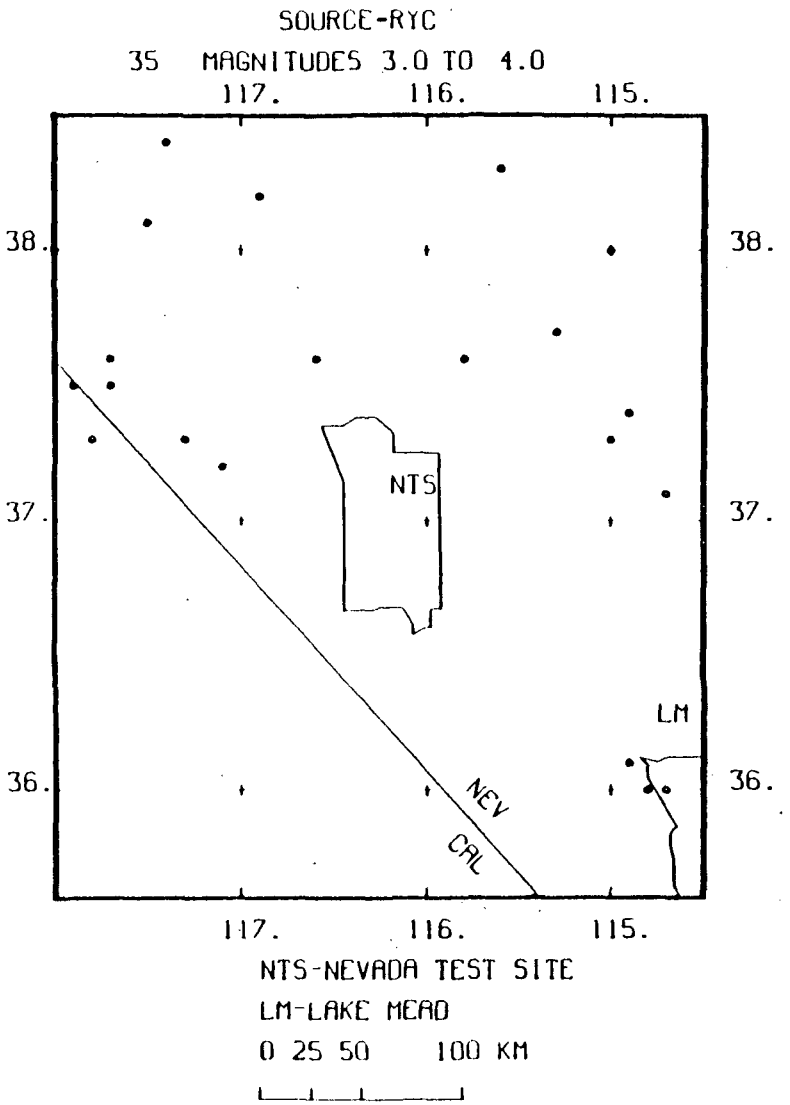

UNMODIFIED RYC
1 READINGS OF 0. MAGNITUDE
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

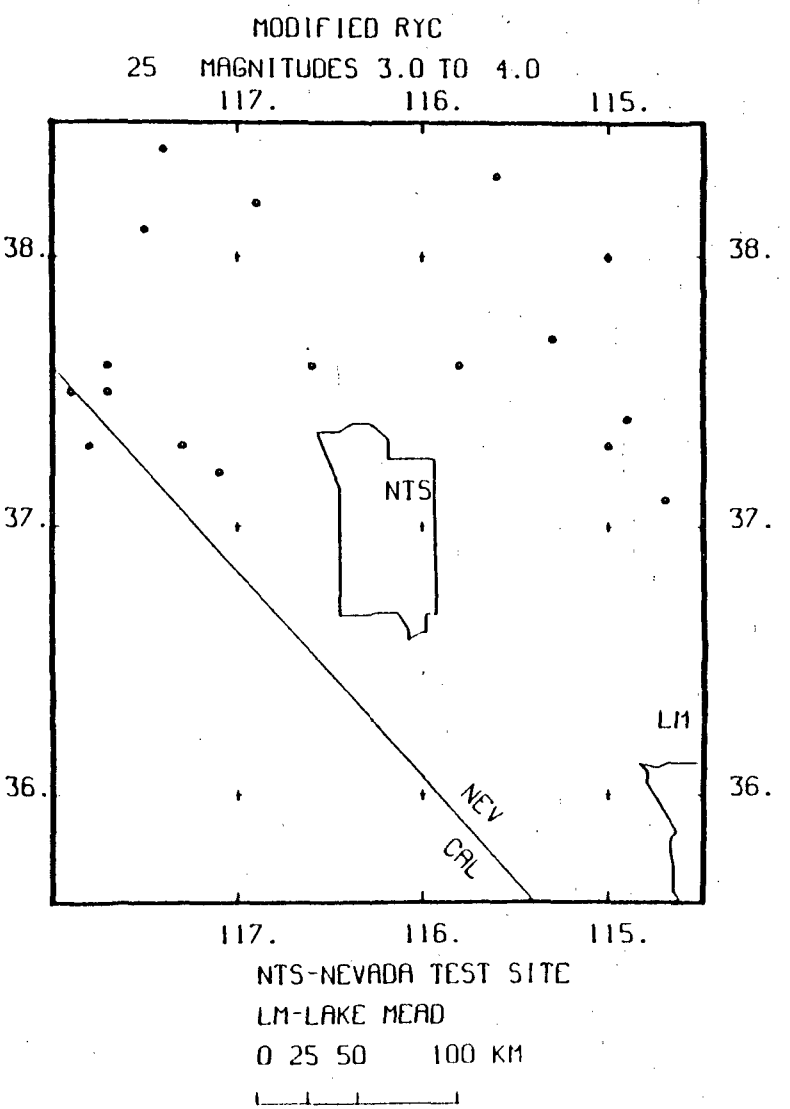

SOURCE-RYC
1 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

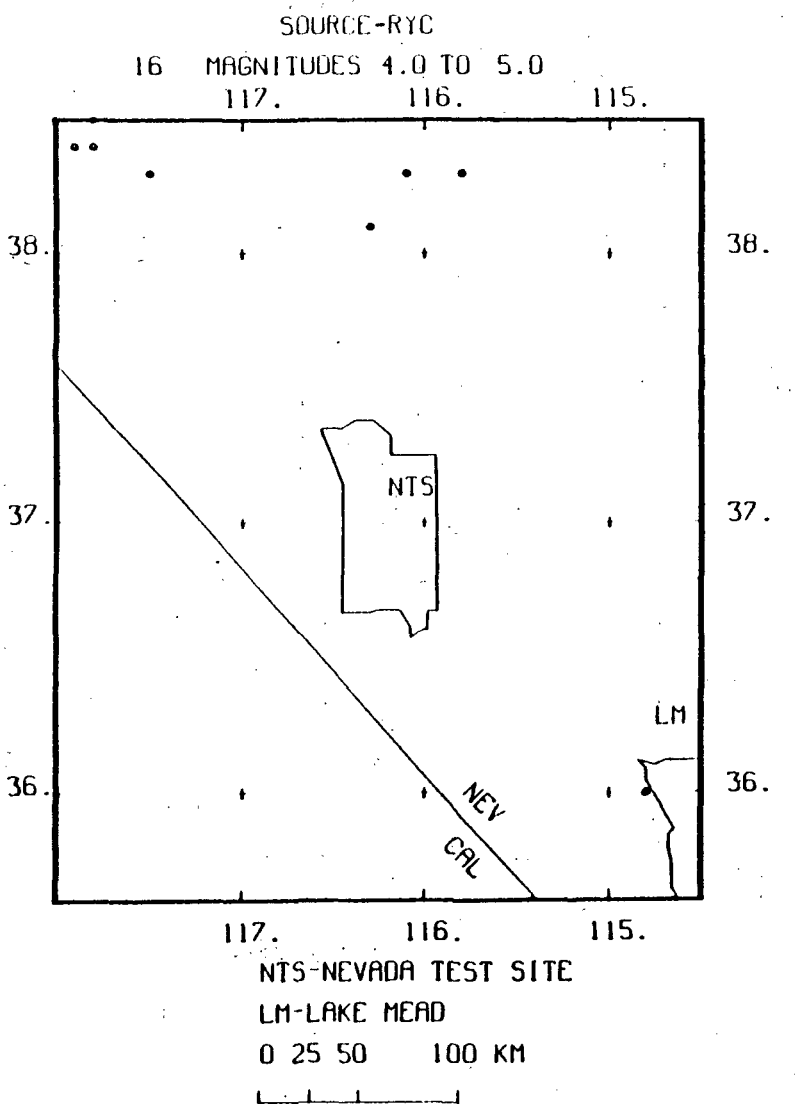

MODIFIED RYC
1 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

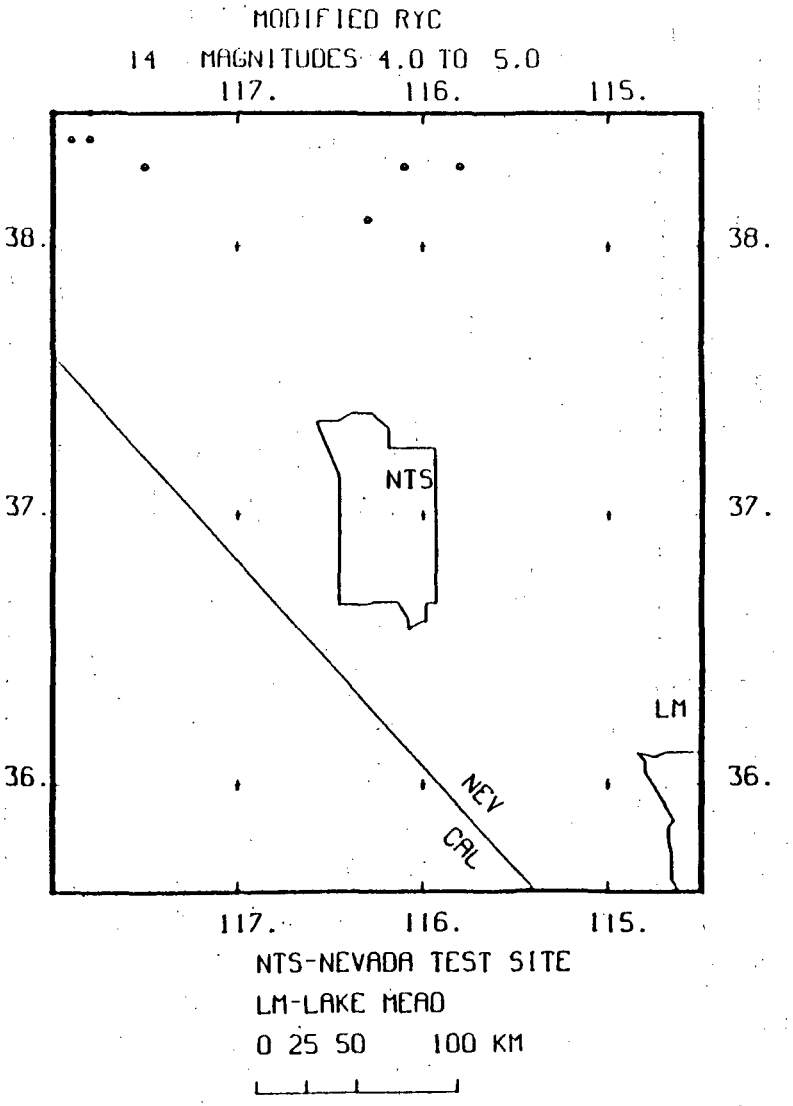

SOURCE-RYC
10 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

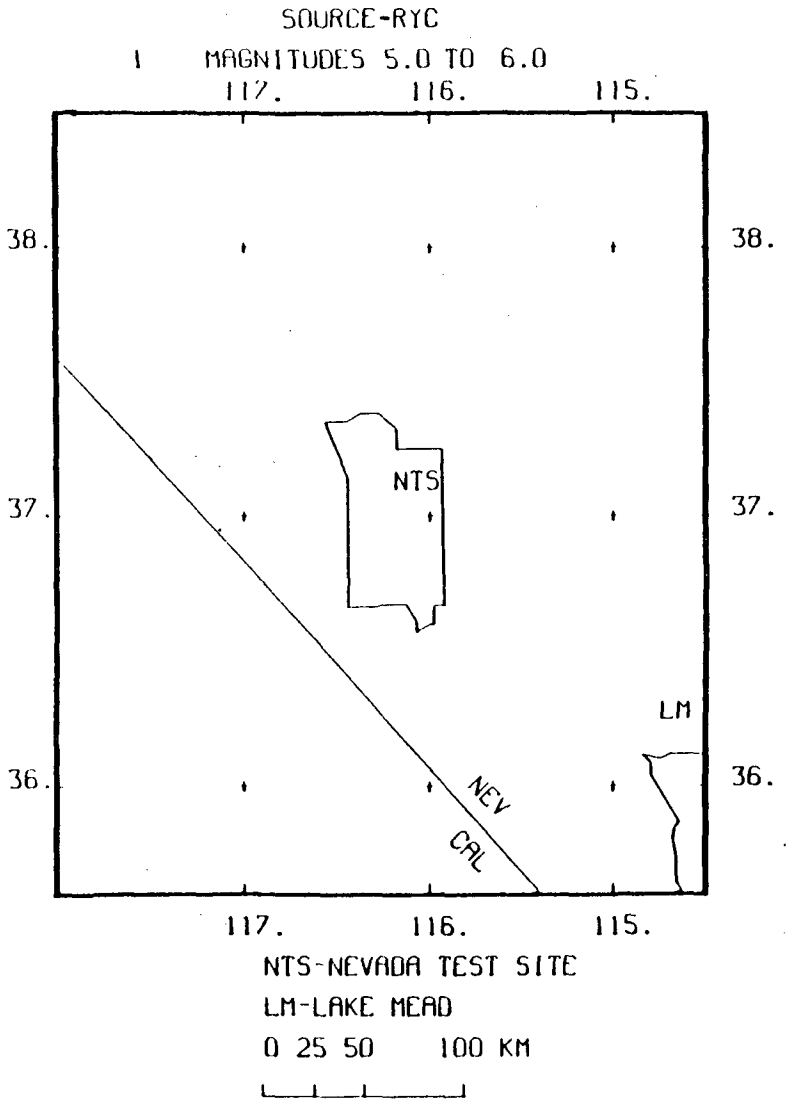

MODIFIED RYC
6 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

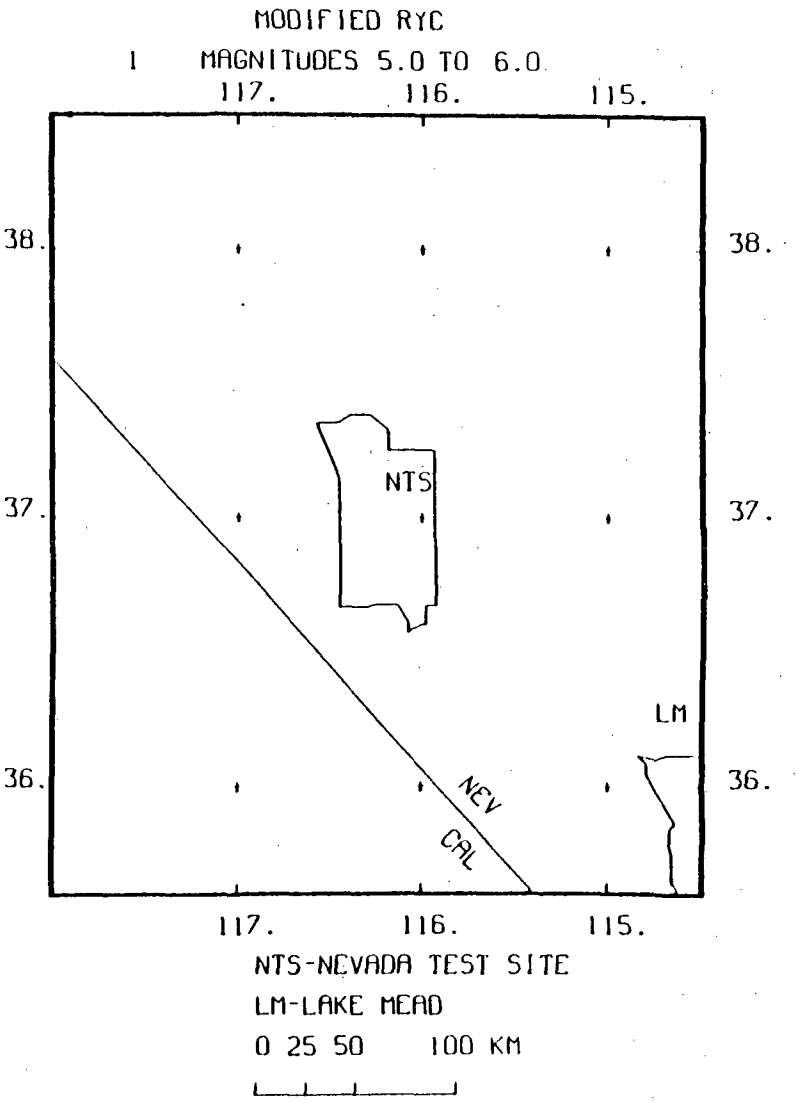

SOURCE-RYC
35 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED RYC
25 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


SOURCE-RYC
16 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

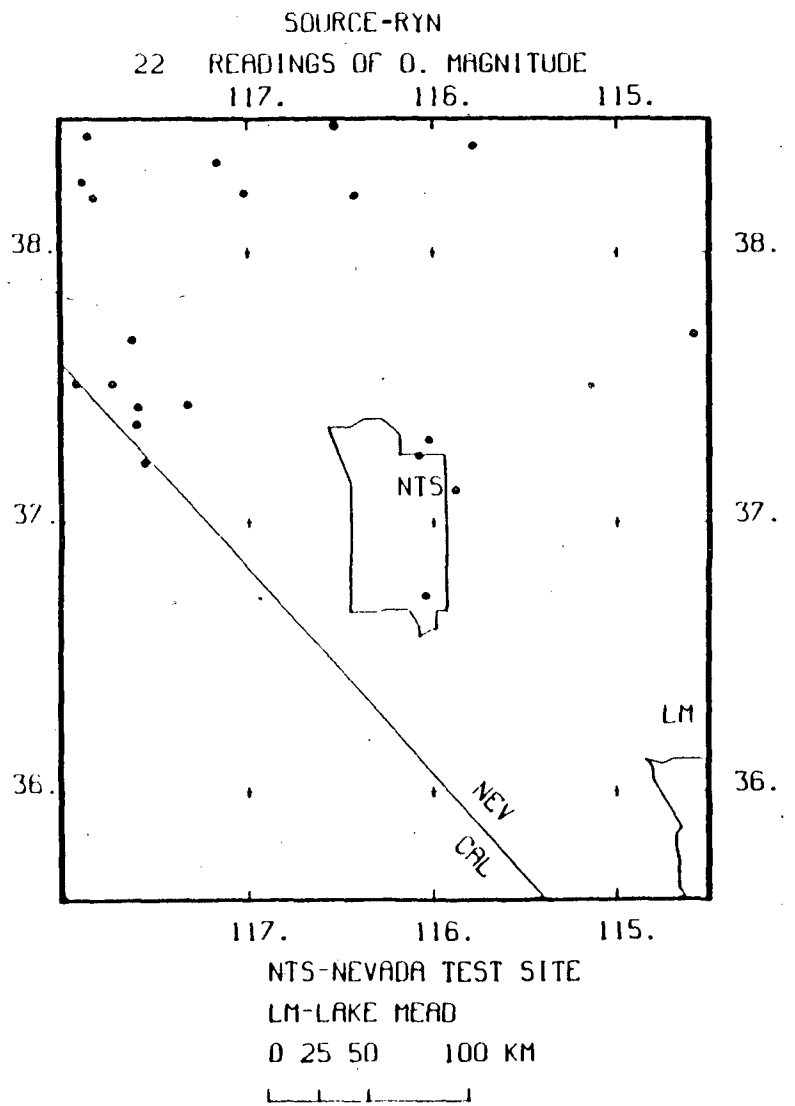

MODIFIED RYC
14 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

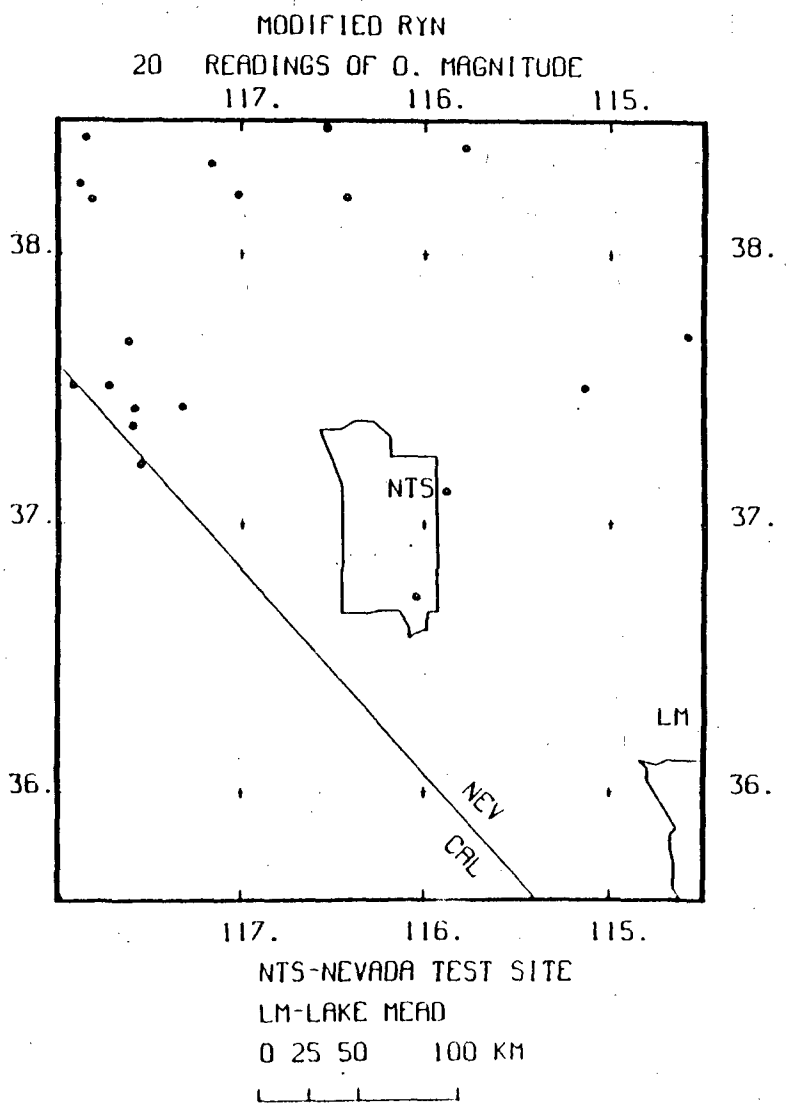

SOURCE-RYC
1 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

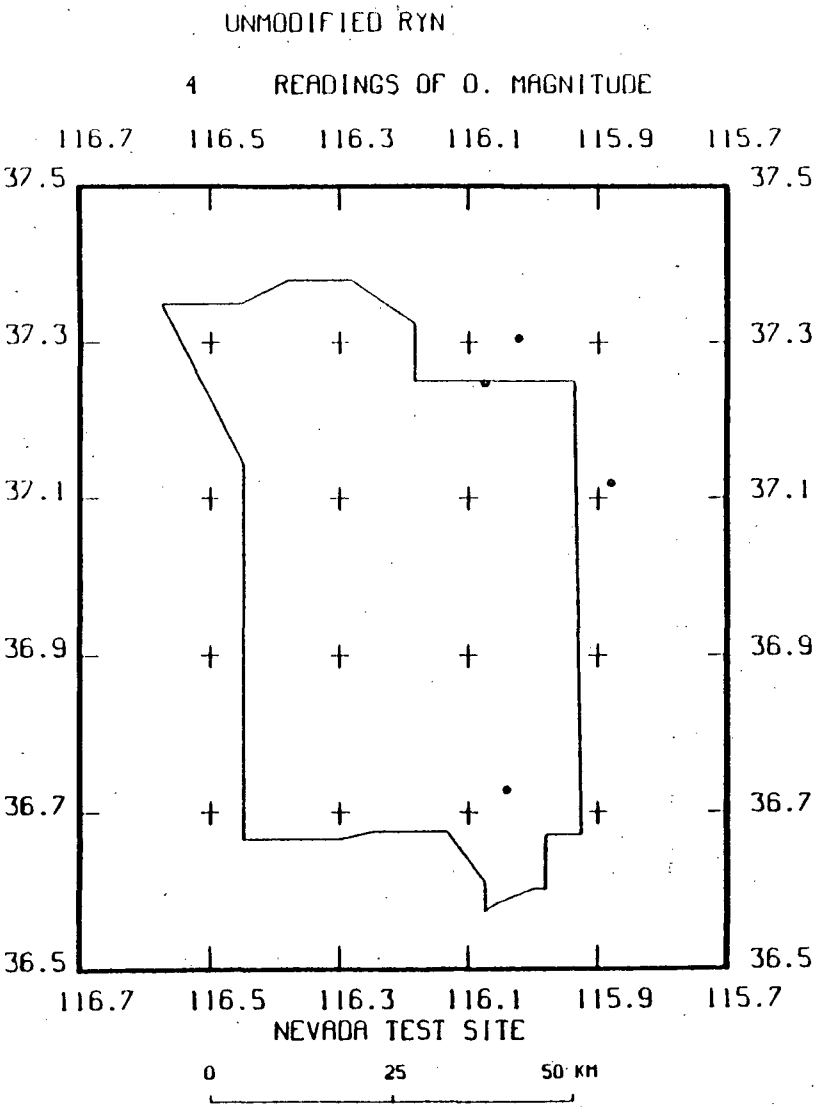

MODIFIED RYC
1 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

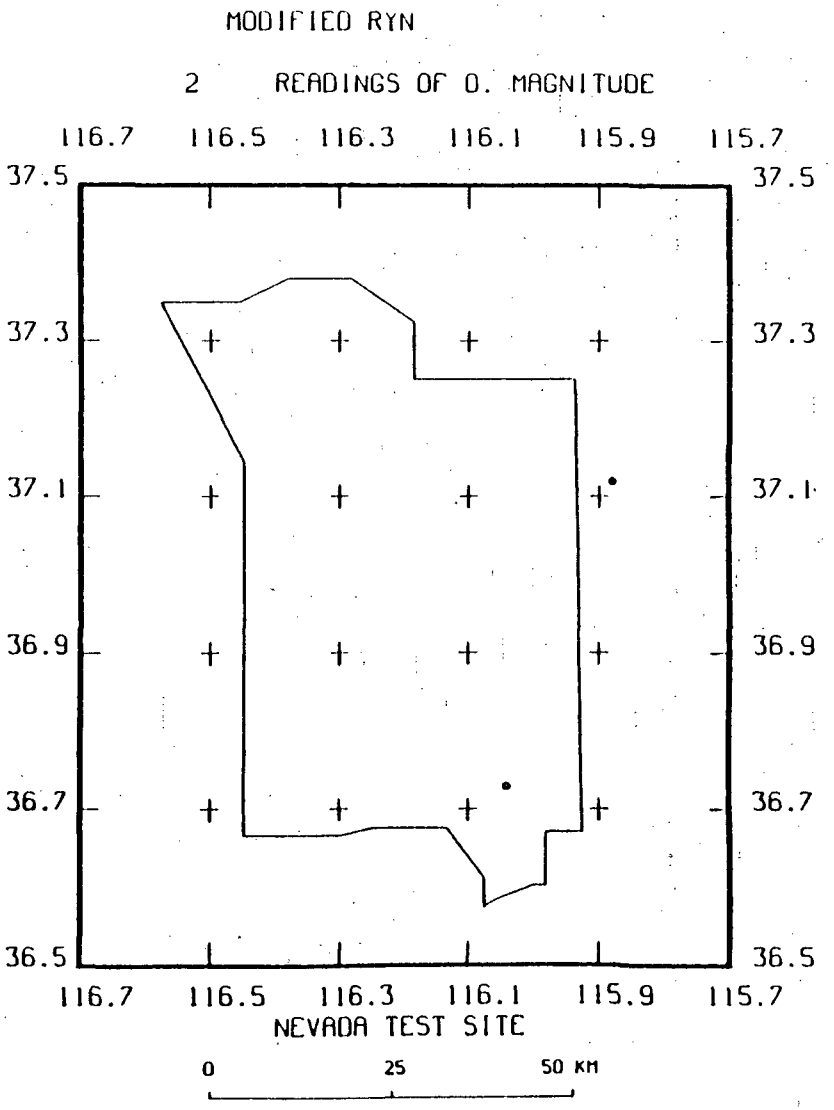
APPENDIX Q

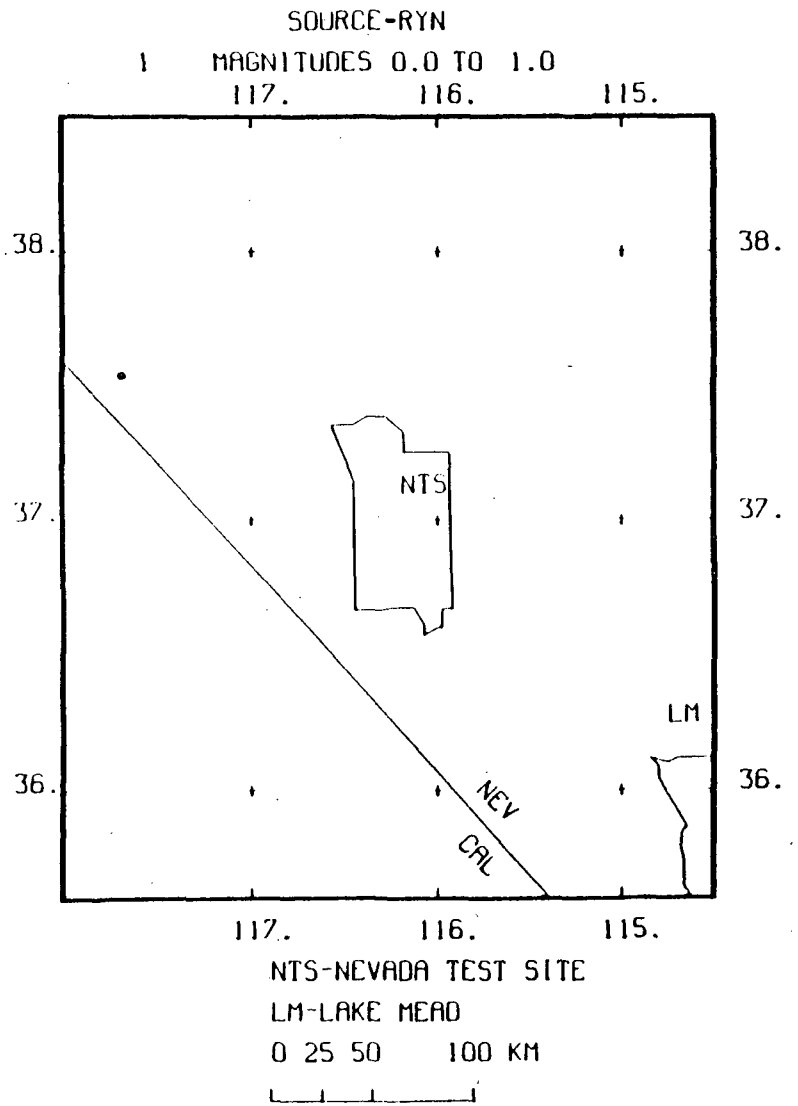
SOURCE - RYN

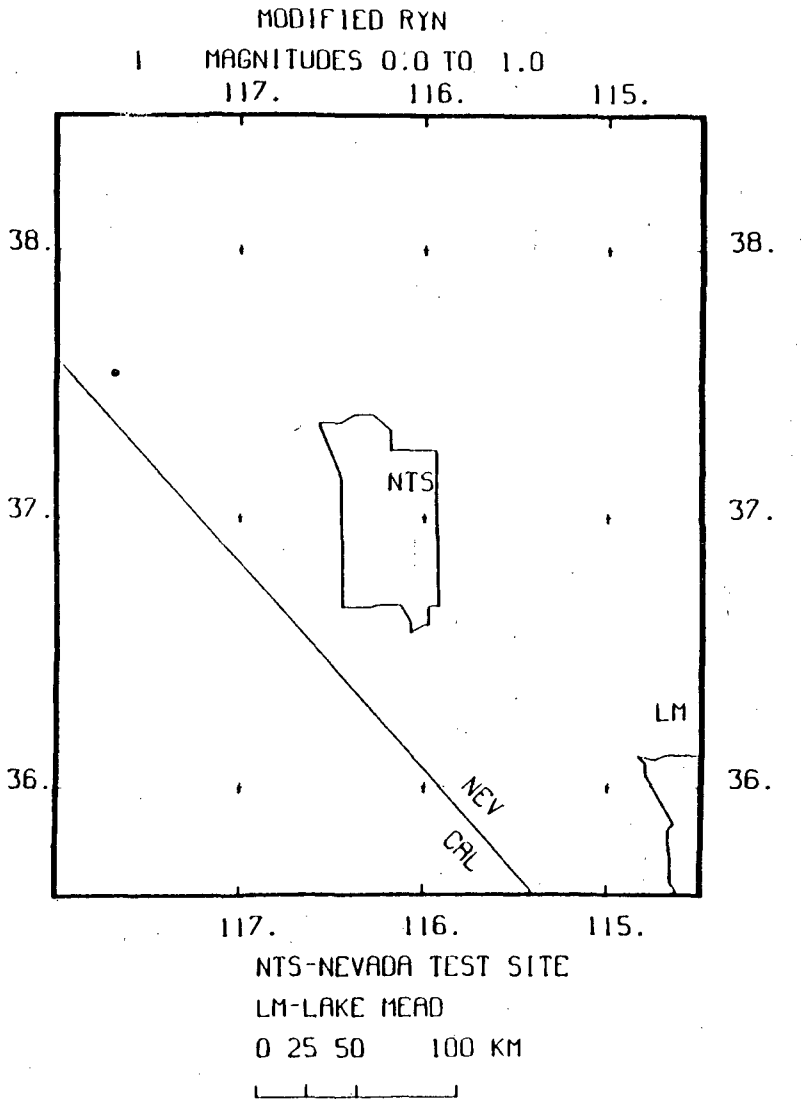

SOURCE-RYN
22 READINGS OF O. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

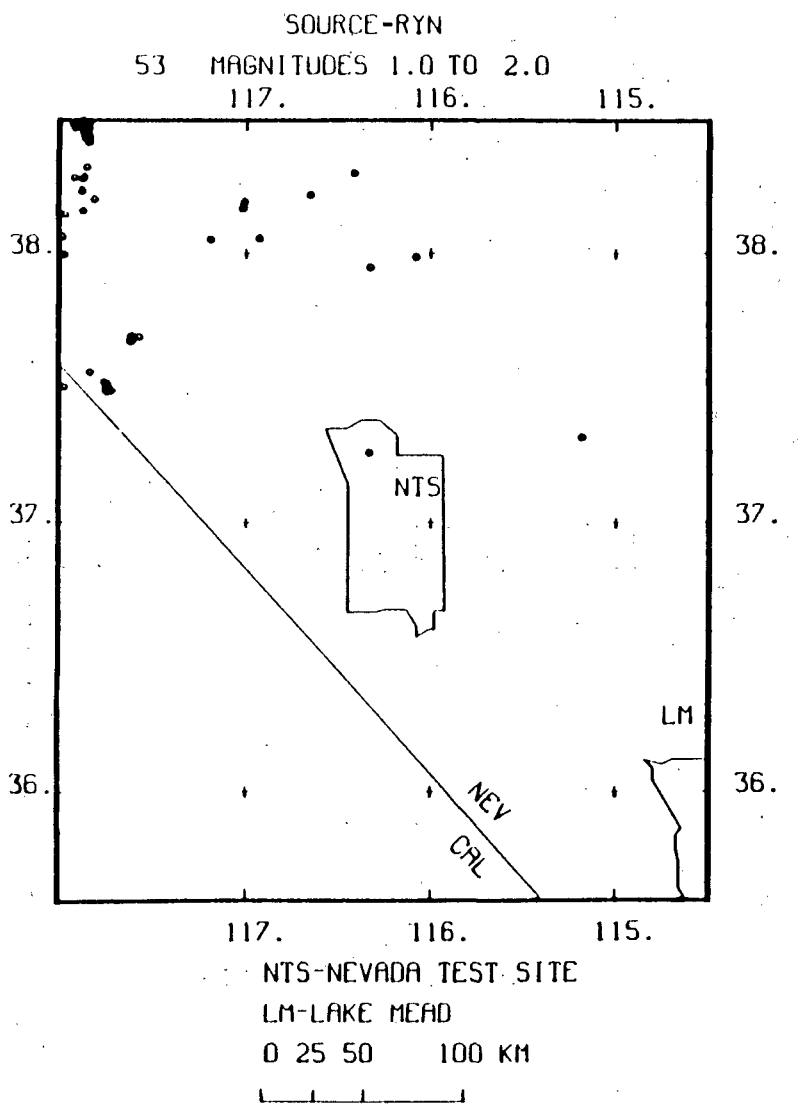

MODIFIED RYN
20 READINGS OF O. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

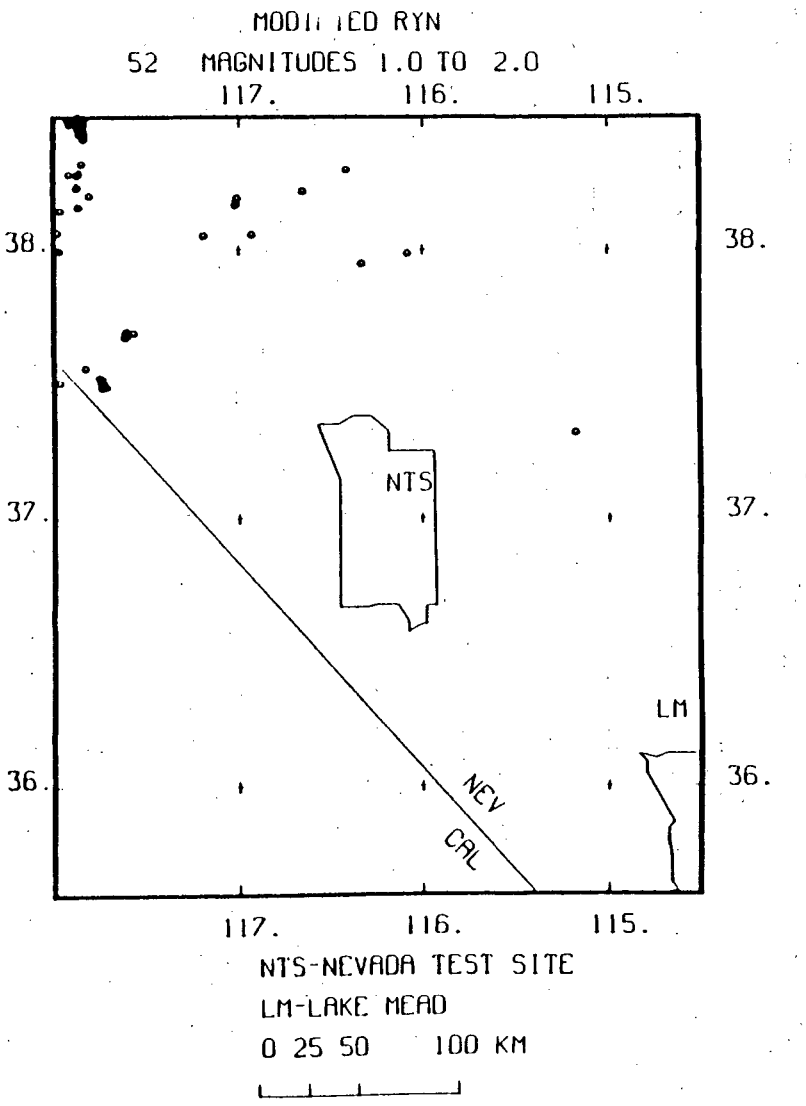

UNMODIFIED RYN
4 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

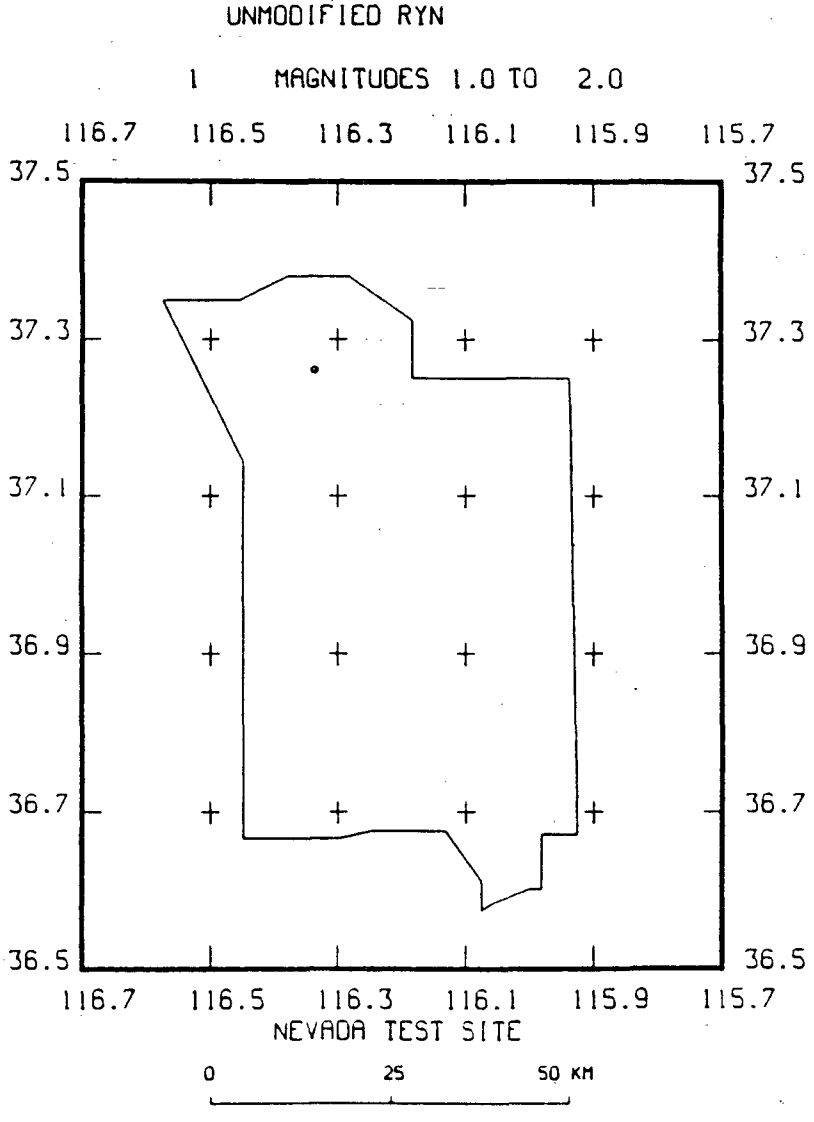

MODIFIED RYN
2 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

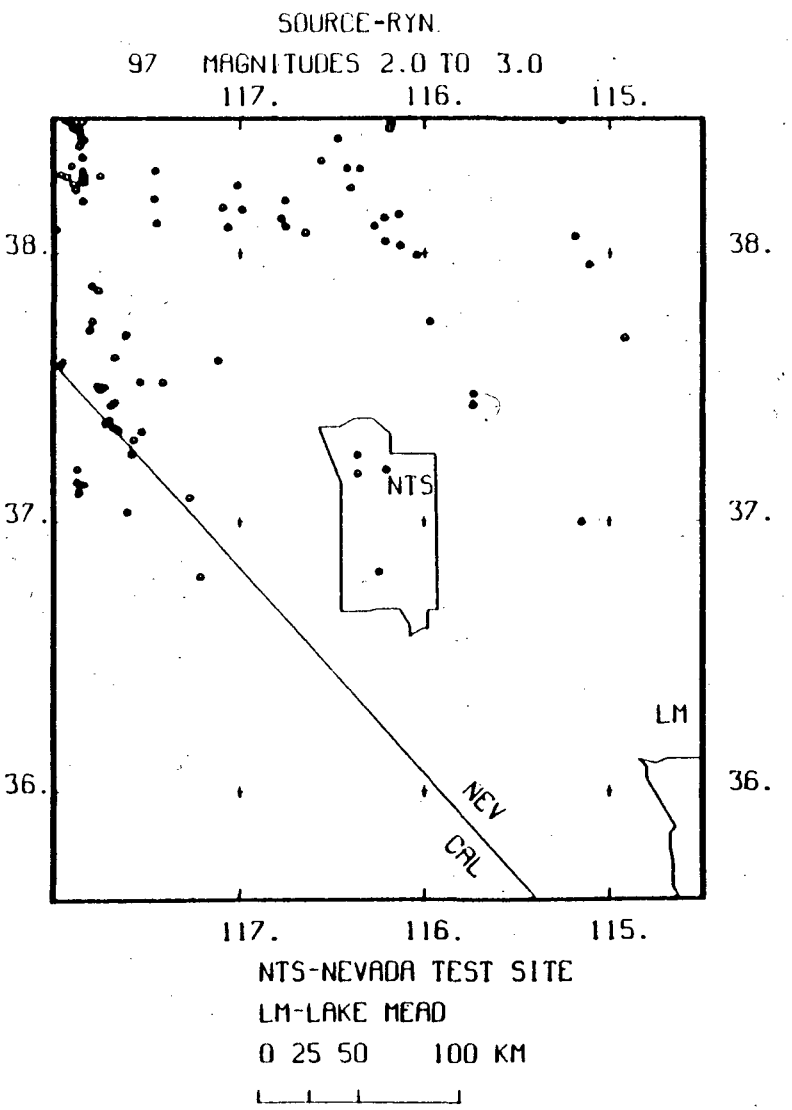

SOURCE-RYN
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

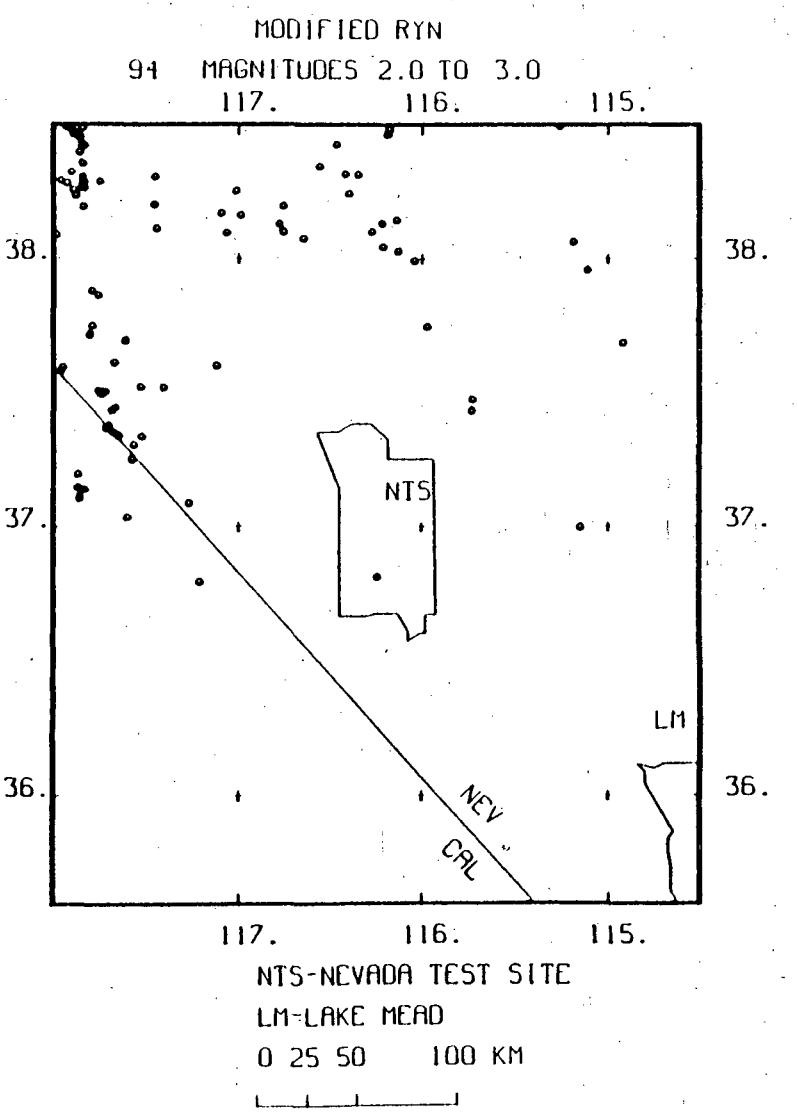

MODIFIED RYN
1 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

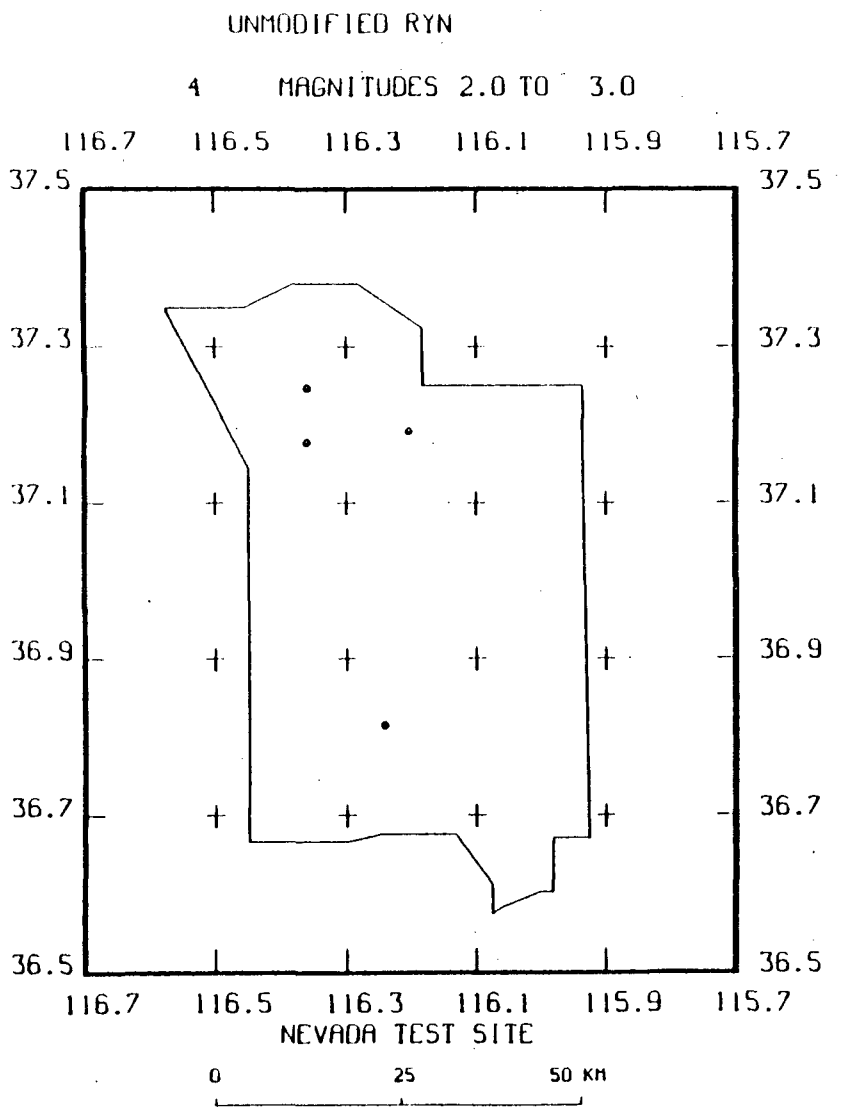

SOURCE-RYN
53 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

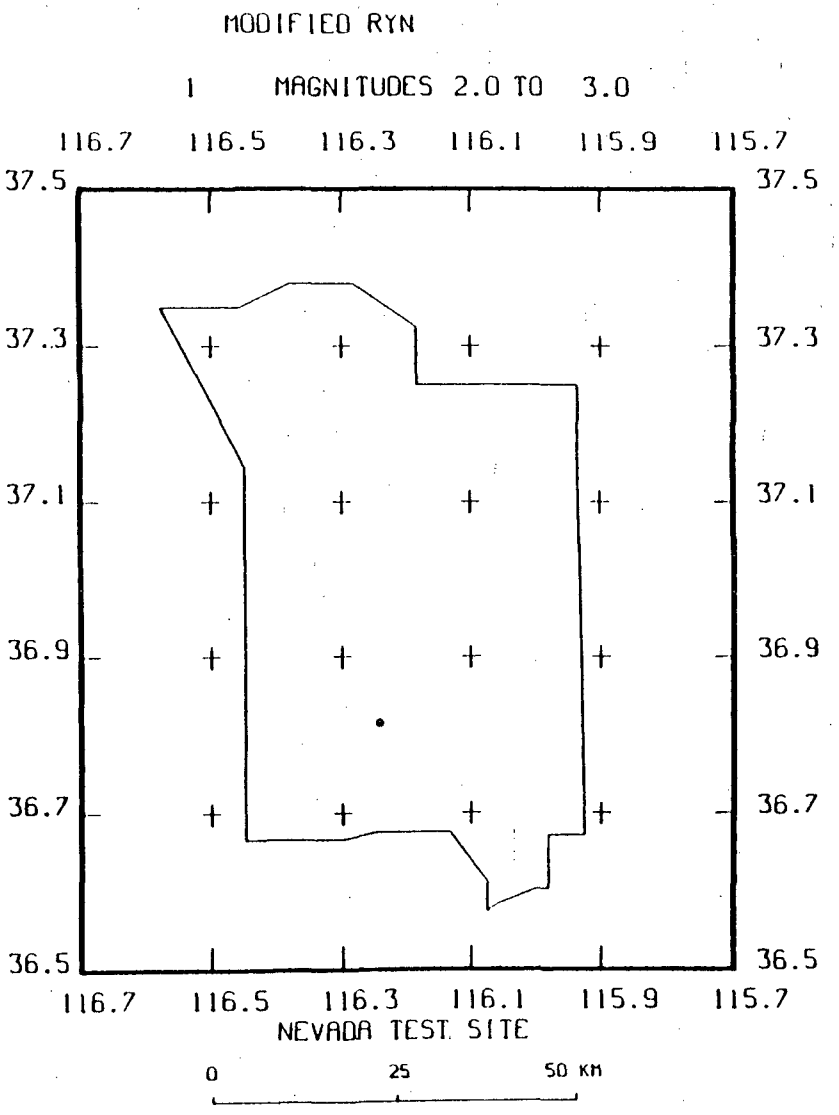

MODIFIED RYN
52 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

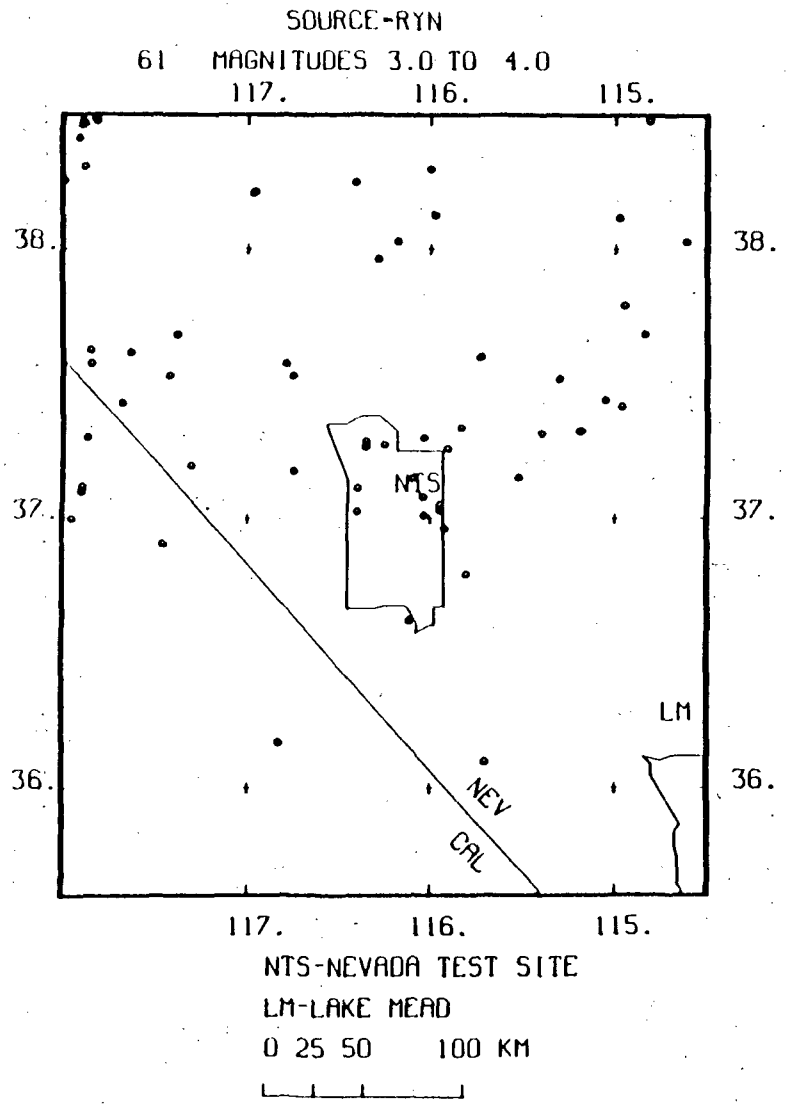

UNMODIFIED RYN
1 MAGNITUDES 1.0 TO 2.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

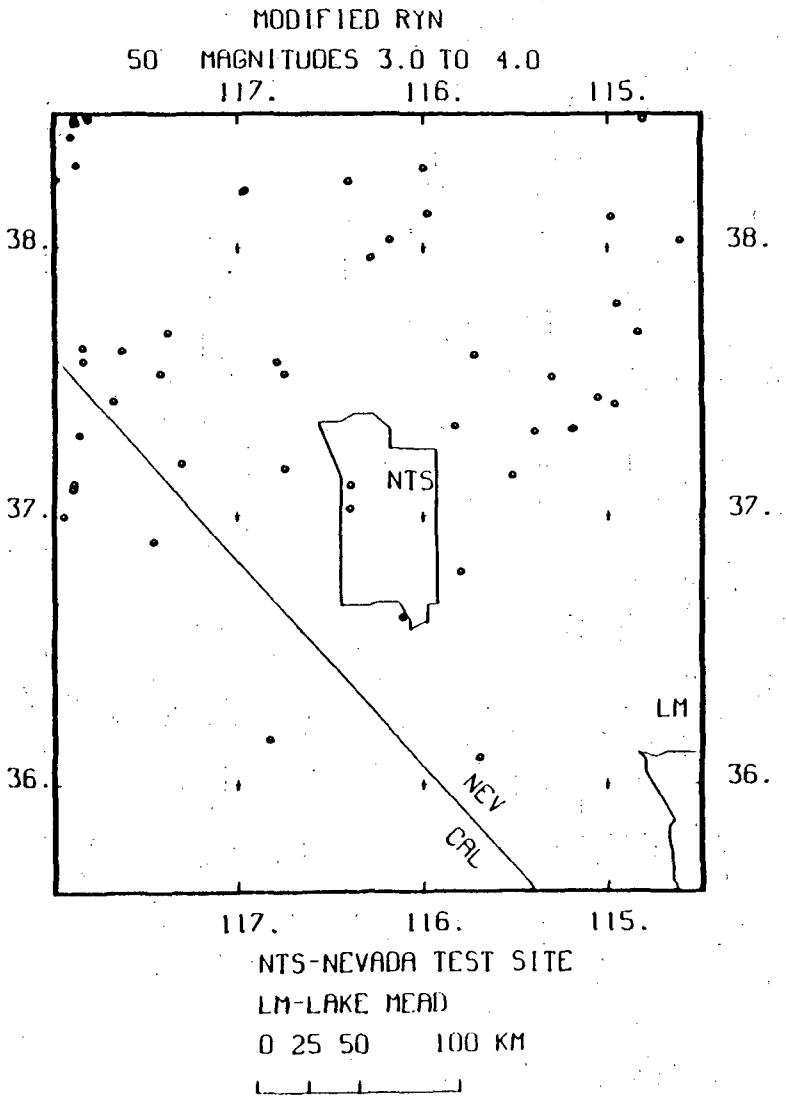

SOURCE-RYN
97 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

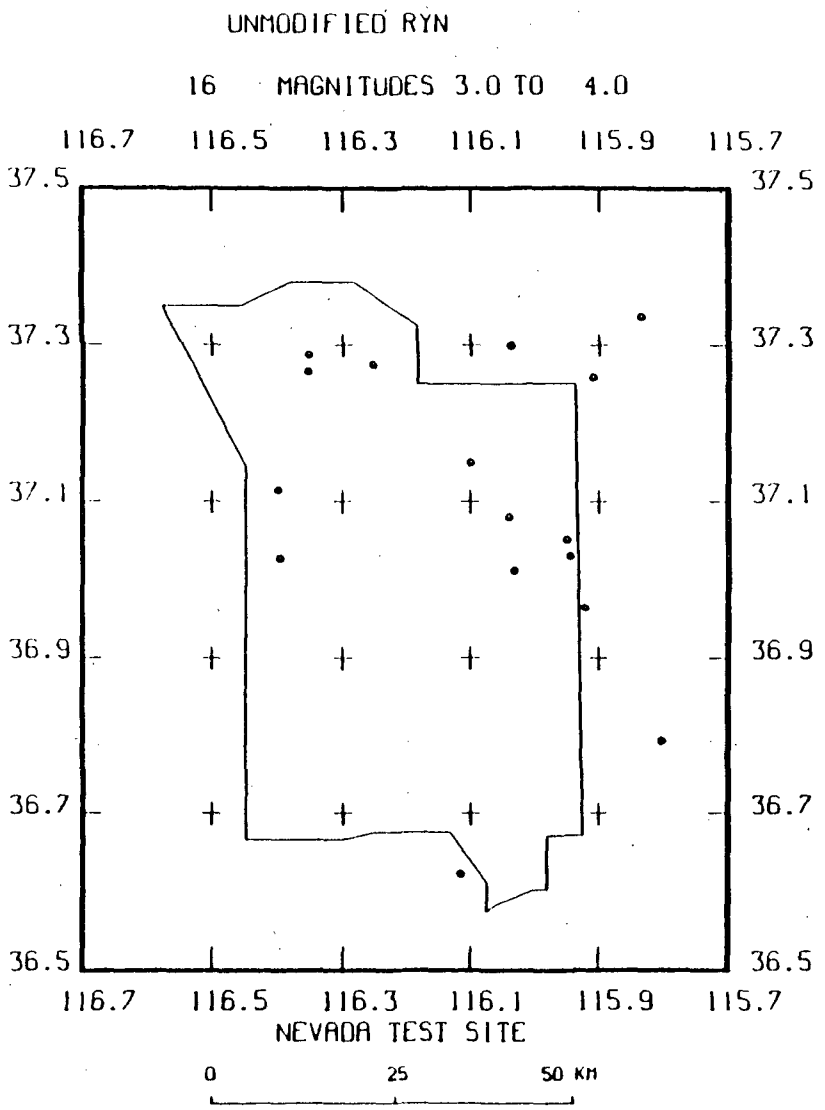

MODIFIED RYN
94 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

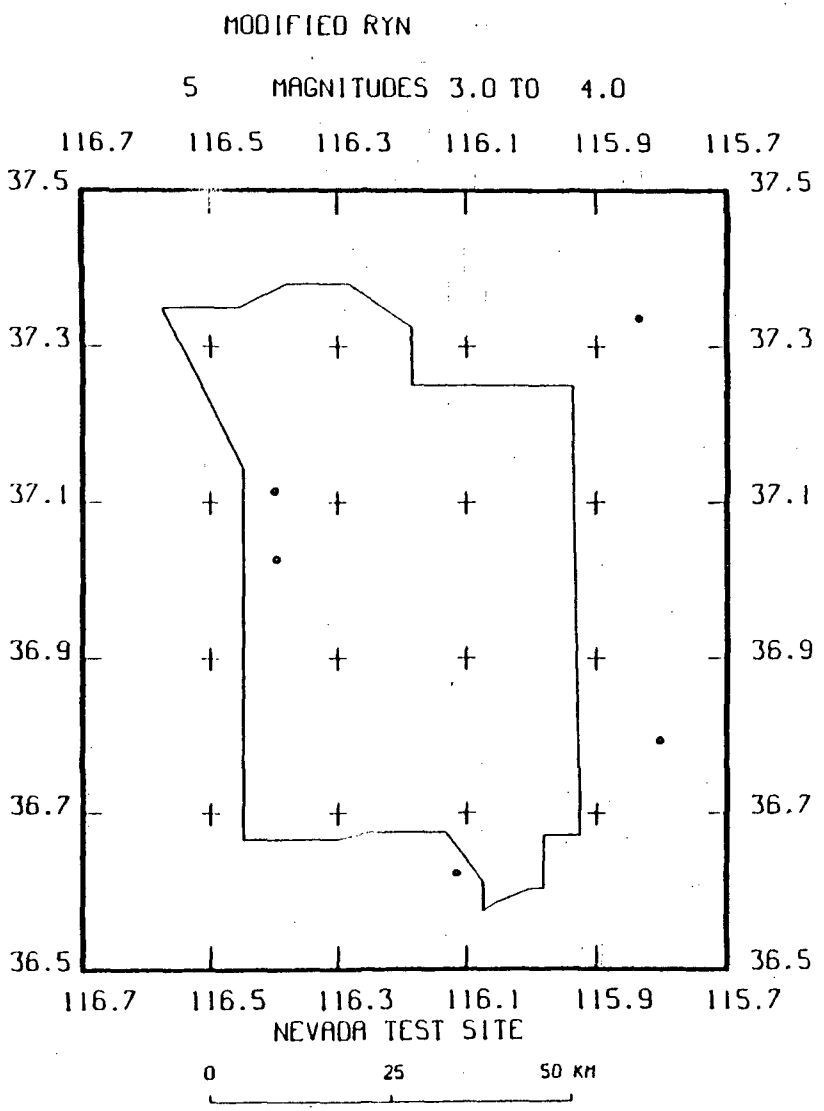

UNMODIFIED RYN
4 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

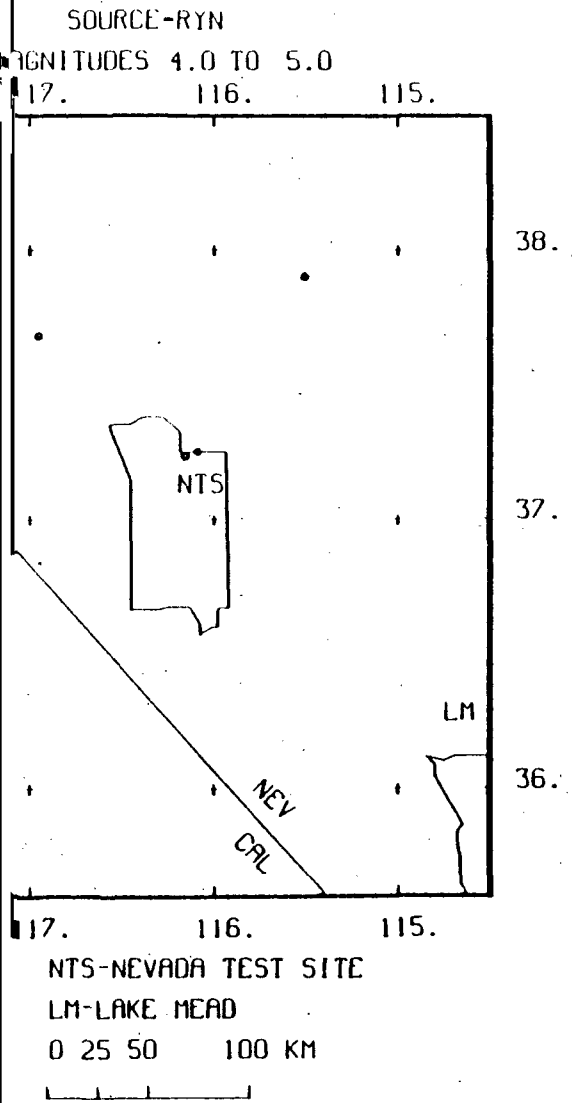

MODIFIED RYN
1 MAGNITUDES 2.0 TO 3.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

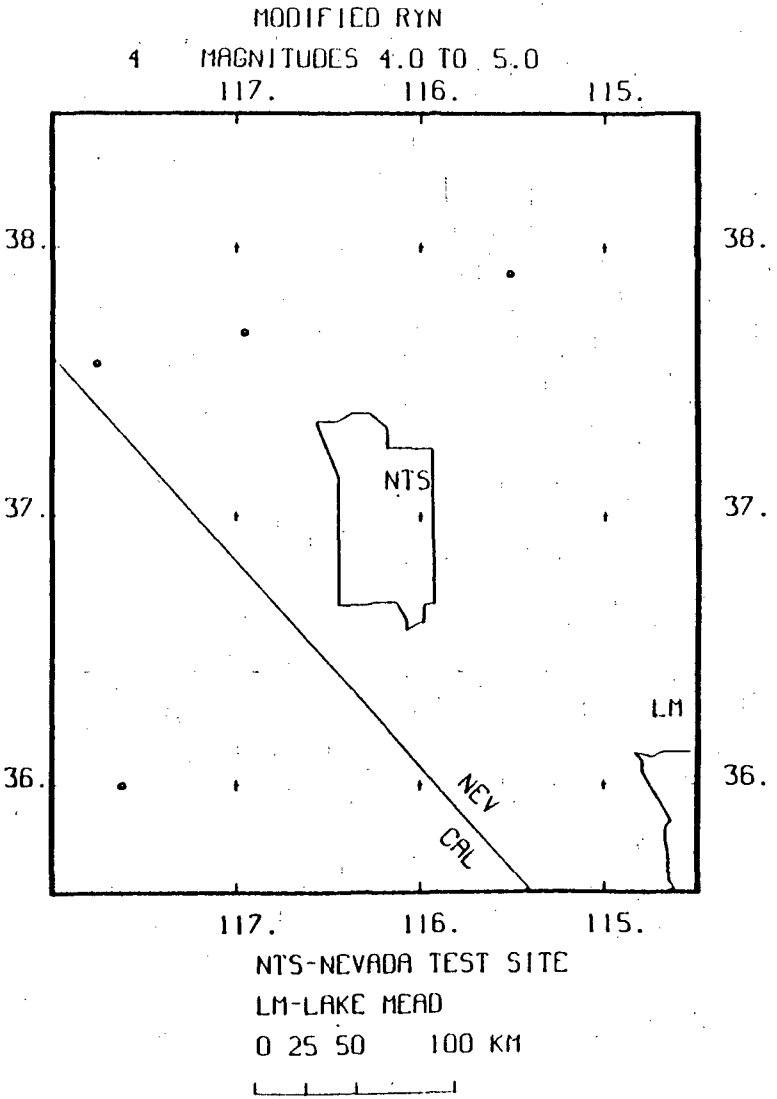

SOURCE-RYN
61 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

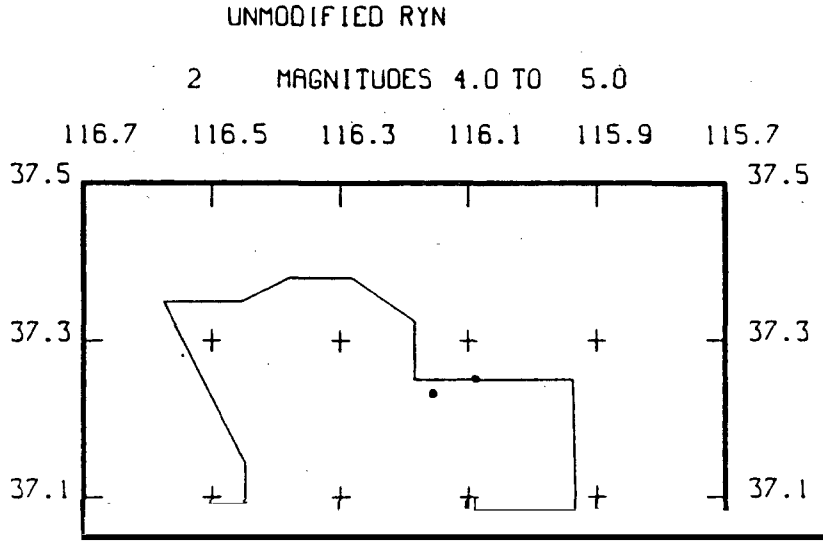

MODIFIED RYN
50 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


UNMODIFIED RYN
16 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


MODIFIED RYN
5 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

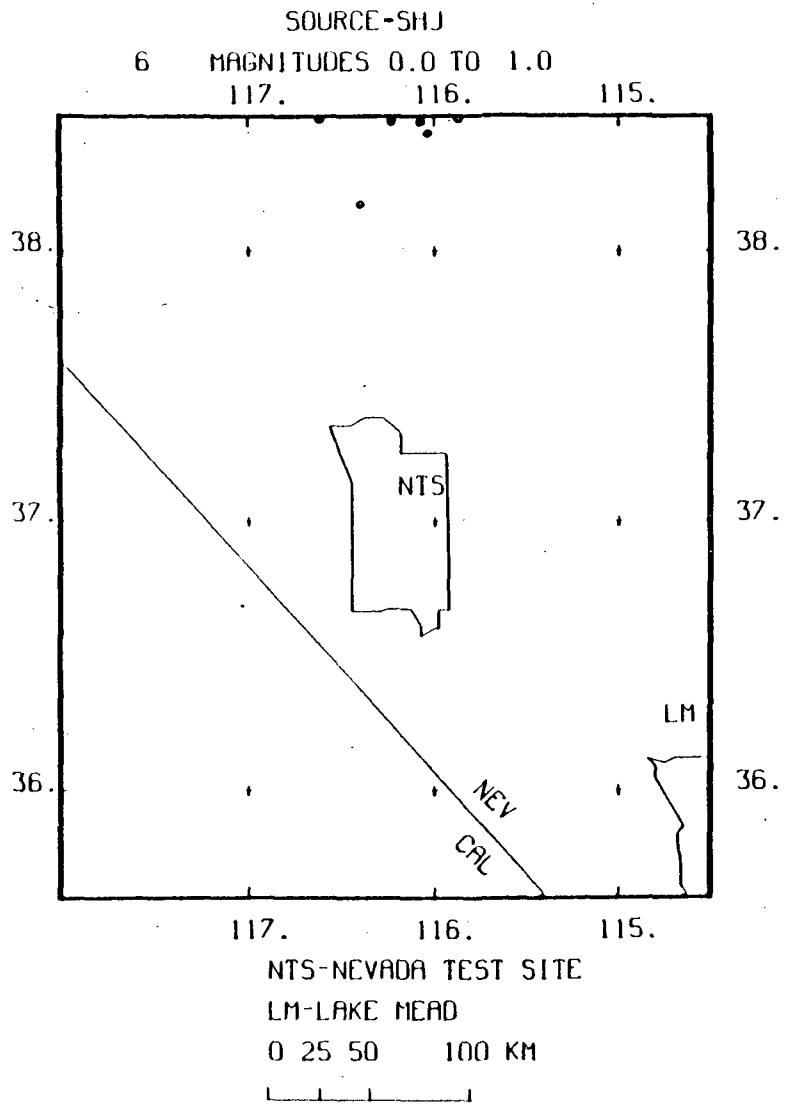

SOURCE-RYN
AGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

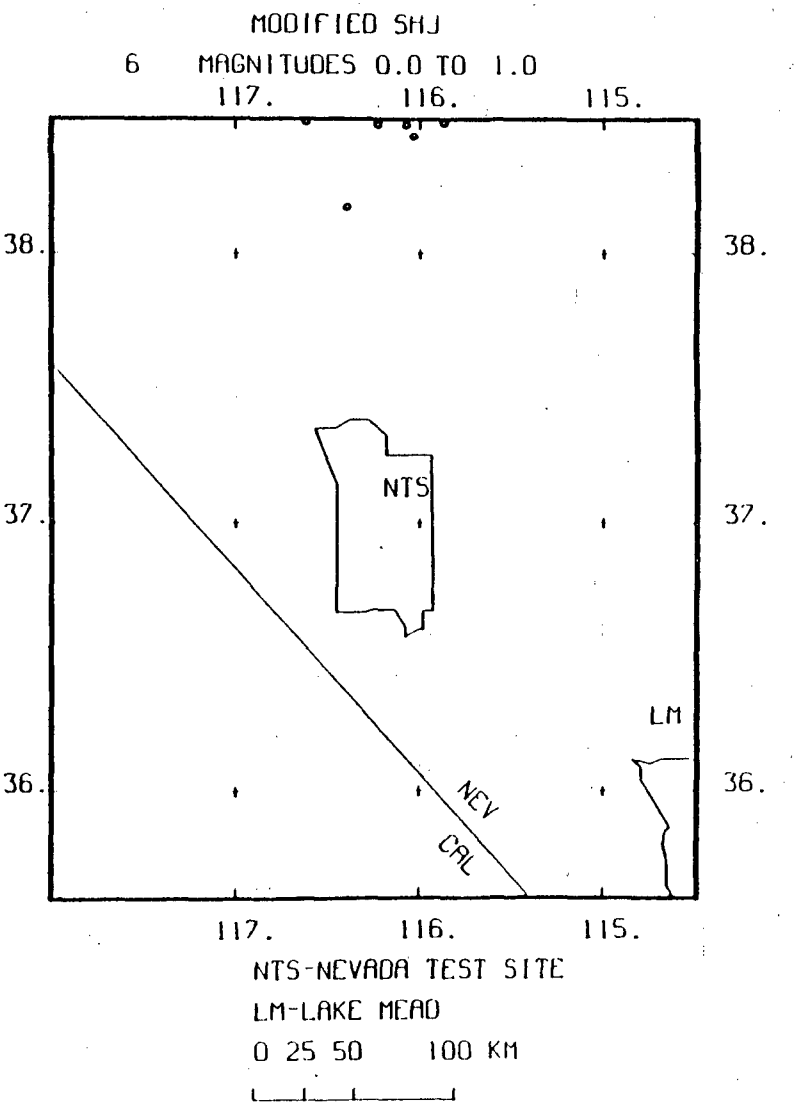

MODIFIED RYN
4 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

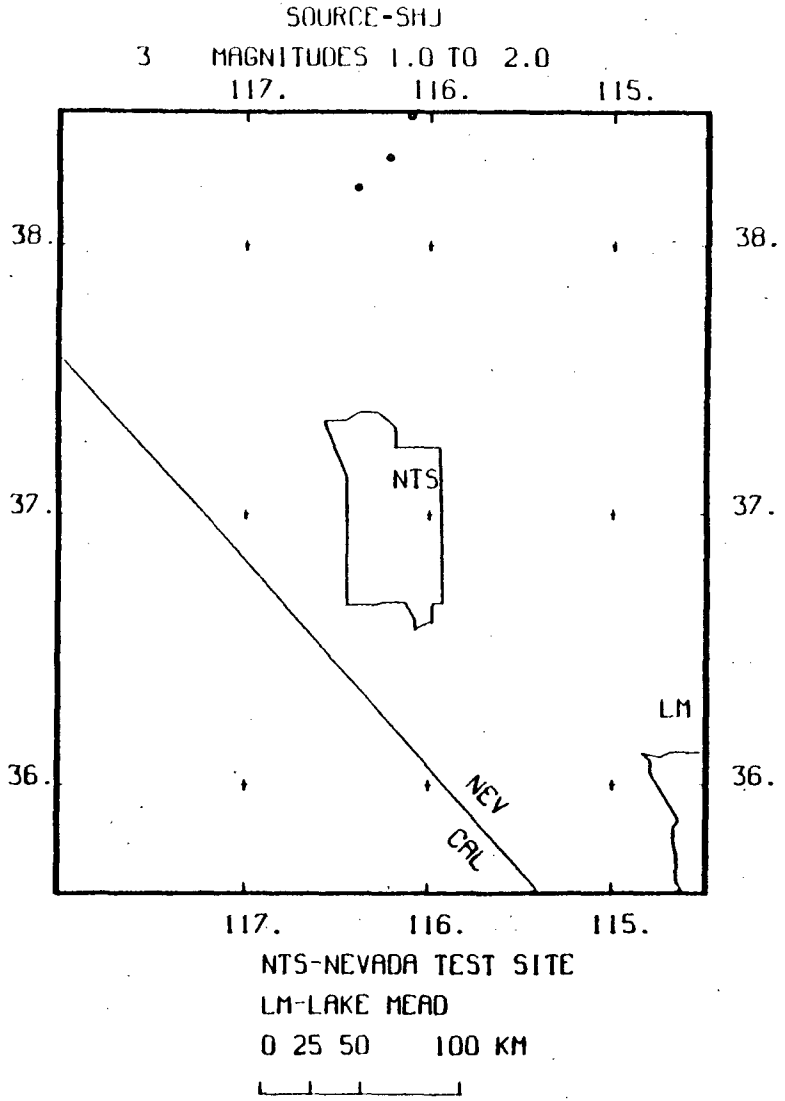

UNMODIFIED RYN
2 MAGNITUDES 4.0 TO 5.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1

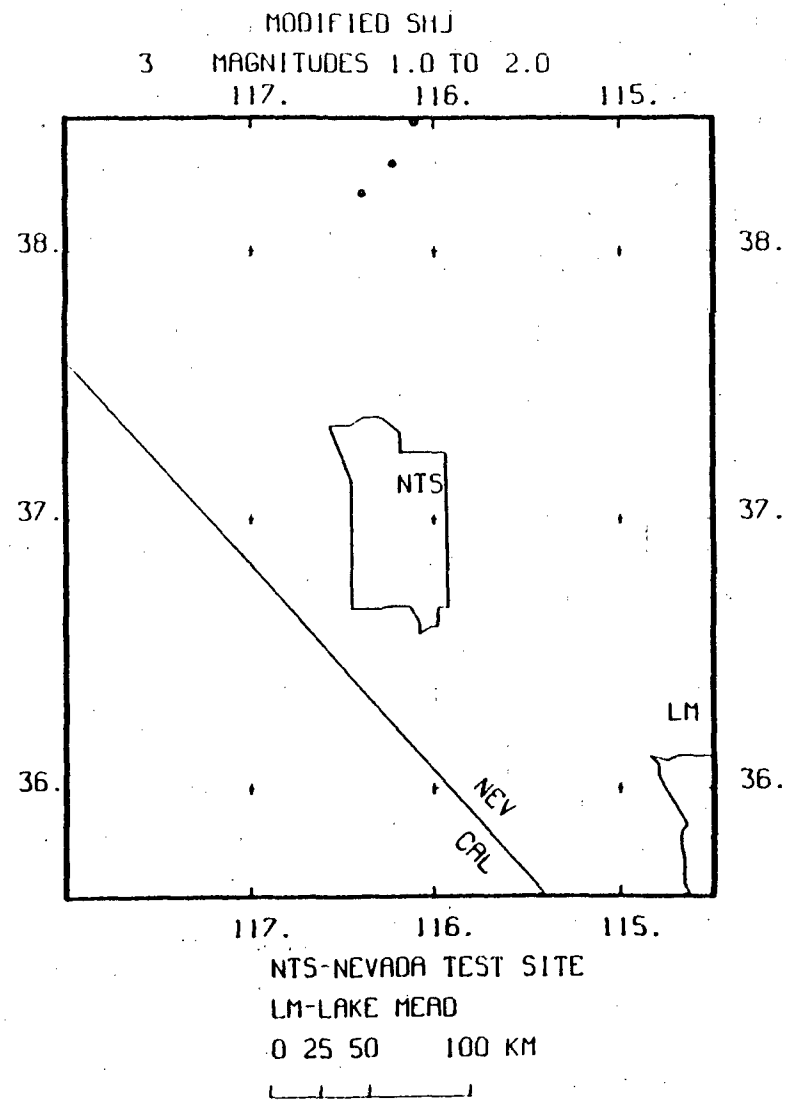
APPENDIX R

SOURCE - SHJ


SOURCE-SHJ
6 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

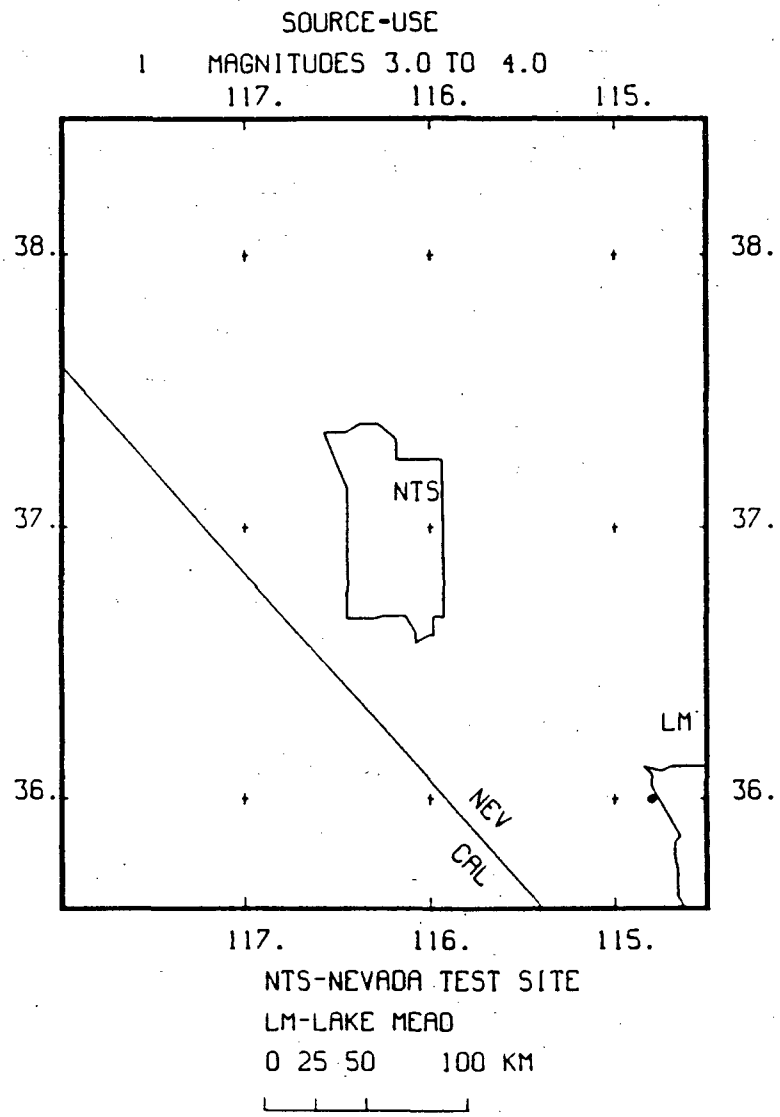

MODIFIED SHJ
6 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


SOURCE-SHJ
3 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED SHJ
3 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

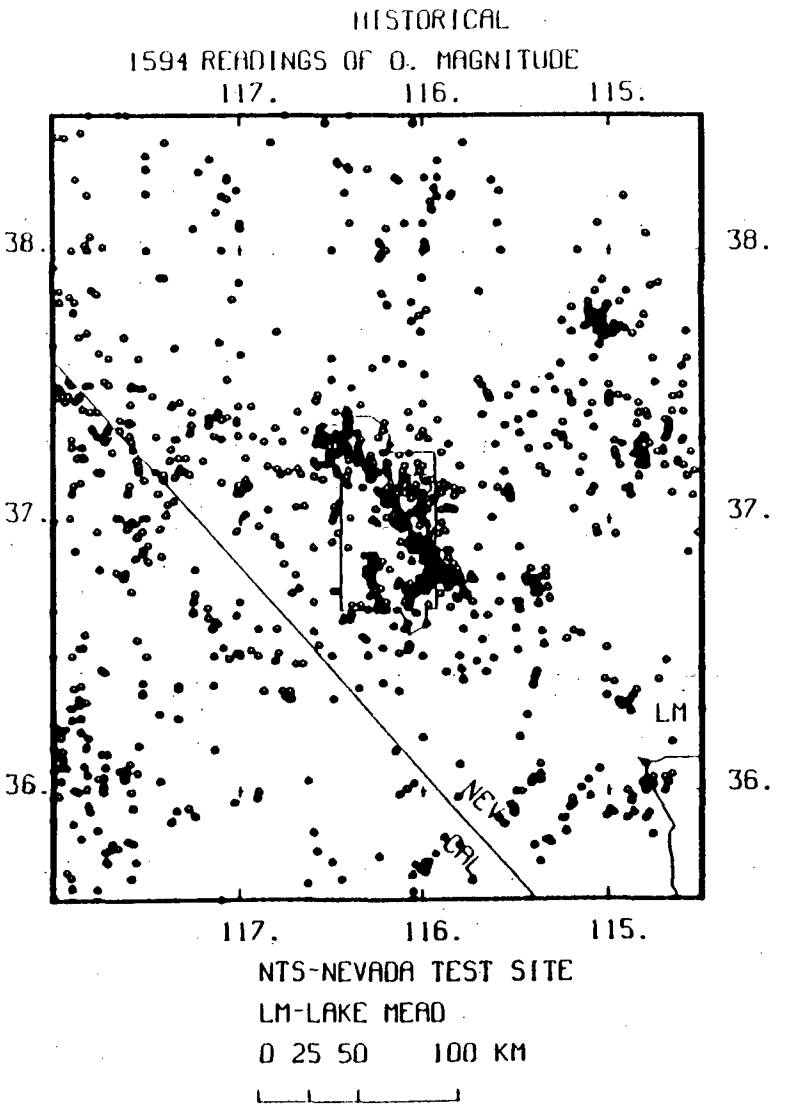
APPENDIX S

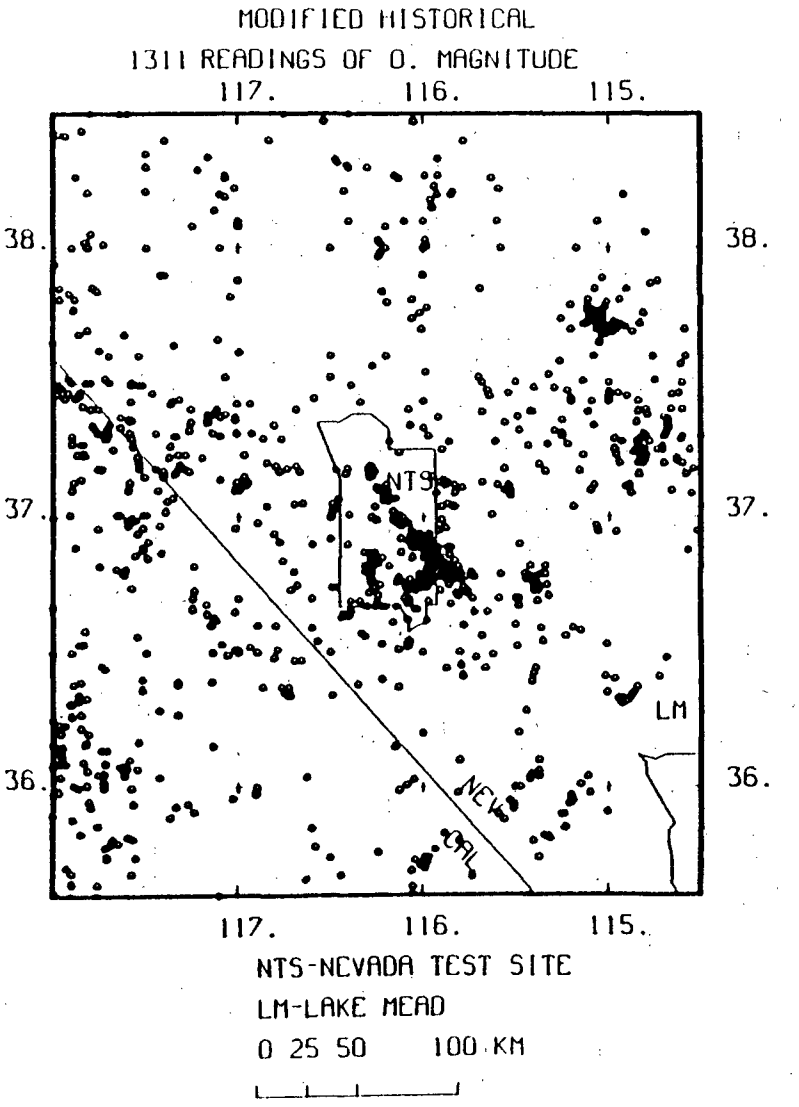
SOURCE - USE

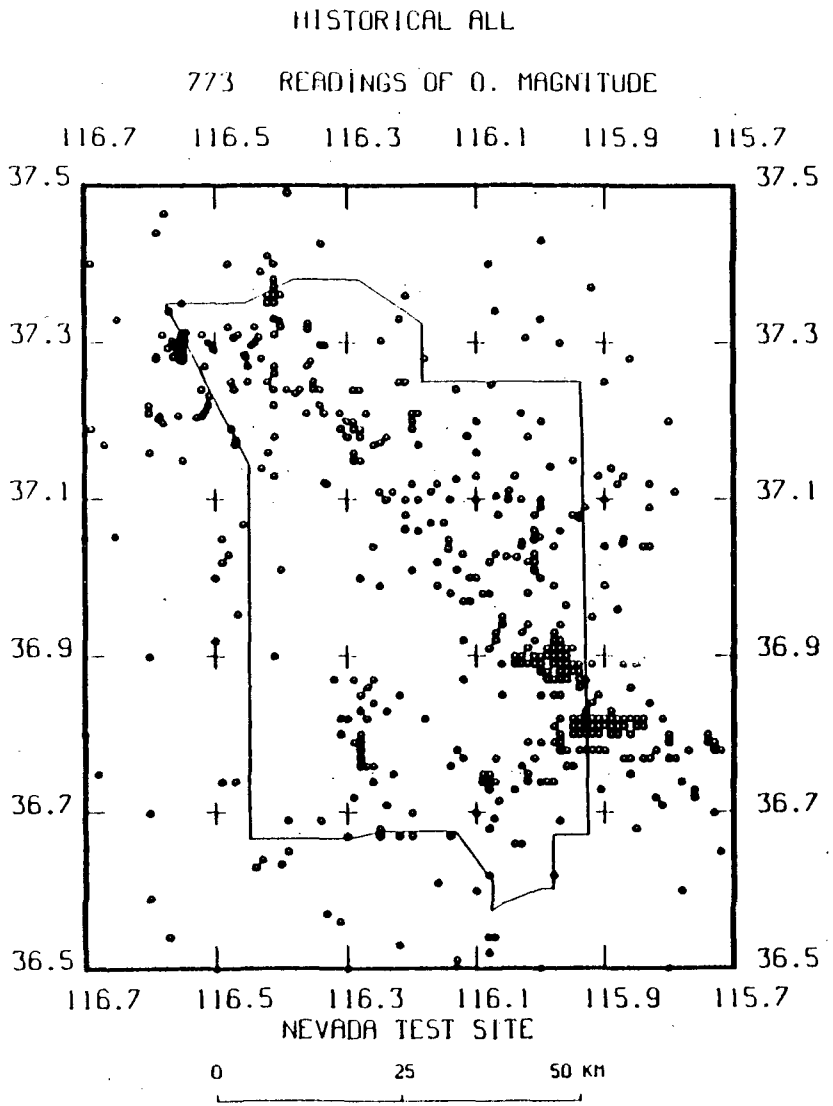

SOURCE-USE
1 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

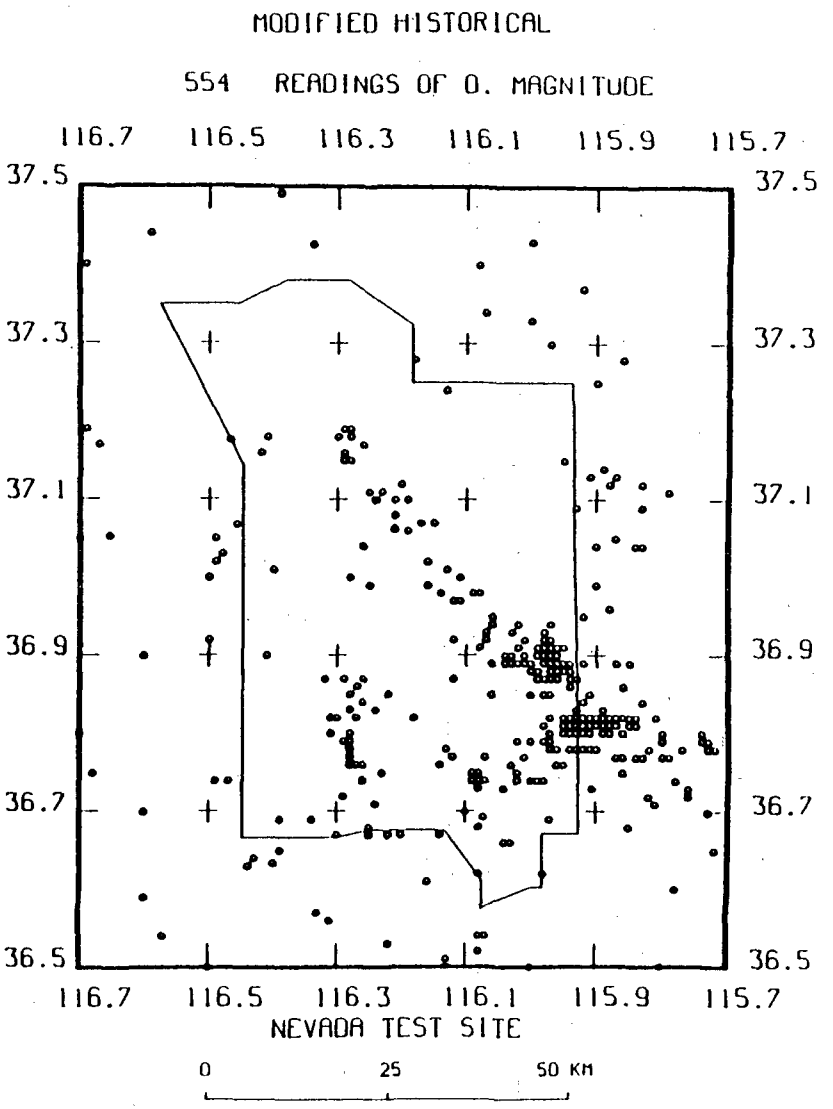
APPENDIX T

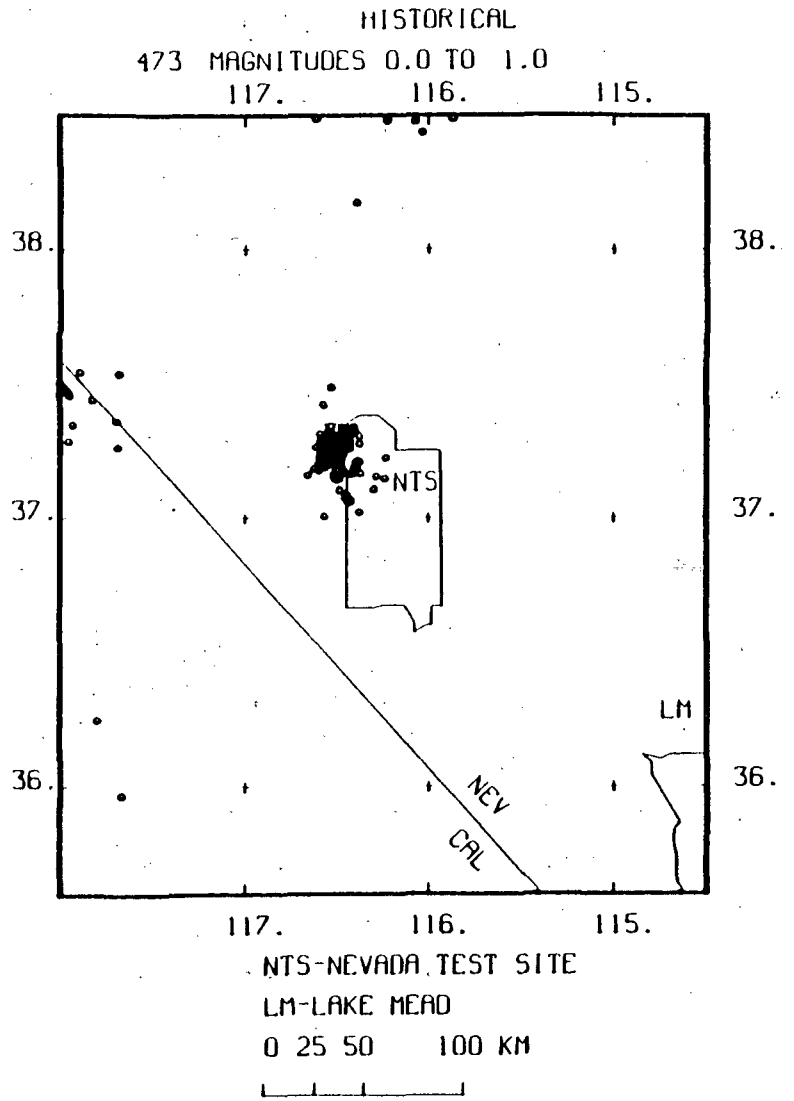
SOURCE - HISTORICAL

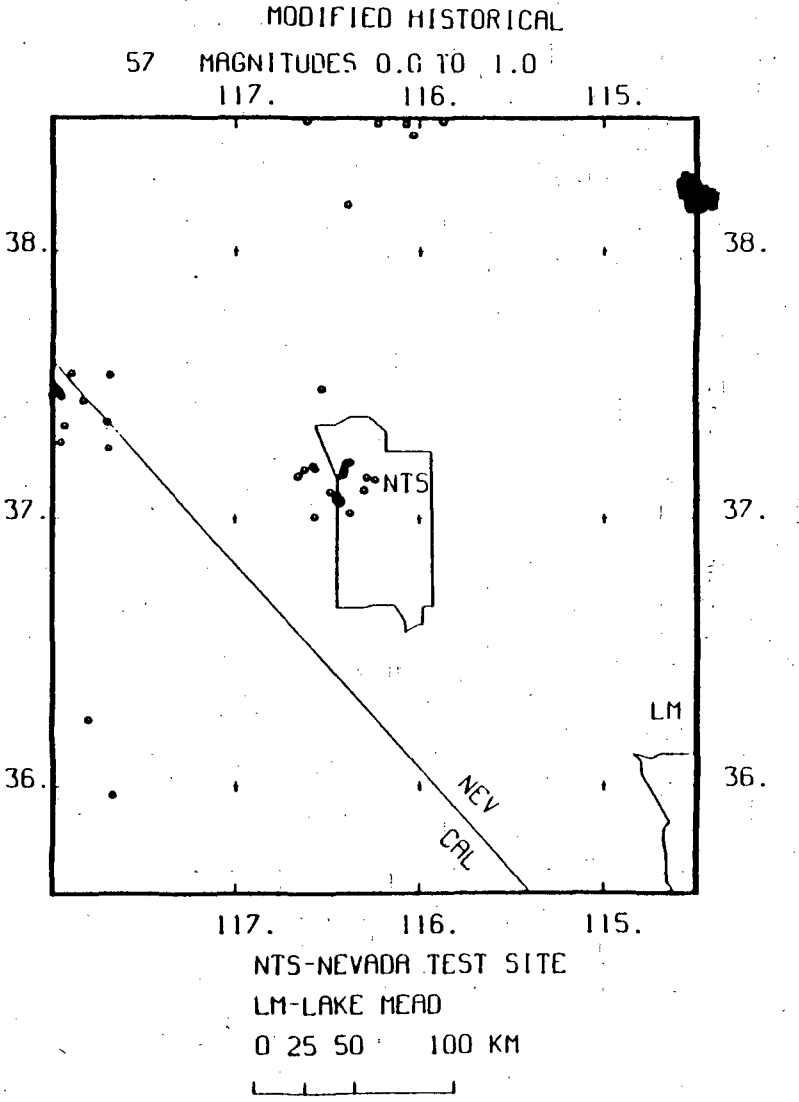

HISTORICAL
1594 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
LM
NEVA
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

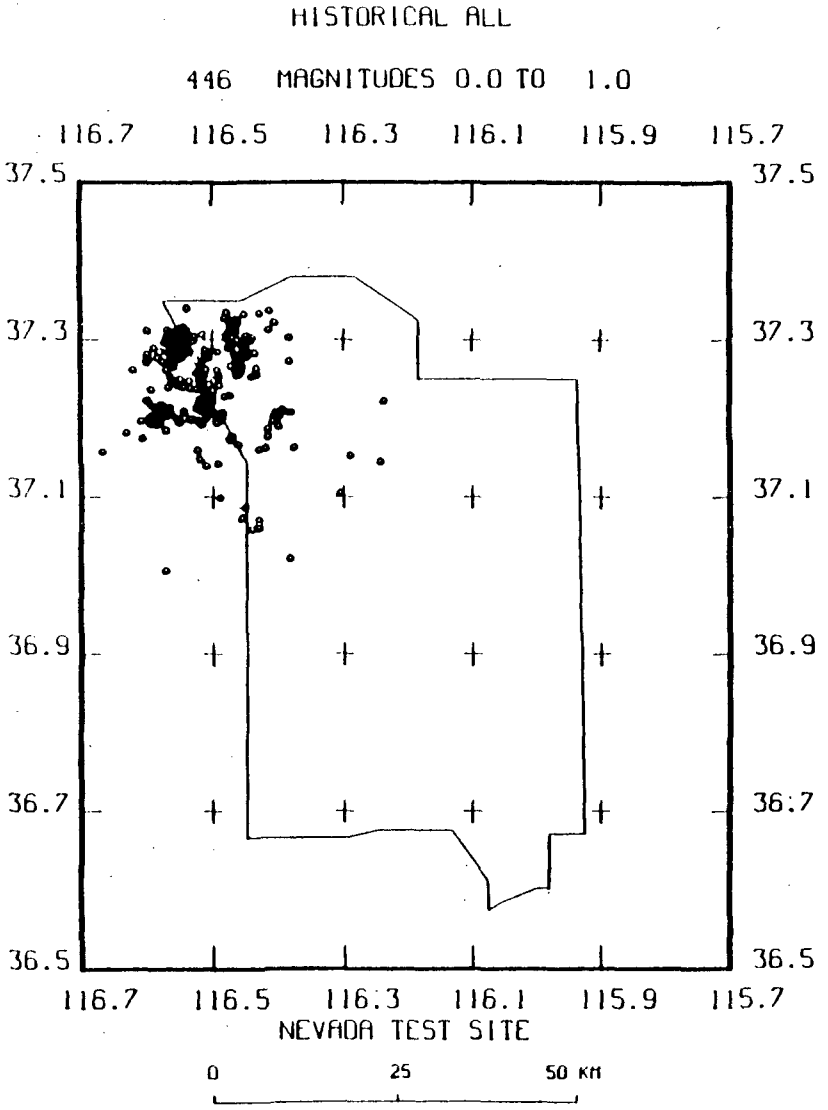

MODIFIED HISTORICAL
1311 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEVA
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

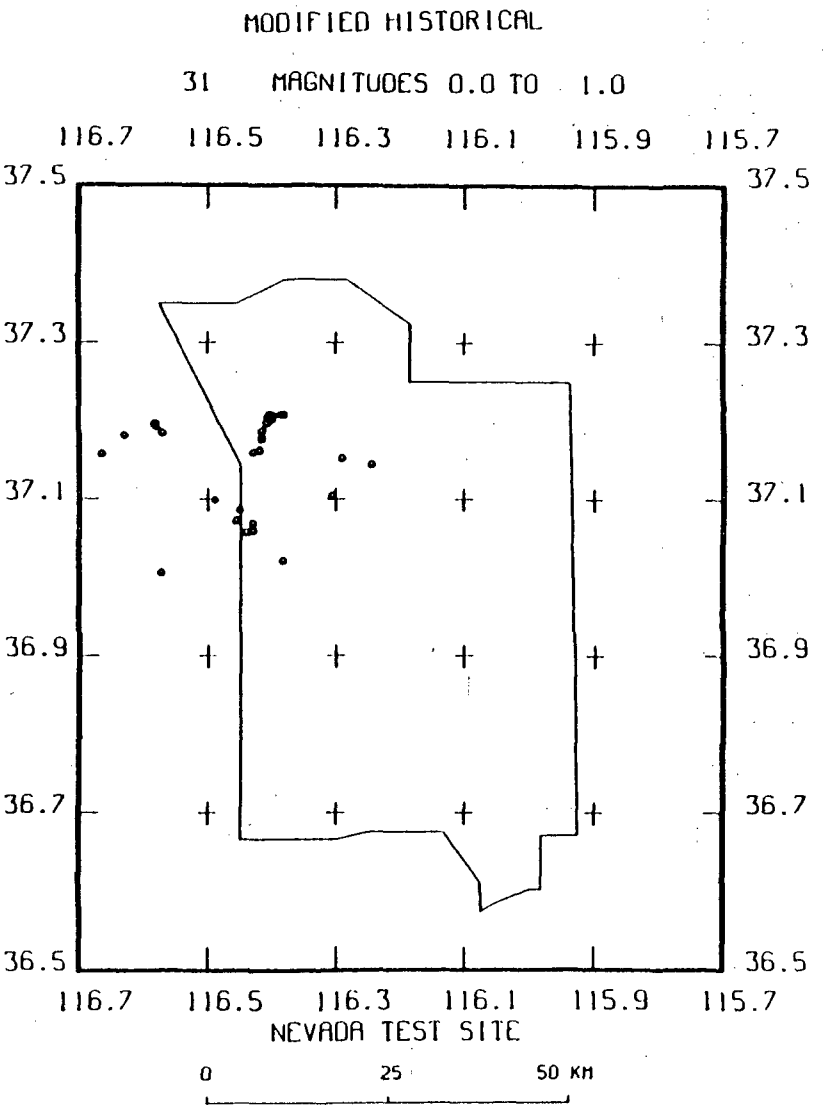

HISTORICAL ALL
773 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

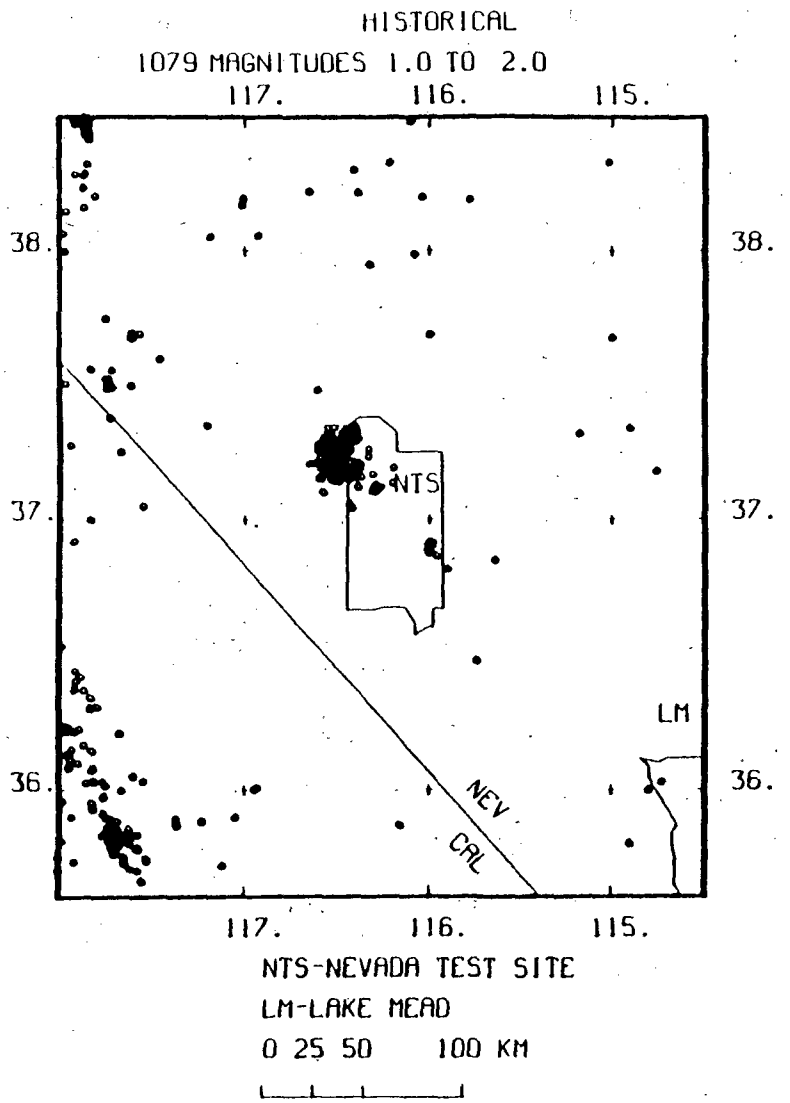

MODIFIED HISTORICAL
554 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

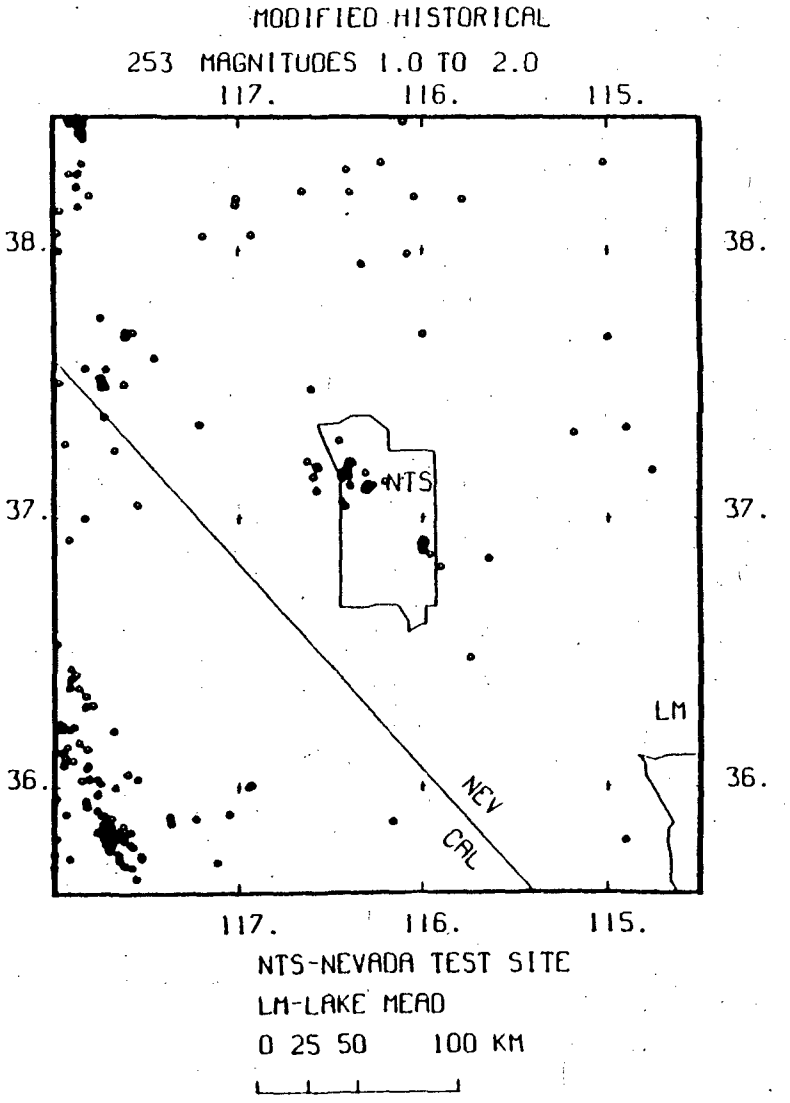

HISTORICAL
473 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

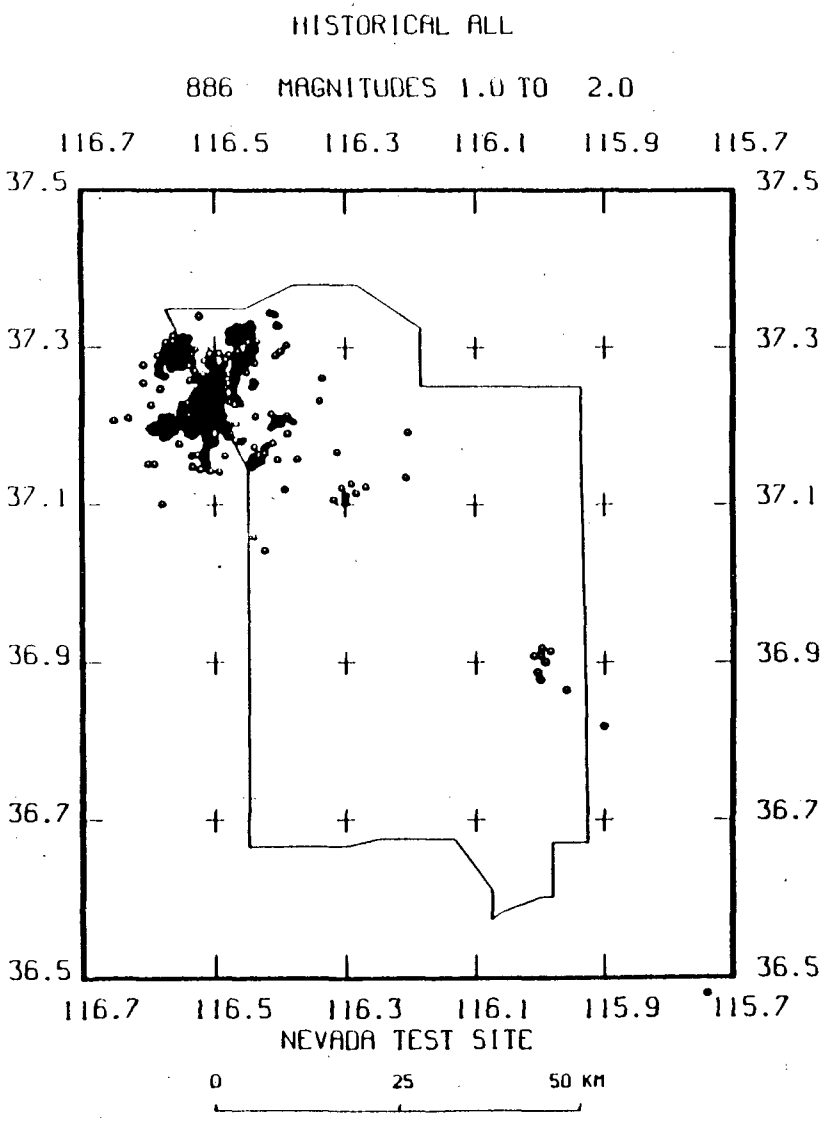

MODIFIED HISTORICAL
57 MAGNITUDES 0.0 TO 1.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

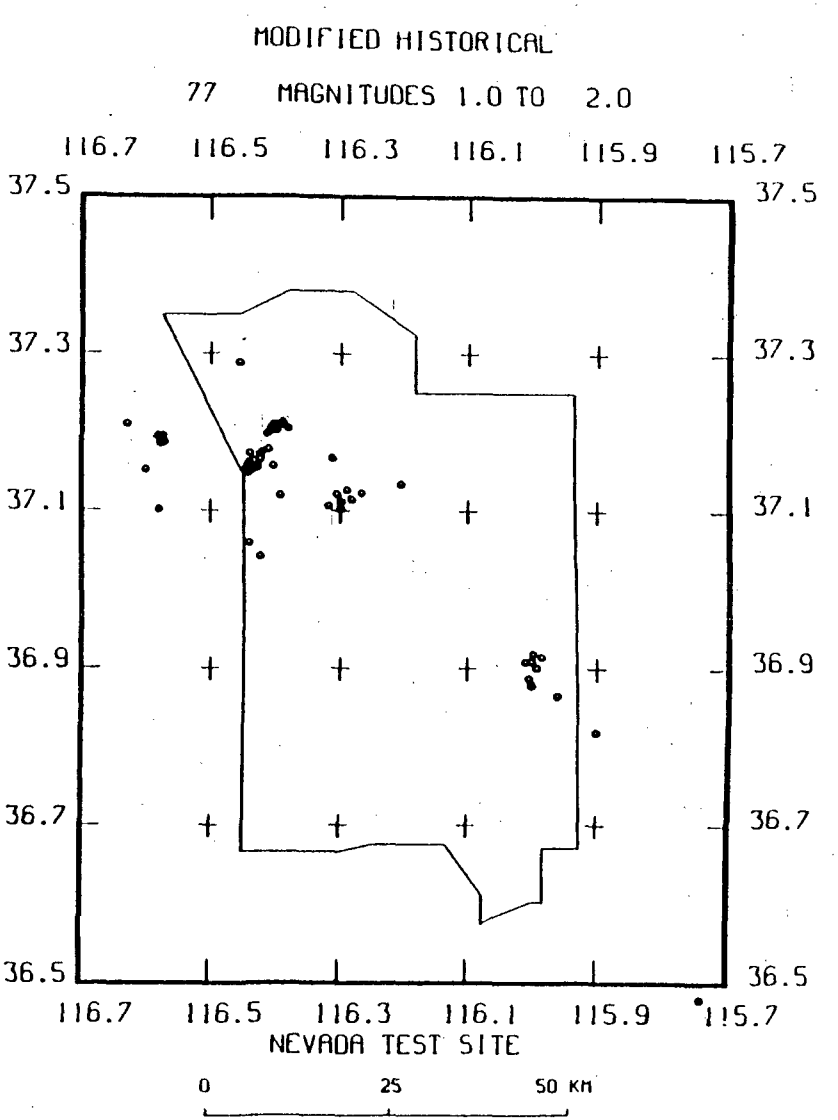

HISTORICAL ALL
446 MAGNITUDES 0.0 TO 1.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

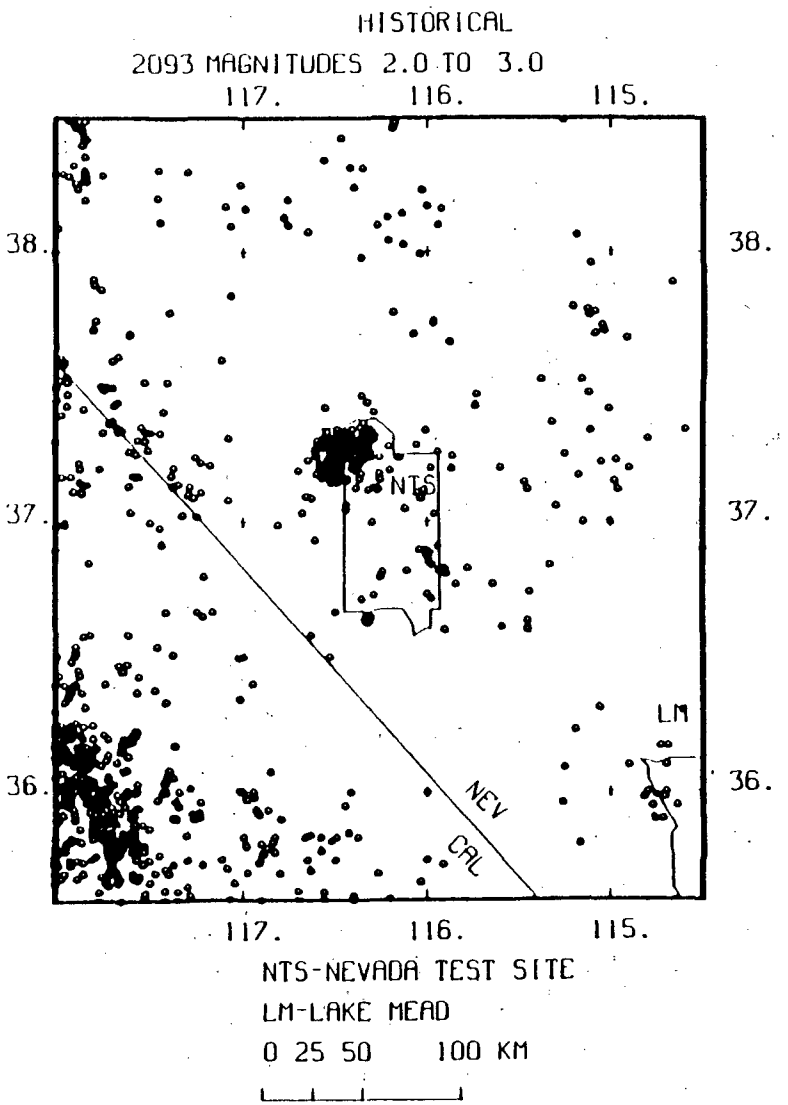

MODIFIED HISTORICAL
31 MAGNITUDES 0.0 TO 1.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

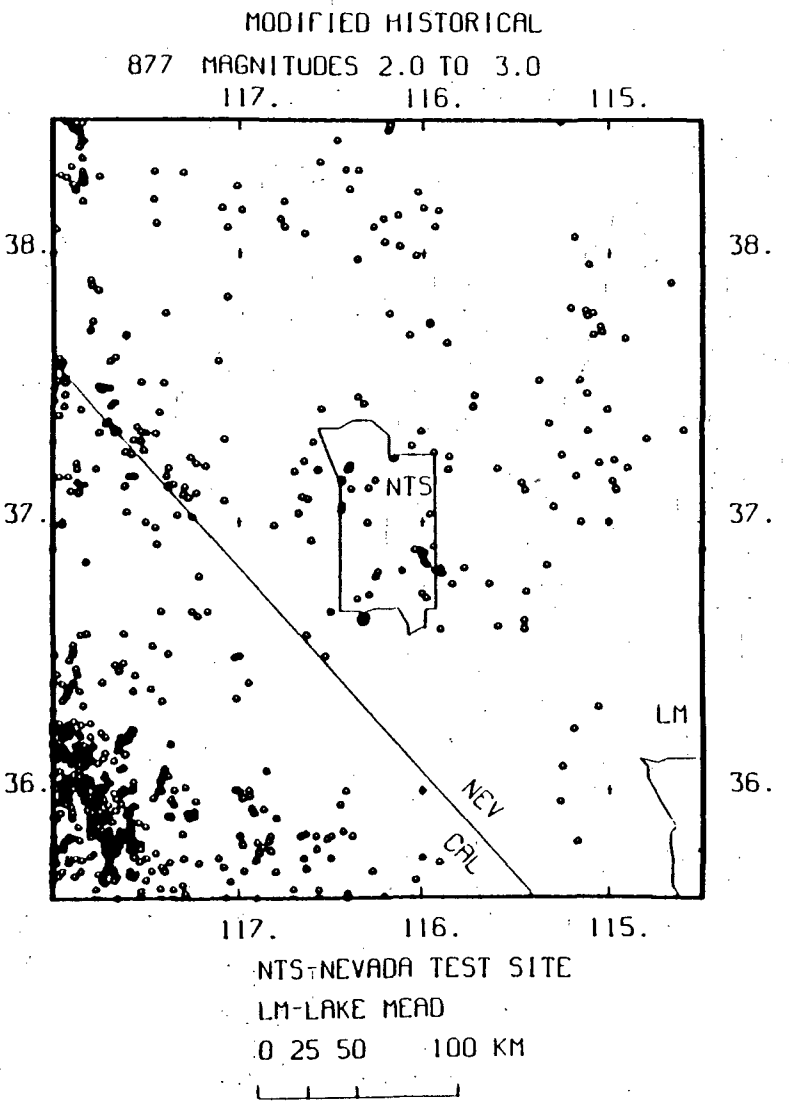

HISTORICAL
1079 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

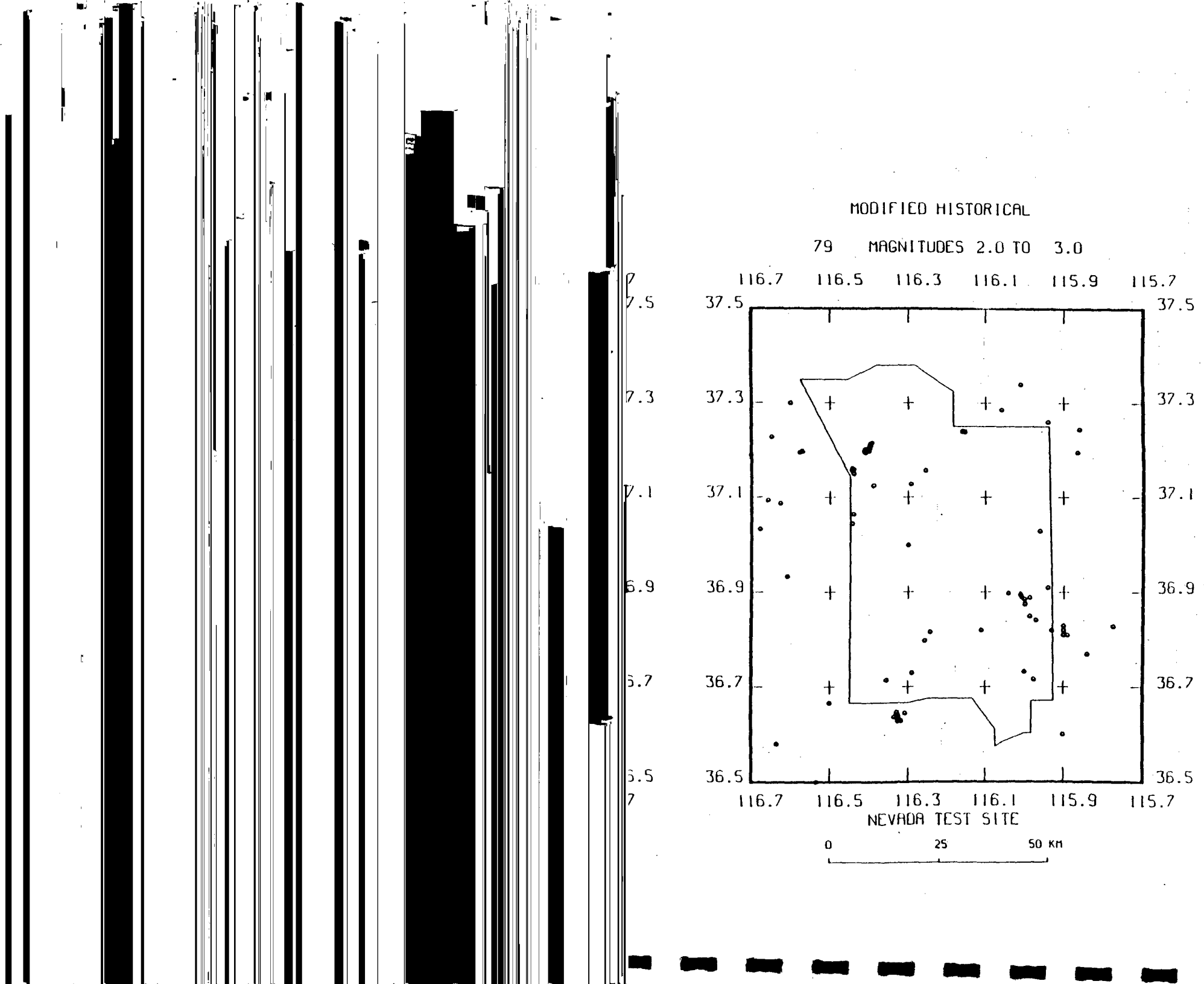

MODIFIED HISTORICAL
253 MAGNITUDES 1.0 TO 2.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

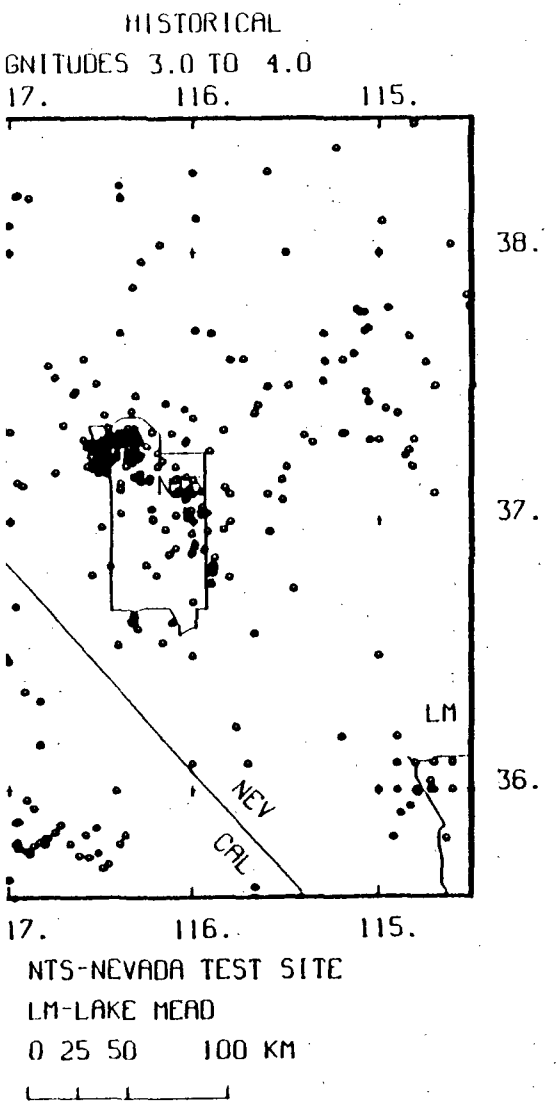

HISTORICAL ALL
886 MAGNITUDES 1.0 TO 2.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

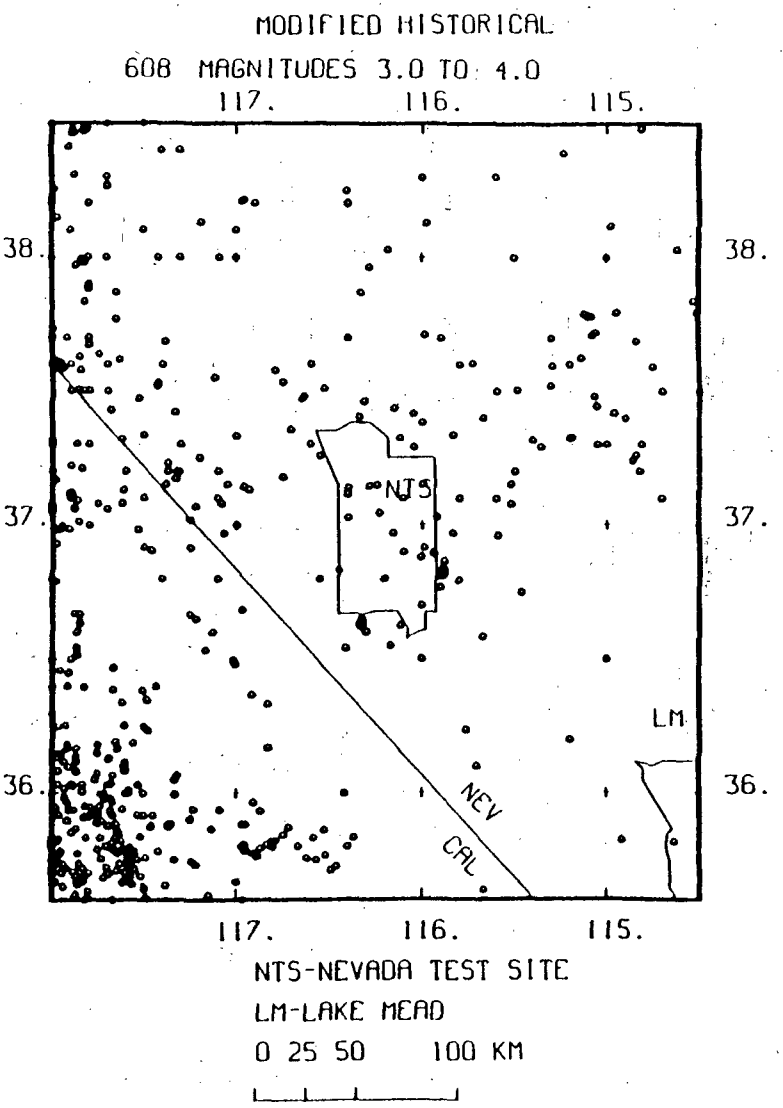

MODIFIED HISTORICAL
77 MAGNITUDES 1.0 TO 2.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

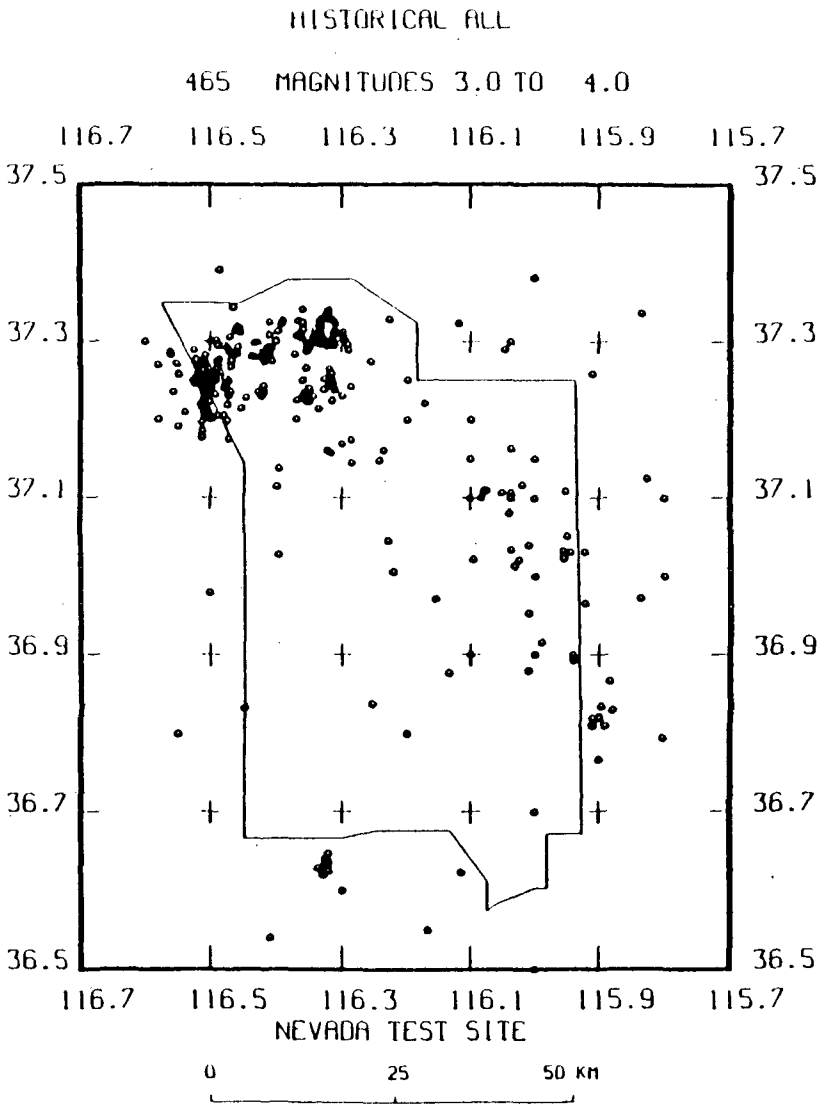

HISTORICAL
2093 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

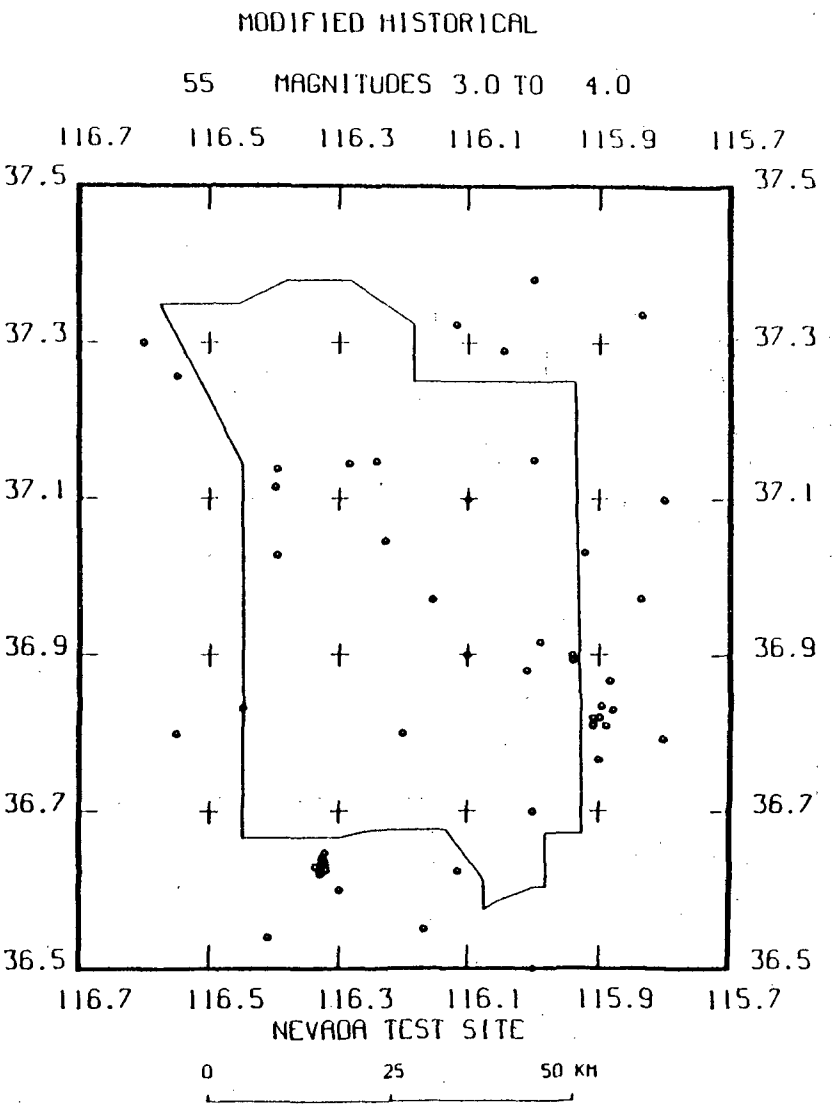

MODIFIED HISTORICAL
877 MAGNITUDES 2.0 TO 3.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

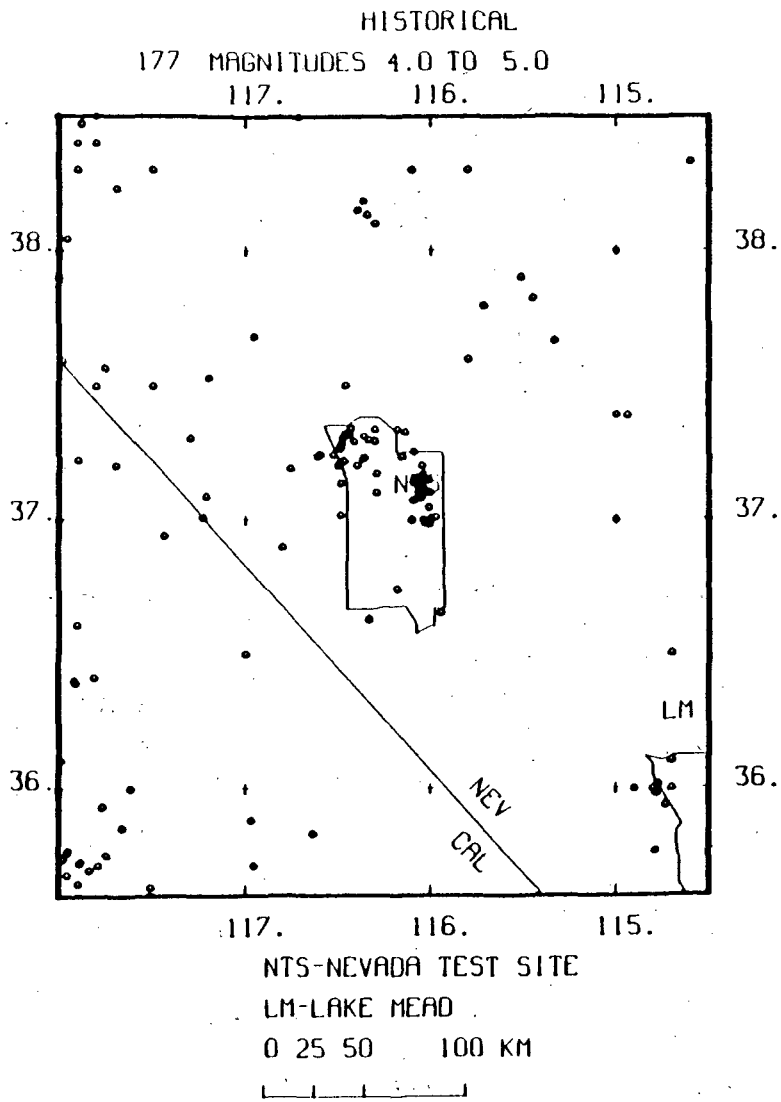

MODIFIED HISTORICAL
79 MAGNITUDES 2.0 TO 3.0
116.7
116.5
116.3
116.1
115.9
115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

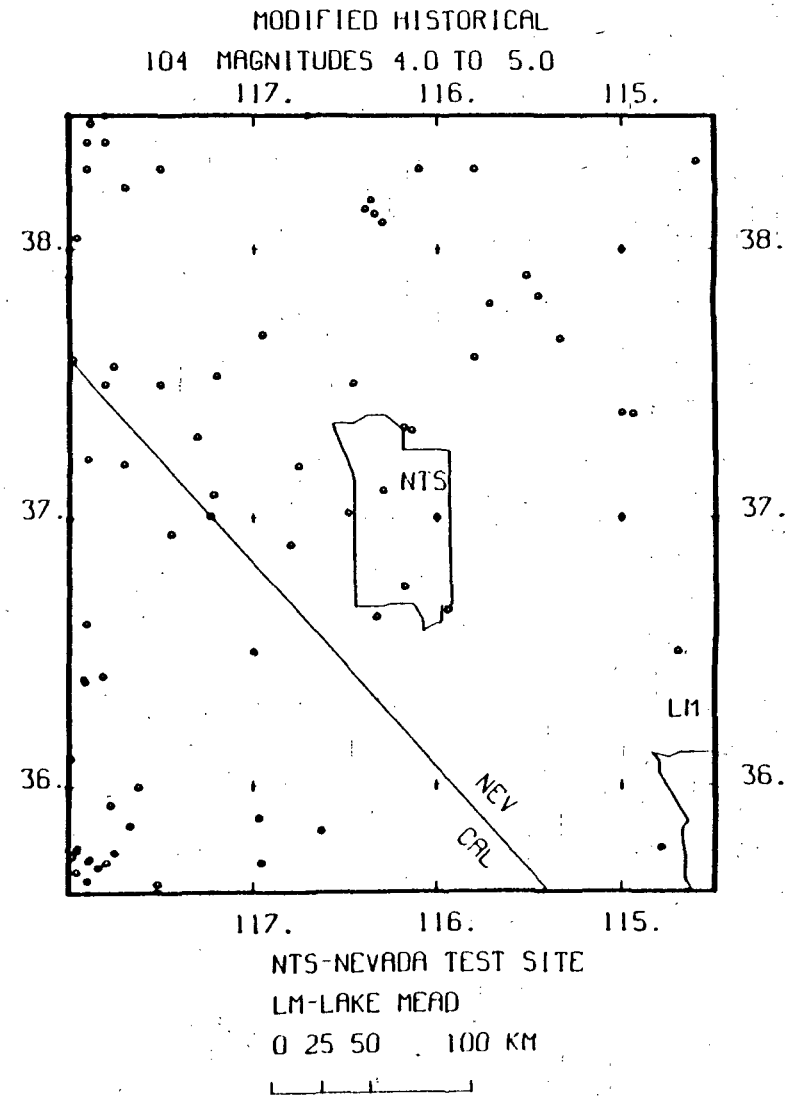

HISTORICAL
GNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
117.
116.
115.
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

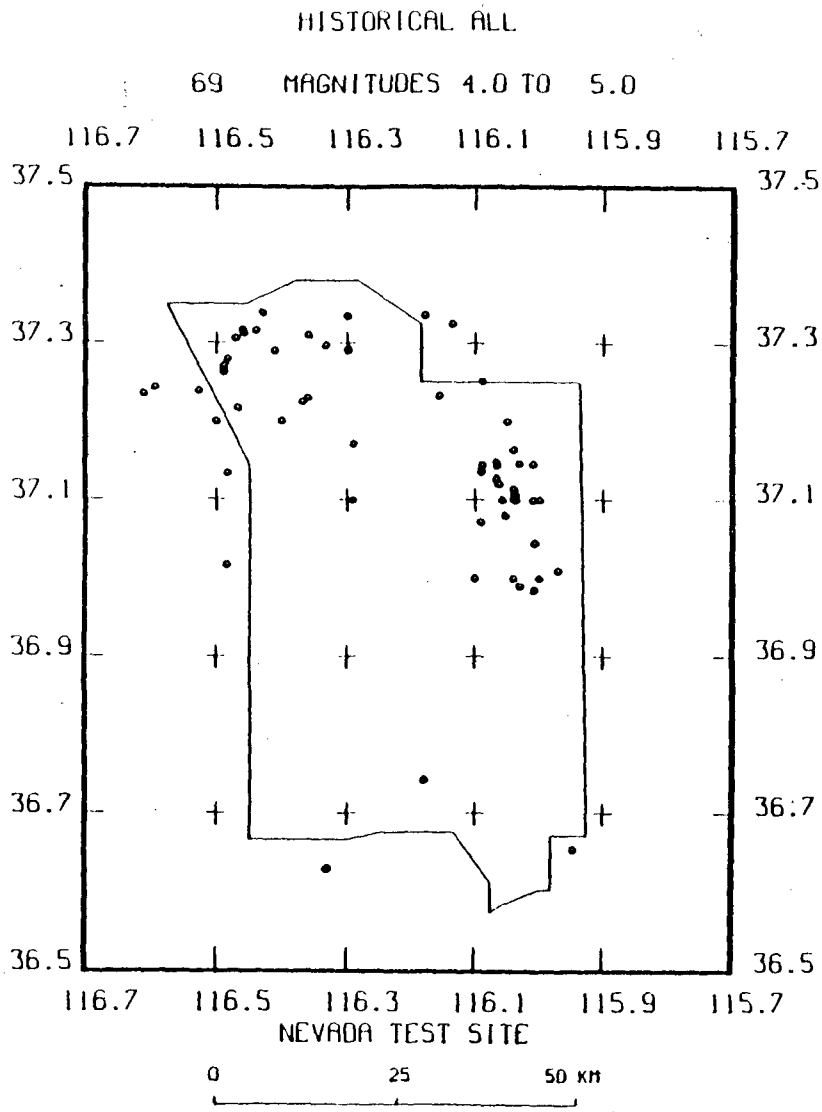

MODIFIED HISTORICAL
608 MAGNITUDES 3.0 TO 4.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
117.
116.
115.
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

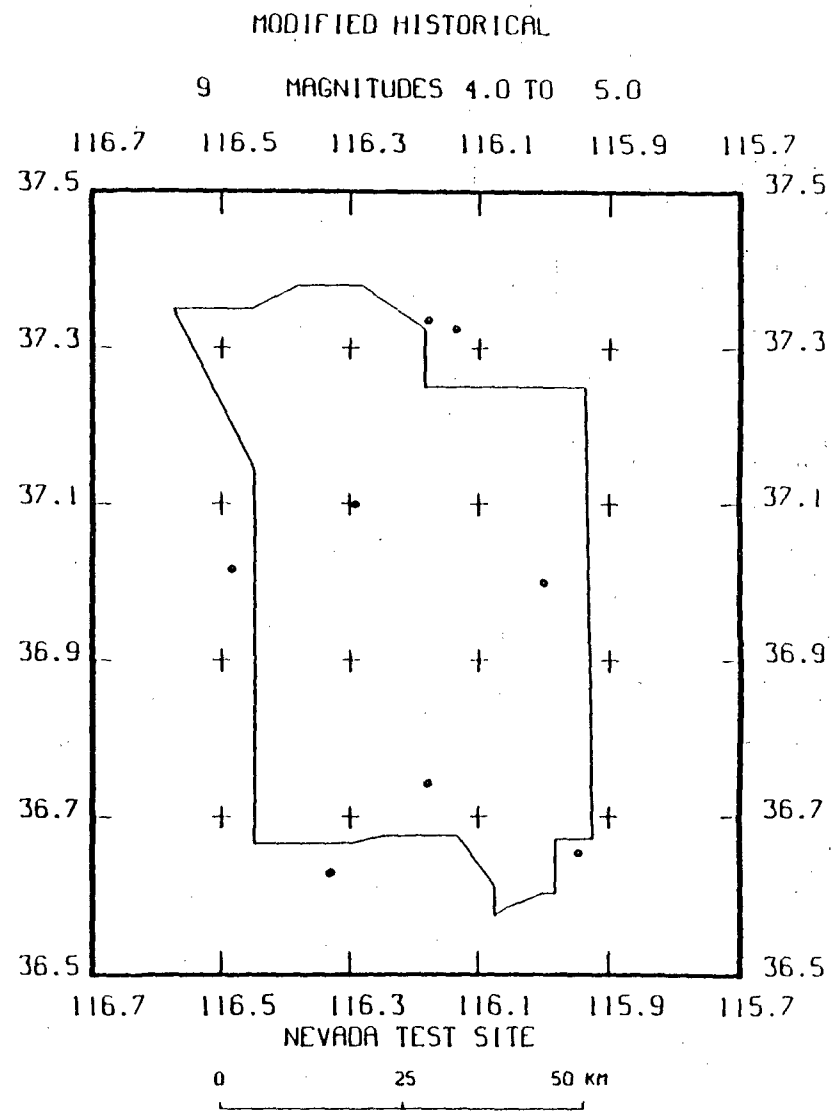

HISTORICAL ALL
465 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

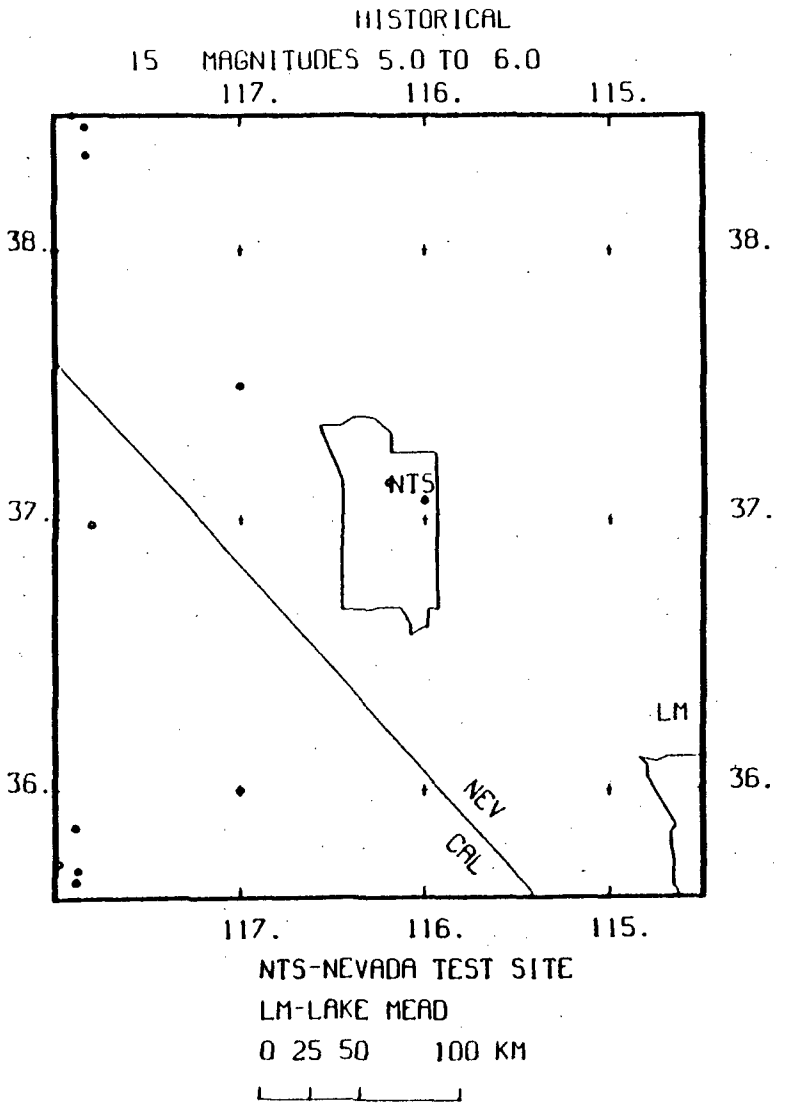

MODIFIED HISTORICAL
55 MAGNITUDES 3.0 TO 4.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

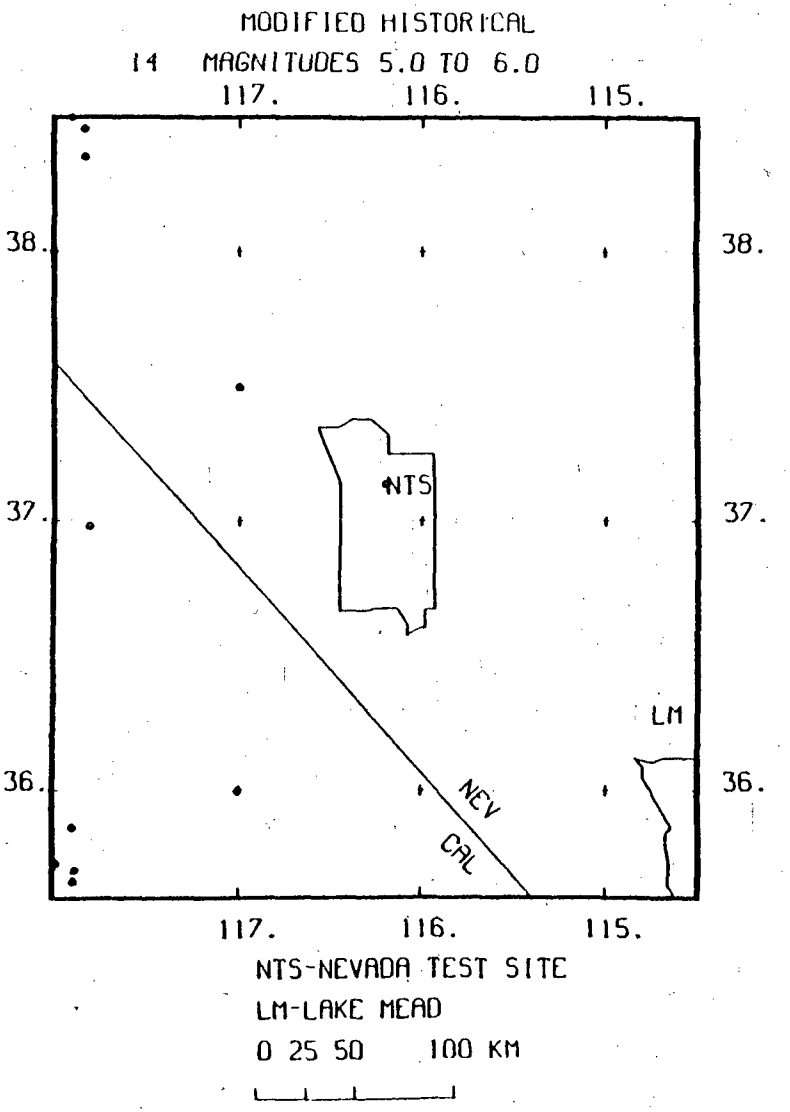

HISTORICAL
177 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

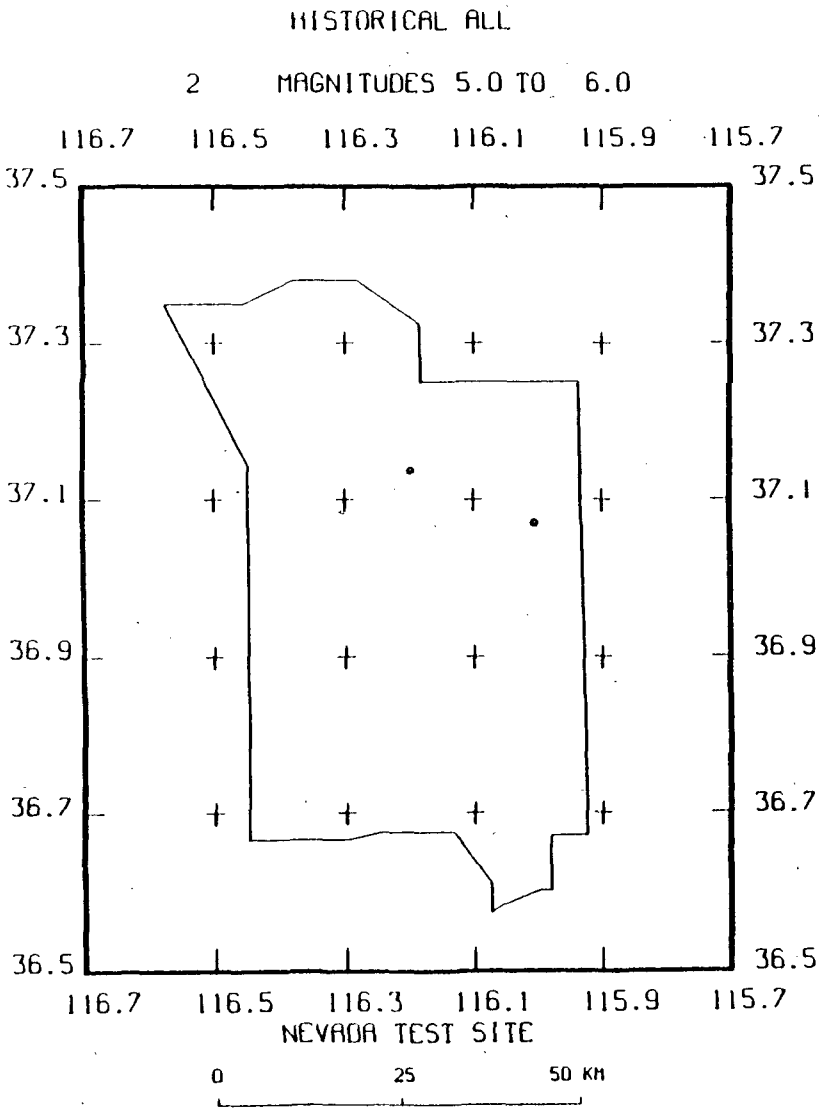

MODIFIED HISTORICAL
104 MAGNITUDES 4.0 TO 5.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

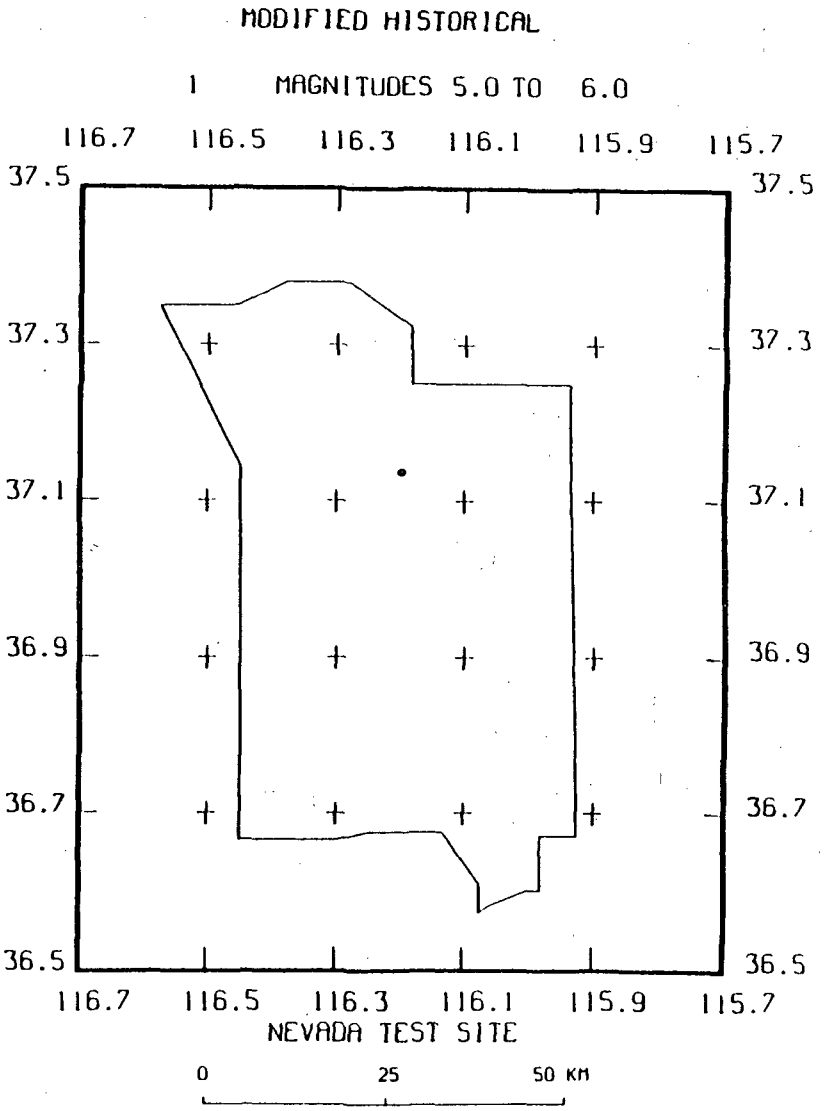

HISTORICAL ALL
69 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 Km


MODIFIED HISTORICAL
9 MAGNITUDES 4.0 TO 5.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 Km

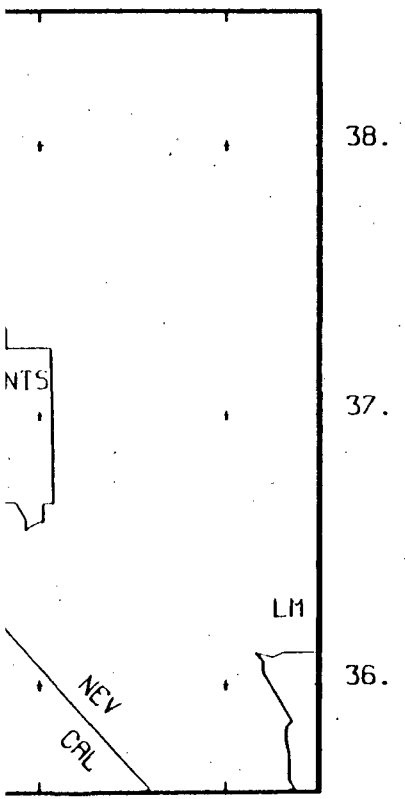

HISTORICAL
15 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


MODIFIED HISTORICAL
14 MAGNITUDES 5.0 TO 6.0
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


HISTORICAL ALL
2 MAGNITUDES 5.0 TO 6.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

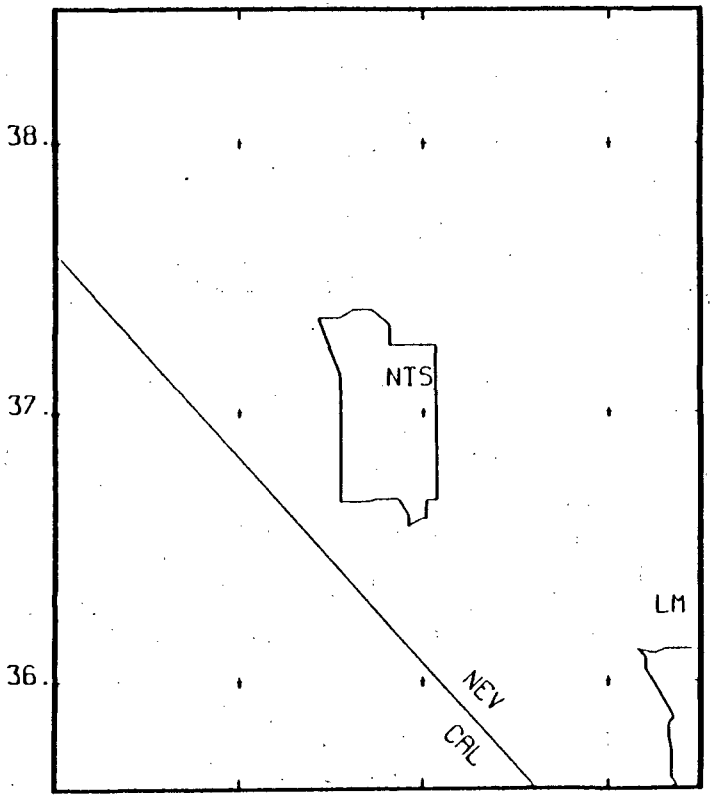

MODIFIED HISTORICAL
1 MAGNITUDES 5.0 TO 6.0
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM

STORICAL
5.0 TO 7.0



DA TEST SITE
MEAD
100 KM

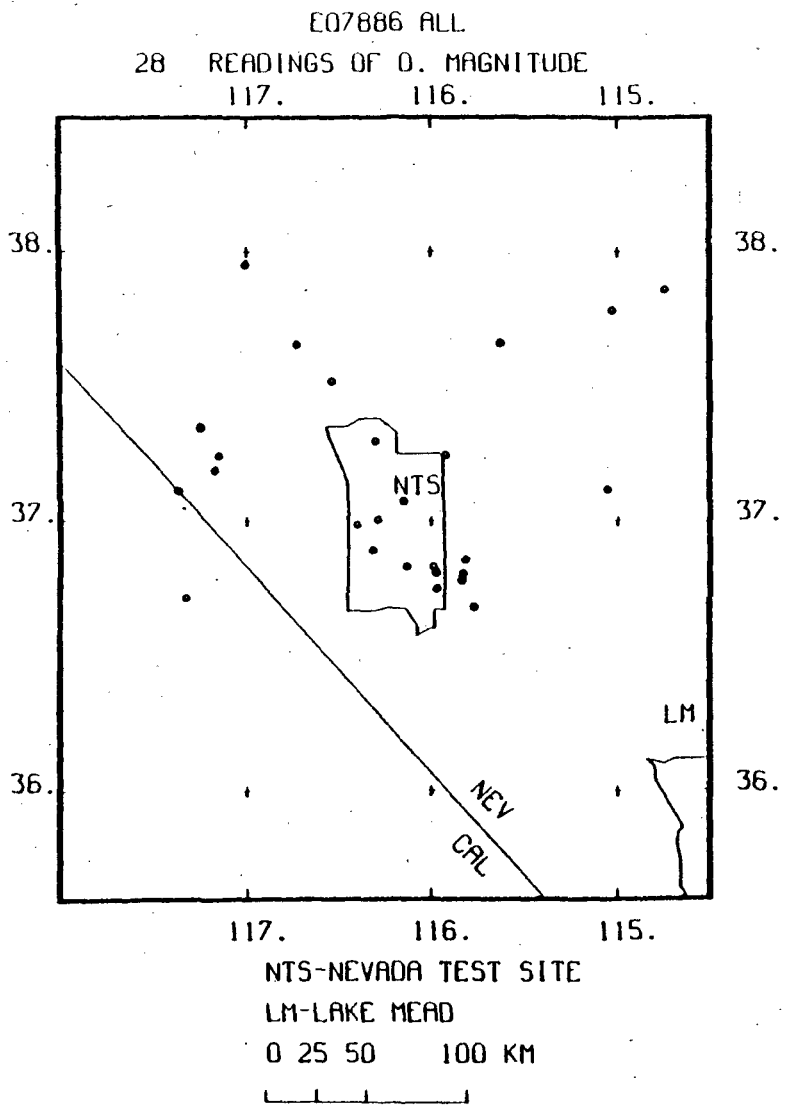
MODIFIED HISTORICAL
2 MAGNITUDES 6.0 TO 7.0

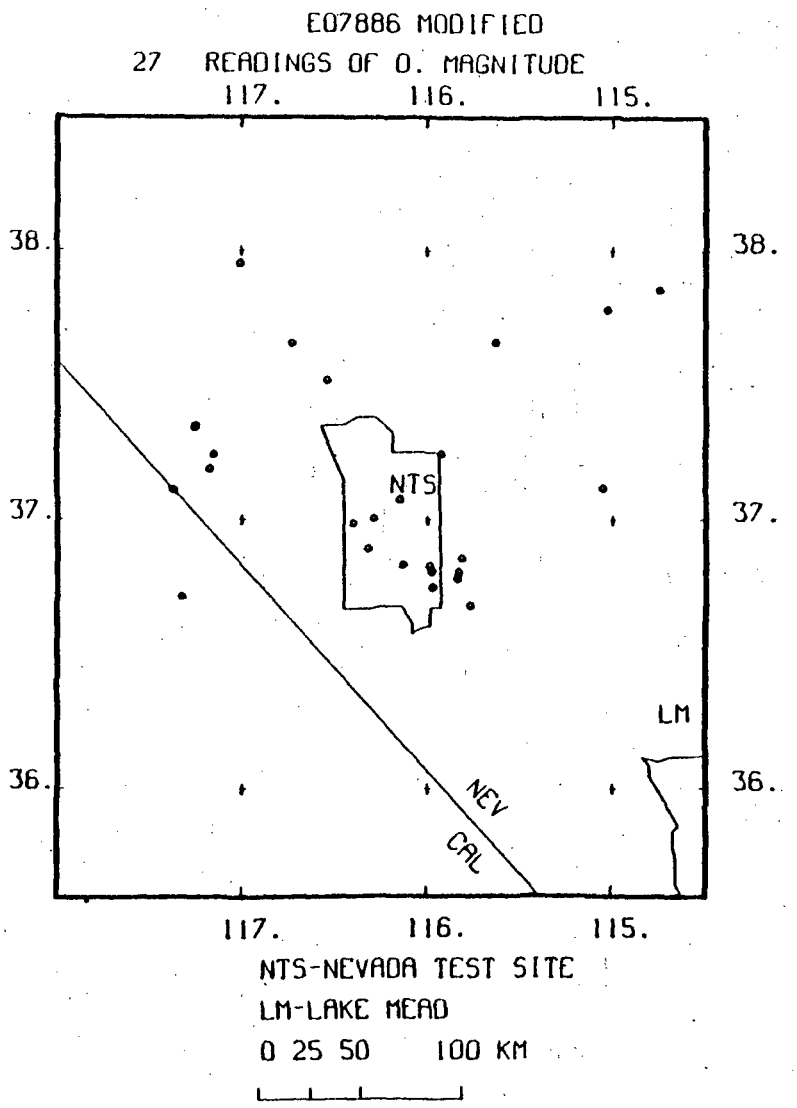


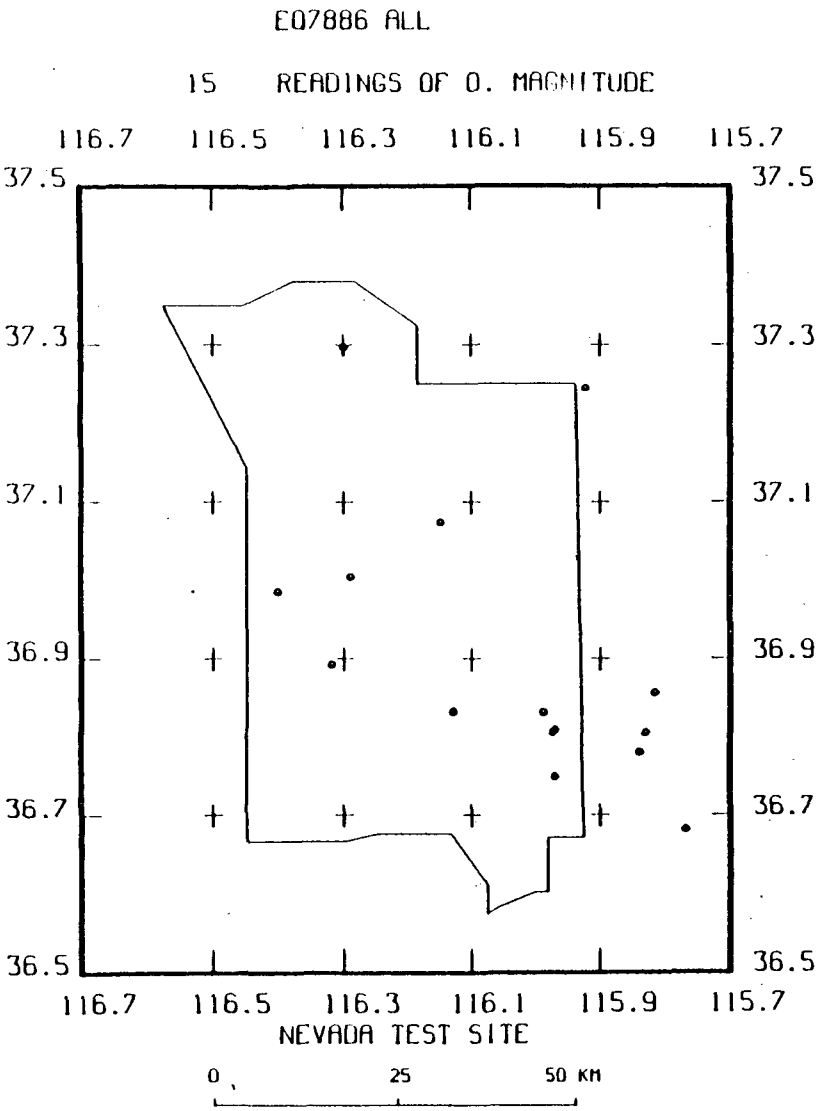
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM

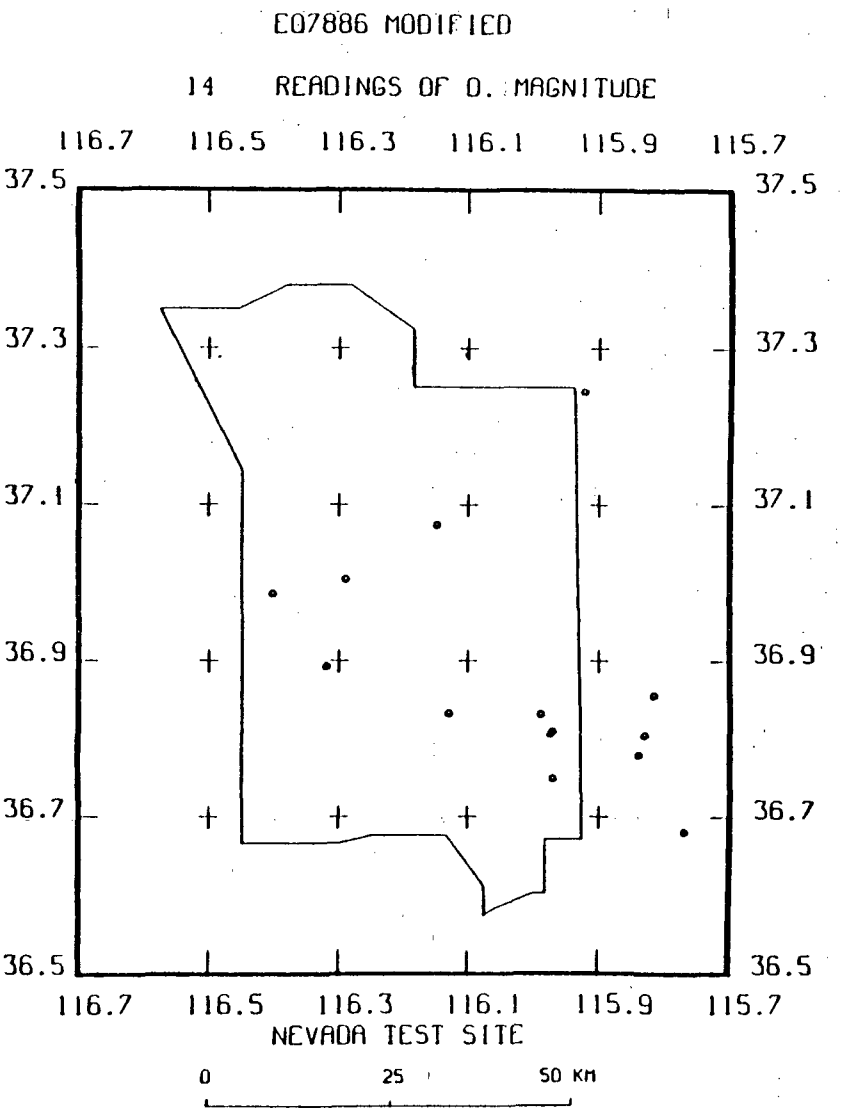
APPENDIX U

SOURCE - SNSN


E07886 ALL
28 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


E07886 MODIFIED
27 READINGS OF 0. MAGNITUDE
117.
116.
115.
38.
37.
36.
NTS
LM
NEV
CAL
NTS-NEVADA TEST SITE
LM-LAKE MEAD
0 25 50 100 KM


EQ7886 ALL
15 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
37.1
36.9
36.7
36.5
NEVADA TEST SITE
0 25 50 KM


EQ7886 MODIFIED
14 READINGS OF 0. MAGNITUDE
116.7 116.5 116.3 116.1 115.9 115.7
37.5
37.3
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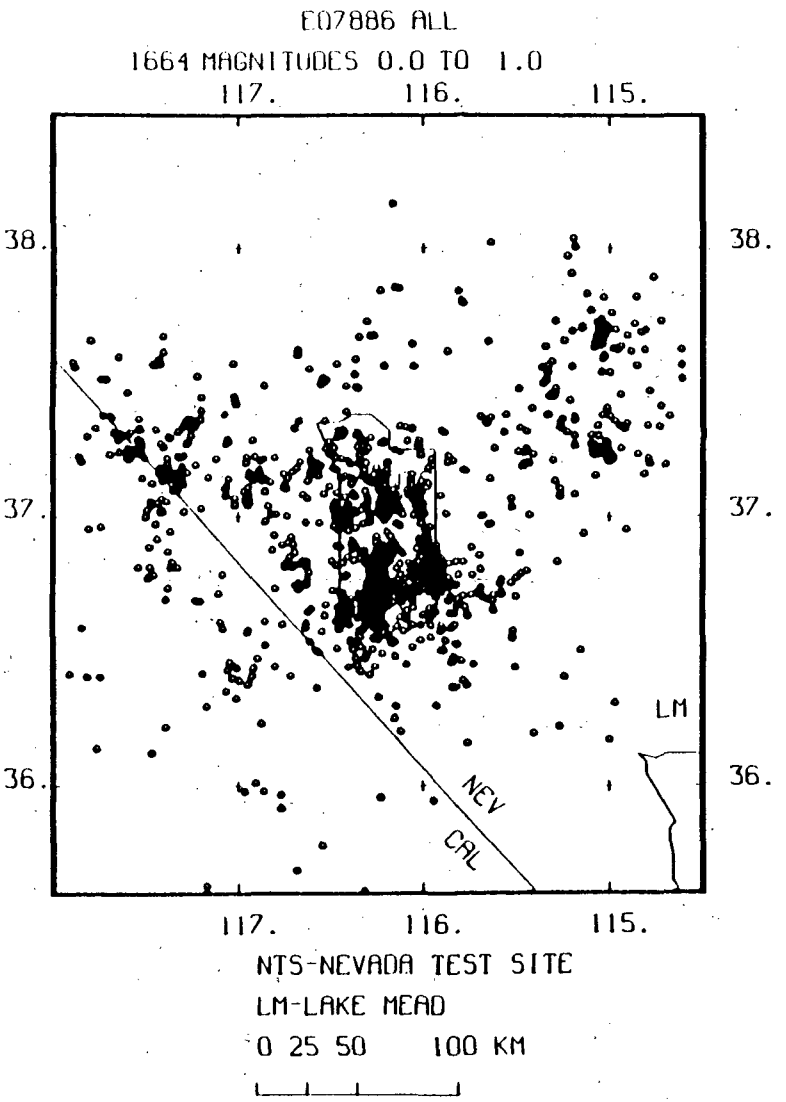
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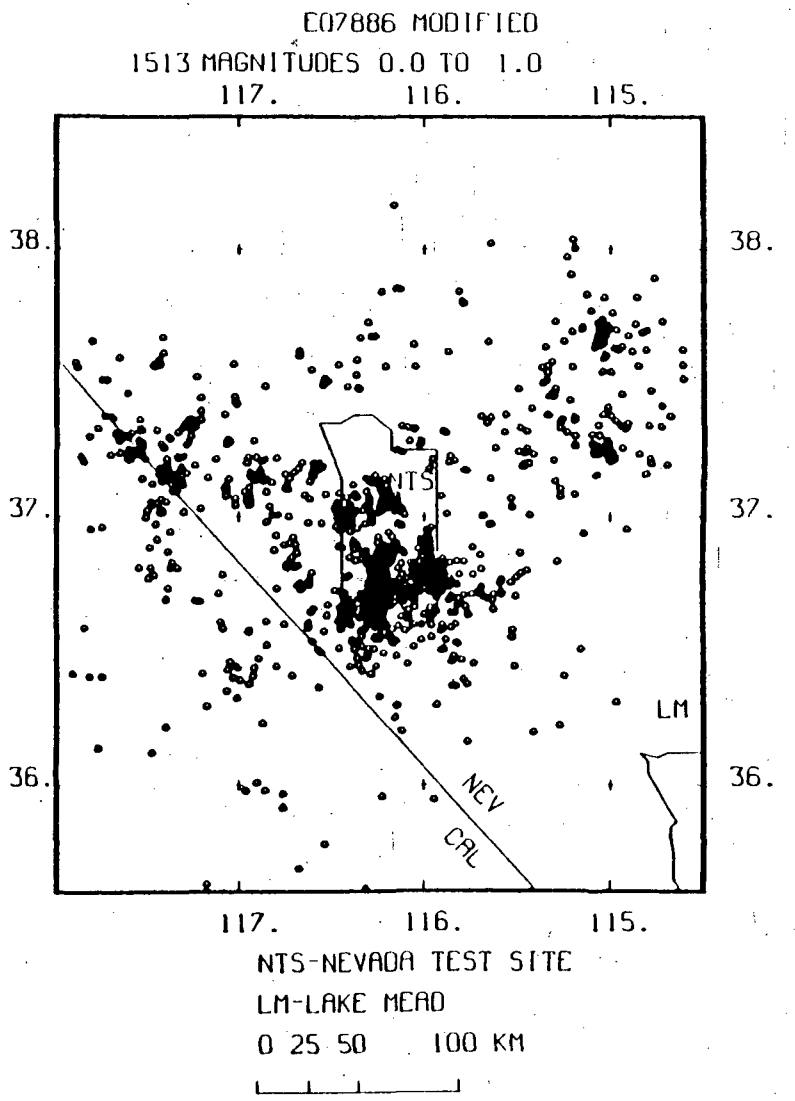
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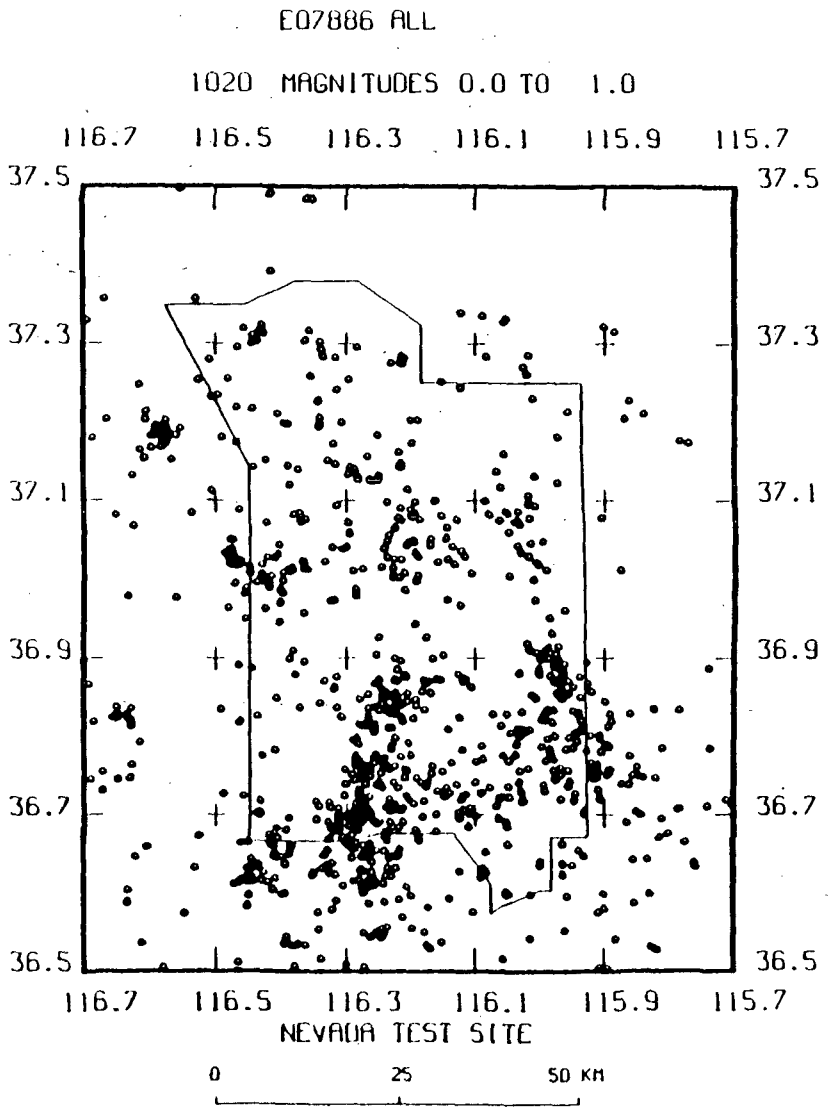
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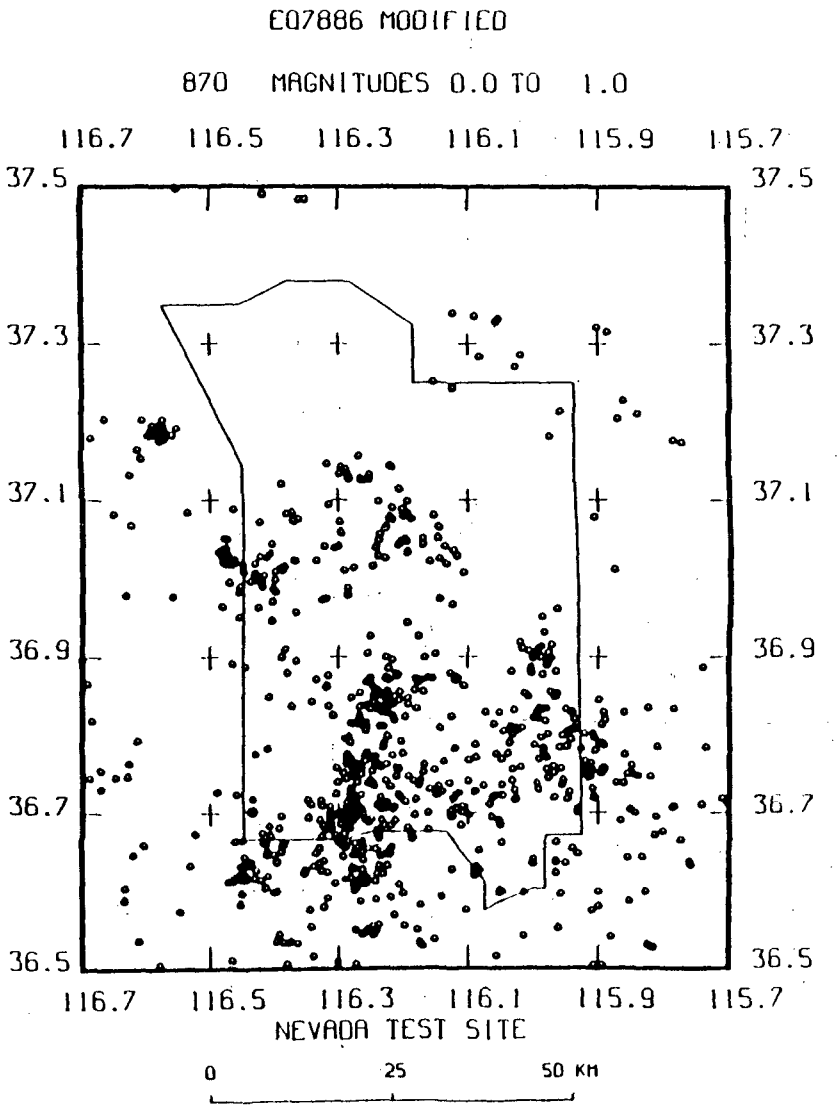
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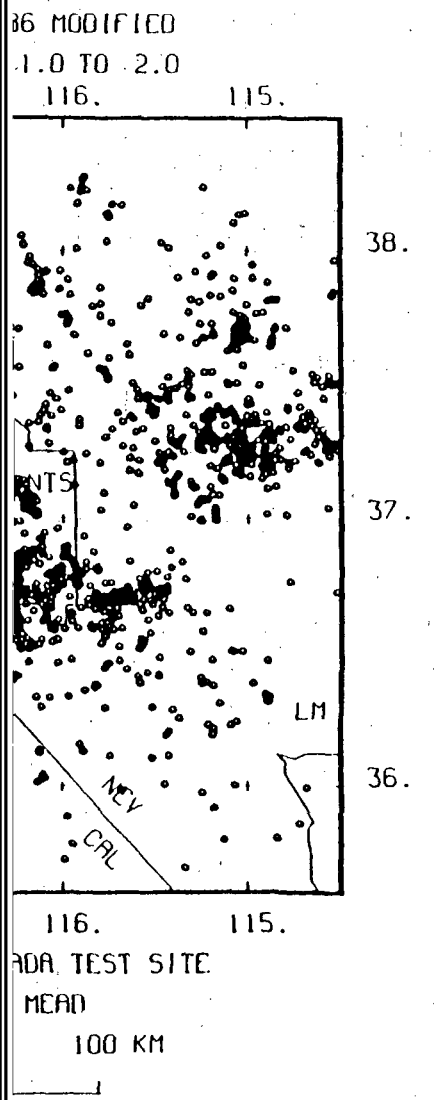
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1.0 TO 2.0
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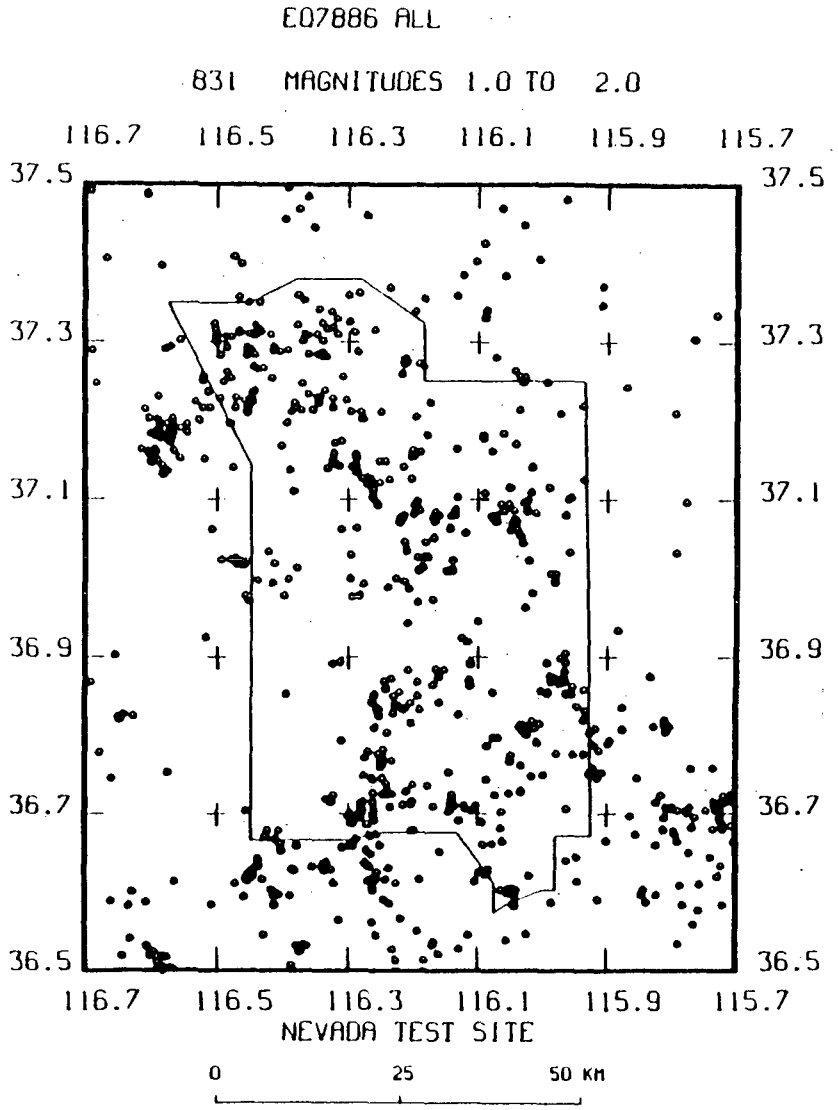
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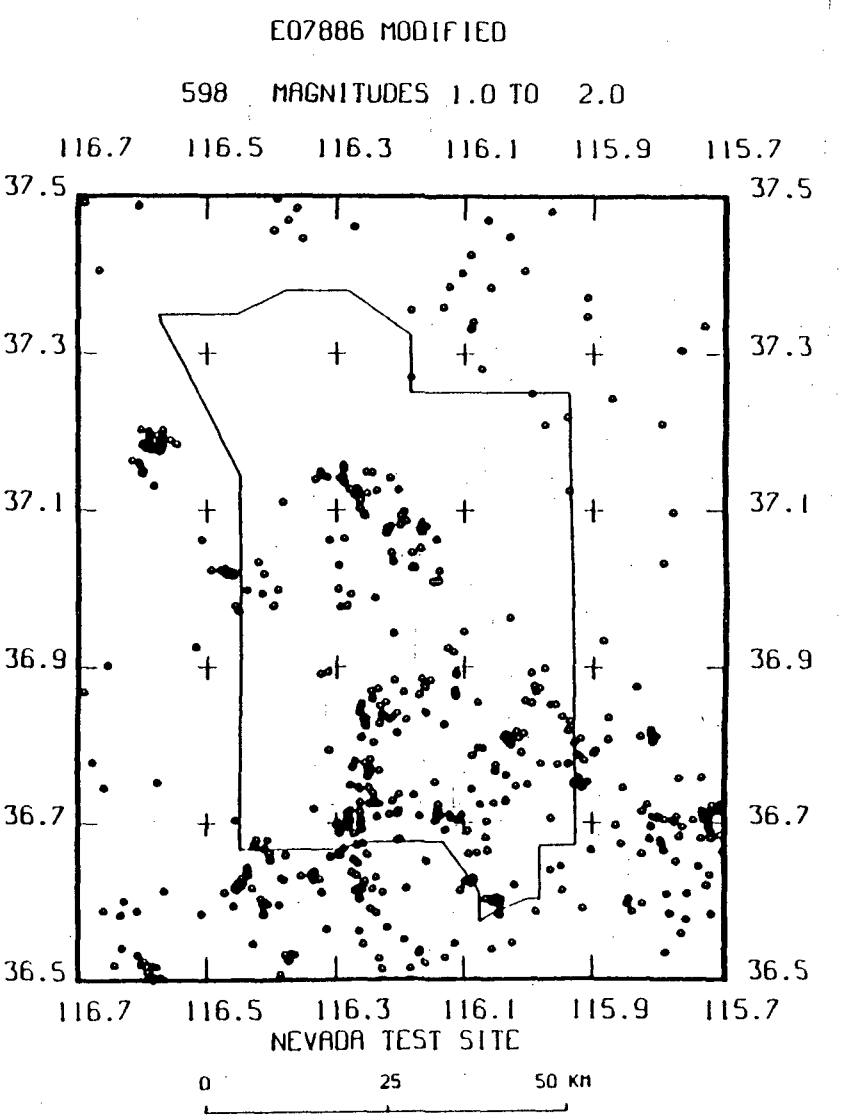
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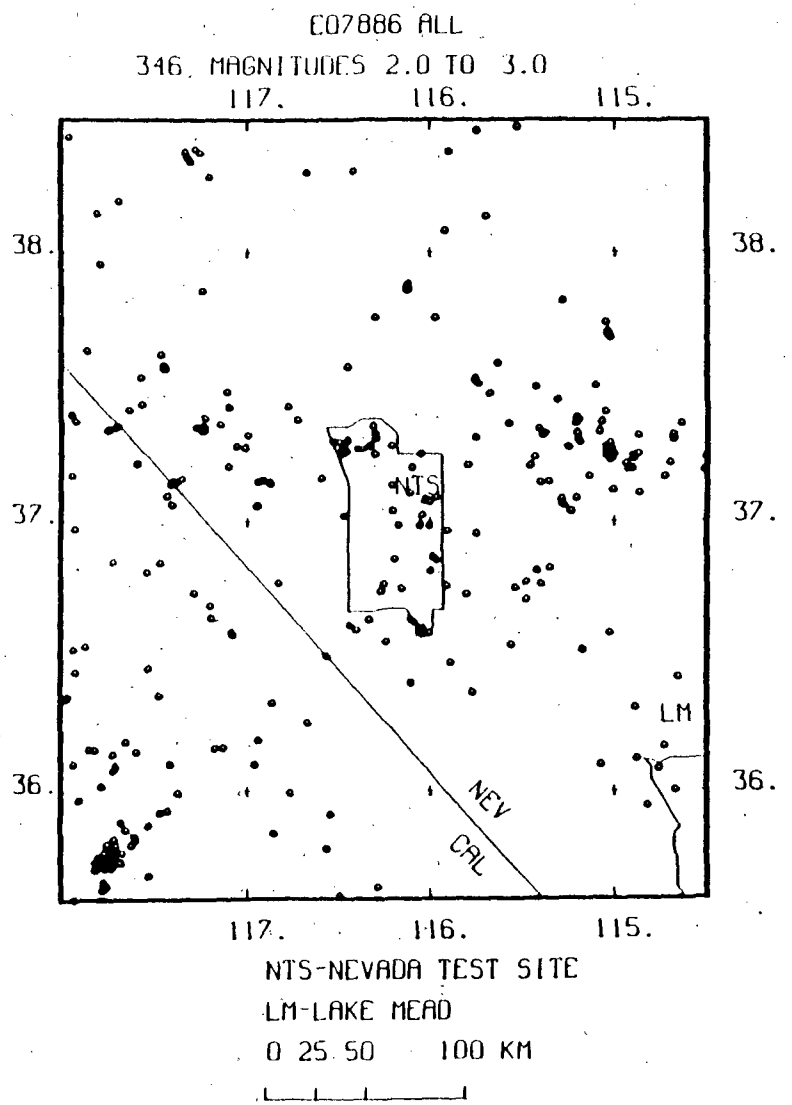
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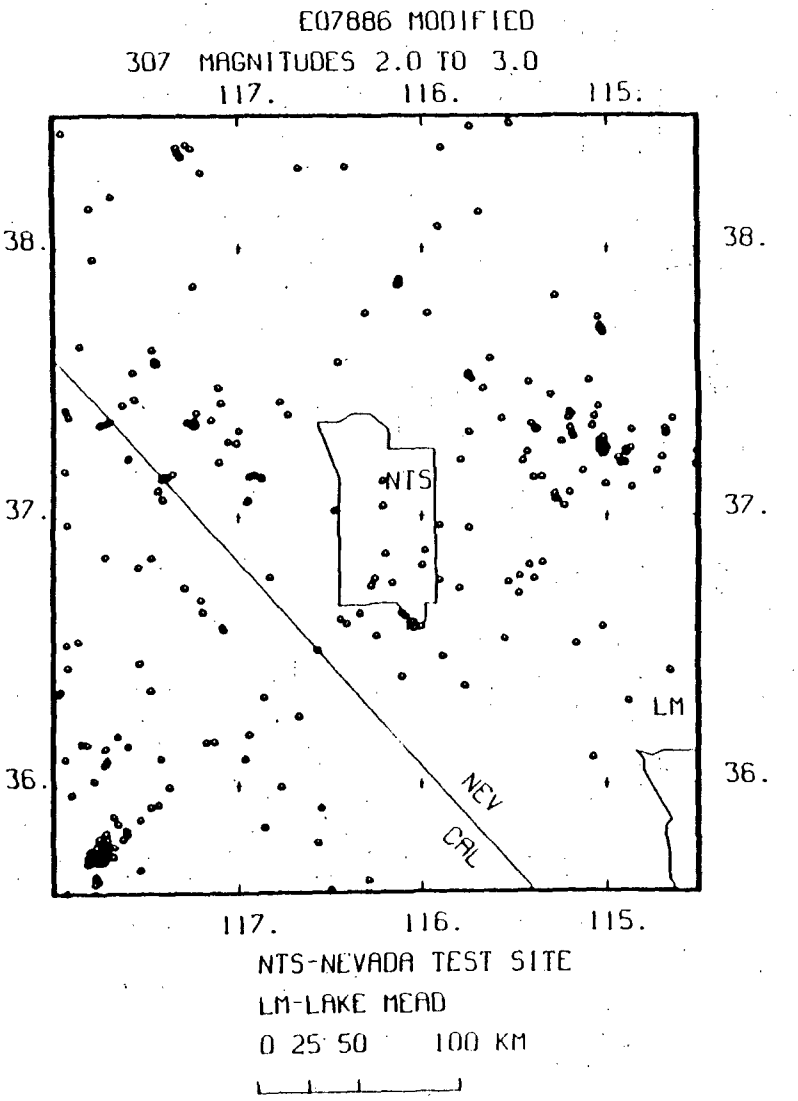
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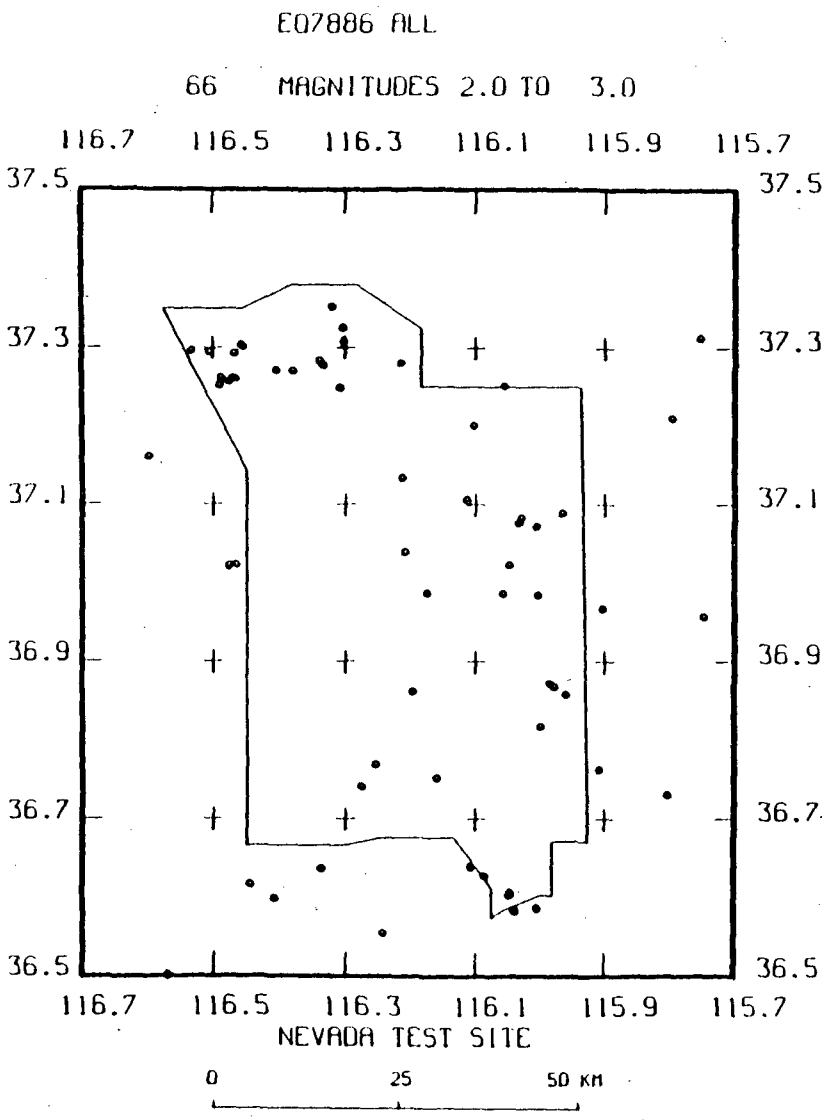
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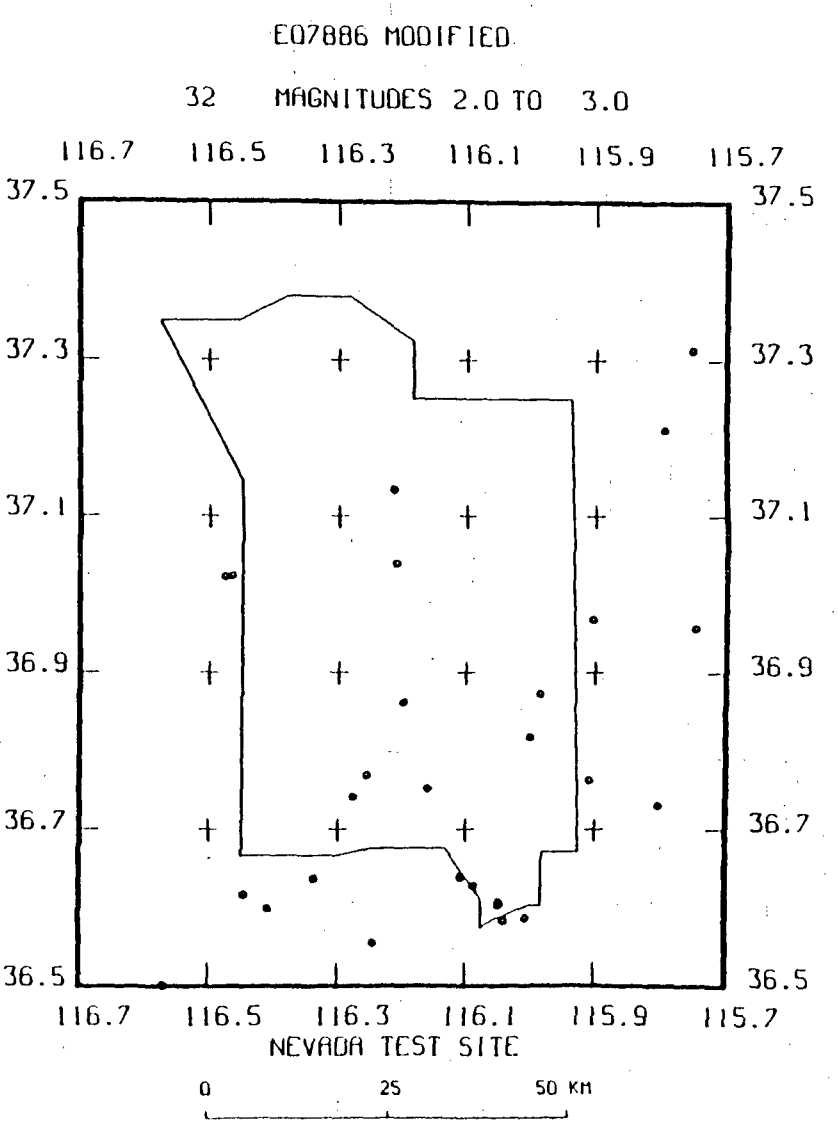
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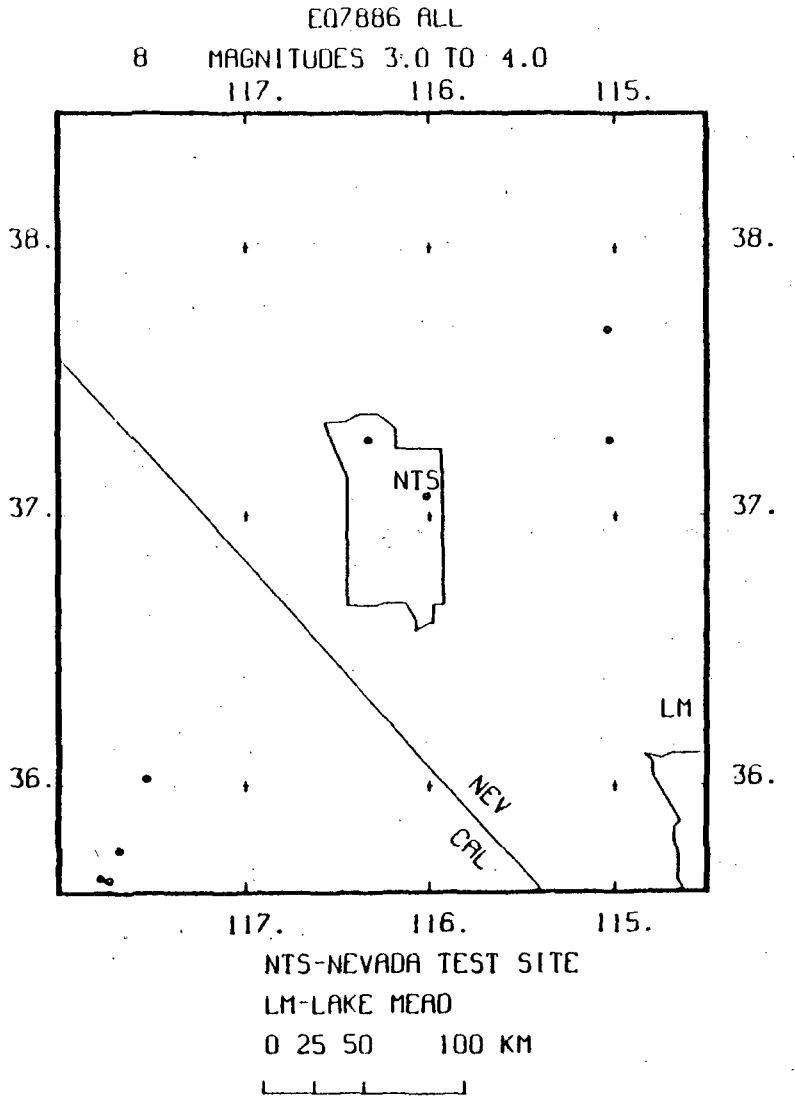
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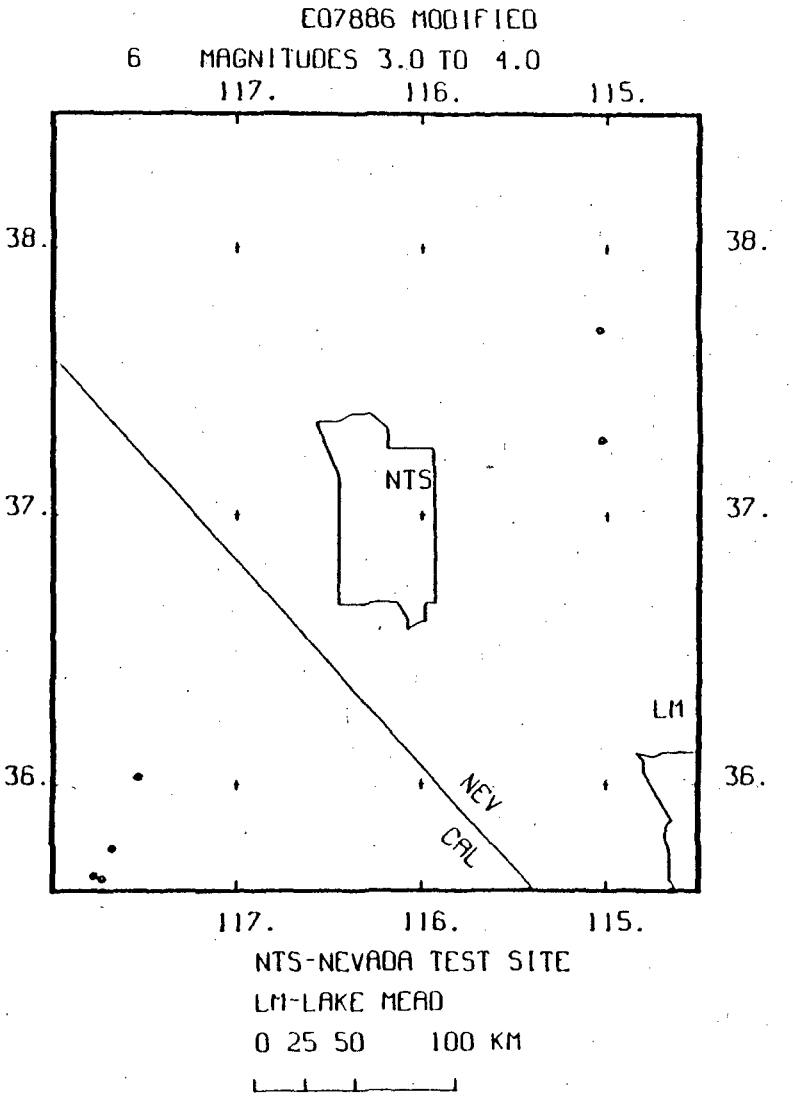
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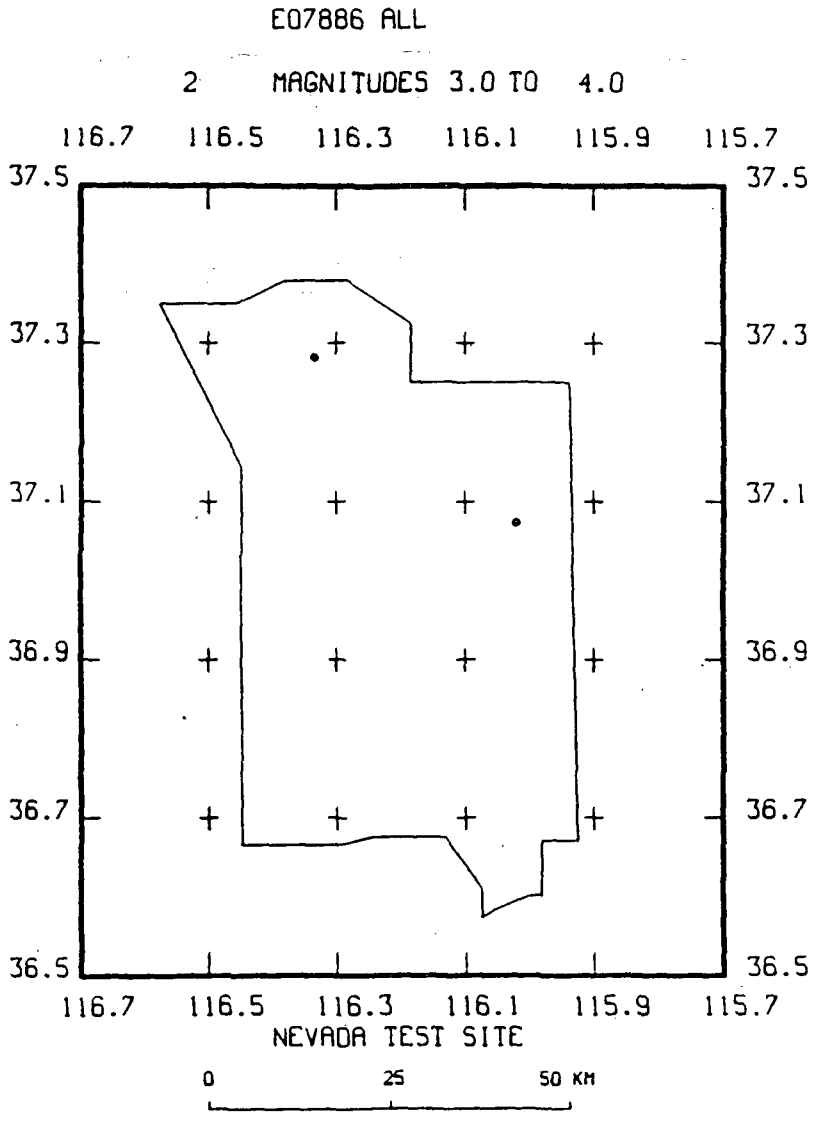
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37.1
36.9
36.7
36.5
NEVADA TEST SITE
0
25
50 KM

APPENDIX V

Information from the Reference Information Base Used in this Report

This report contains no information from the Reference Information Base.

Candidate Information for the Reference Information Base

This report contains no candidate information for the Reference Information Base.

Candidate Information for the Site & Engineering Properties Data Base

This report contains no candidate information for the Site and Engineering Properties Data Base.

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