UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE 2

APR 0 3 1981

MEMORANDUM FOR: Robert E. Jackson, Chief
Geosciences Branch, DE

THRU: Leon Reiter, Leader
Seismology Section, GSB, DE

FROM: Jeff Kimball, Seismologist
Seismology Section, GSB, DE

SUBJECT: STAFF EXAMINATION OF CONSUMERS POWER SITE SPECIFIC RESPONSE SPECTRA - PART 1

I have examined Part 1 of the Consumers Power submittal, Site Specific Response Spectra. The collection of real time histories to be used in developing Site Specific Response Spectra is dependent on the following input parameters: range of magnitudes from earthquakes which recorded strong motion, site conditions of the recording stations and the distance at which these records were recorded. What has been submitted by Consumer Power's Consultant, Weston Geophysical, is an analysis which uses a smaller subset of the total data set available by fine tuning the above input parameters. Response spectra results are dependent on the selection of this subset of data, therefore the sensitivity of each input parameter should be assessed when a fine tuned analysis is undertaken. Attached to this memo are comments on some suggested sensitivity tests that could be made on each input parameter or combinations of parameters (magnitude, distance, site conditions) to help resolve this issue. Both this memo and the attachment can be used to inititate discussion for the April 16, 1981 meeting with the applicant.

Jeff Kimball

Jeff Kimball, Seismologist
Seismology Section
Geosciences Branch, DE

Attachment:
As stated

cc: J. Knight
J. Kimball
L. Reiter
T. Cardone
D. Hood
J. Kane
H. Levin

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Attachment

1. Magnitude Range of Records Selected

As listed in Table 2 of the Part 1 submittal the range of magnitudes used was m_b = 4.7 to 5.2, M_L = 4.9 - 5.5 (mean M_L = 5.35). As stated in the October 14, 1980 letter from the NRC staff to Consumers Power Company, an appropriate magnitude range of M_{b1g} = 5.3 ± .5 was suggested (this roughly corresponds to an M_L range of 4.9 to 5.9 using Chung and Bernreuter, 1980). What would be the effect on the response spectra (84th percentile) of including appropriate records for earthquakes with M_L's up to 5.9?

2. Site Records Selected

Listed below are some uncertainties in the recording site foundation conditions that have been used by Weston in Part 1 of the Midland submittal. The uncertainties are listed not to reject the specific stations but to provide a basis for the possible inclusion of additional site records which also have site foundation condition uncertainties associated with them.

1. Cedar Springs Dam Pump House - The Shannon and Wilson site description (SW-AA, 1980) listed 8 feet of alluvium over poorly indurated sandstone with a possible sharp density contrast at 37 ft. While the general description may have some similarity to the Midland site the actual shear wave velocity profile was not measured and can only be estimated.
2. Gavilan College, Gilroy - While the contrast at about 40 feet matches the Midland site fairly well the shear wave velocity in Shannon and Wilson (SW-AA, 1980) is listed as greater than 3600 feet per second with the log terminating at 77 feet while figure A-7 in part 1 continues to about 110 feet.

3. Golden Gate Park, San Francisco - As noted on page A6 of the Part 1 submittal there is some uncertainty of the "true" subsurface site conditions (shear wave velocity profile). As shown either the velocity is comparable without the known Midland contrast at 40 feet or the velocity contrast may be present but the shear velocities may be very high.
4. Southern Pacific Building, San Francisco - As noted on page A2 of the Part 1 submittal Idriss and Seed (1968) estimate the depth to rock to be 285 feet. While the upper 60 feet generally fit the Midland Profile this site may be a deeper soft soil site compared to Midland.
5. Wrightwood, California - The Shannon and Wilson report (SW-AA, 1980) only give a description of this site. The actual shear wave velocity profile was not measured (the actual boring extended to 88.5 ft) and can only be estimated.

Listed below are stations whose general subsurface soil conditions are known, but the specific shear wave velocity profile is unknown. Based on the uncertainties of the subsurface soil profiles used in Part 1, the sensitivity of including the stations listed below should be evaluated or their exclusion should be justified. Why have these stations and records not been used in Part 1 and what affect would they have on the results if they were used.

1. Eureka Federal Building - while at depths below about 60 feet the shear wave velocity is low compared to Midland, there are impedence contrasts at about 45 feet and 120 feet and the shear velocity profile matches fairly well above 60 feet.
2. San Juan Bautista - Listed as less than 100 feet of alluvium (LLL, 1980).

3. Cholame #2 - 45m of alluvium, stiff to very stiff clays and silts over dense sand; listed as stiff, stiff soil, deep soil (LLL, 1980).
4. Cholame #5 - unconsolidated shallow soil and alluvium over consolidated sand (LLL, 1980).
5. Cholame #8 - Thin alluvium; sandstone (LLL, 1980).
6. Cholame #12 - 30 m of Terrace deposits over sandstone (LLL, 1980).
7. Melendy Ranch - Thin medium dense sand layer over weathered siltstone (LLL, 1980).
8. Stone Canyon - Contact between Quaternary alluvium and Middle Miocene None Marine (LLL, 1980).
9. Oroville CDMG #7 - Cenozoic sediments, Tertiary conglomerate (LLL, 1980).
10. Johnson Ranch, Oroville - 10 m Tertiary Conglomerate over Greenstone (LLL, 1980).
11. Oroville Medical Center - Cenozoic sediments, Terrace Gravels (LLL, 1980).
12. Santa Barbara Recording Stations - General descriptions of shallow alluvium over sandstone (LLL, 1980).

Date	Station	M_L	Horiz. Accel.
9/4/62	Eureka Federal	5.0	.047, .046
11/28/74	San Juan	5.2	.112, .044
6/28/66	Cholame #2	5.6	.480
6/28/66	Cholame #5	5.6	.350, .420
6/28/66	Cholame #8	5.6	.230, .270
6/28/66	Cholame #12	5.6	.050, .060

Date	Station	M_L	Horiz. Accel.
9/4/72	Melendy Ranch	4.75	.600, .470
9/4/72	Stone Canyon	4.75	.190, .140
8/8/75	CDMG #7	4.9	.096, .078
8/8/75	Johnson Ranch	4.9	.185, 0.85
8/2/75	Medical Center	5.2	.077, 0.51
8/15/78	Freitas	5.1-5.7	.230, .115
8/15/78	North Hall	5.1-5.7	.396, .269
8/15/78	Goleta	5.1-5.7	.340, .283

3. Distance of Real Time Records Collected

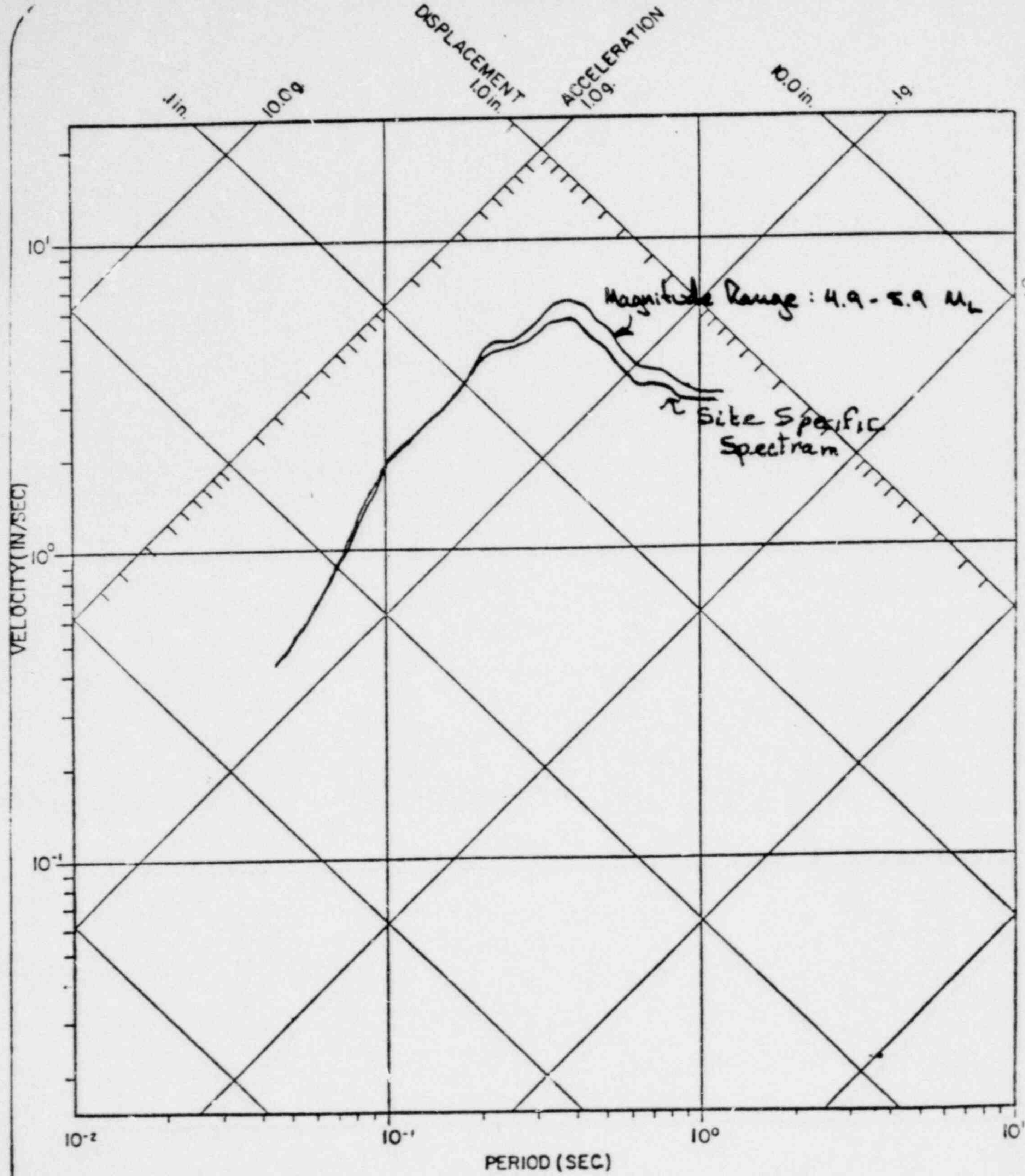
As listed in Table 2 of the Part 1 submittal the range of epicentral distances used was 7 to 33 kilometers. What would be the effect on the response spectra (84th percentile) if the distance at which records were recorded was restricted to 25 kilometers and less? 20 kilometers and less? 15 kilometers and less?

ENCLOSURE 3

VIEWGRAPH SLIDES

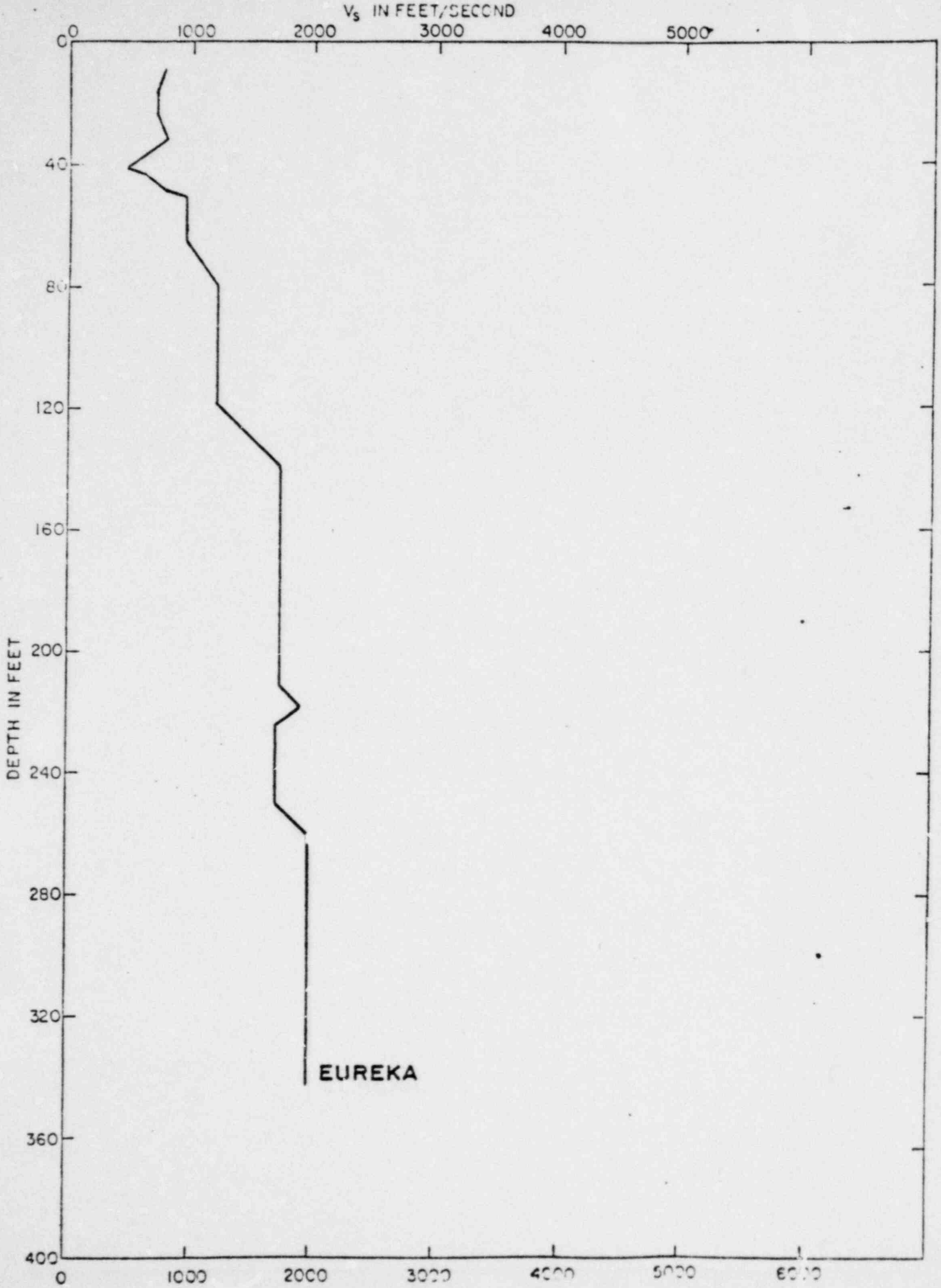
April 16, 1981

(Slides used during presentation which are contained in WGC report Part I are not included)

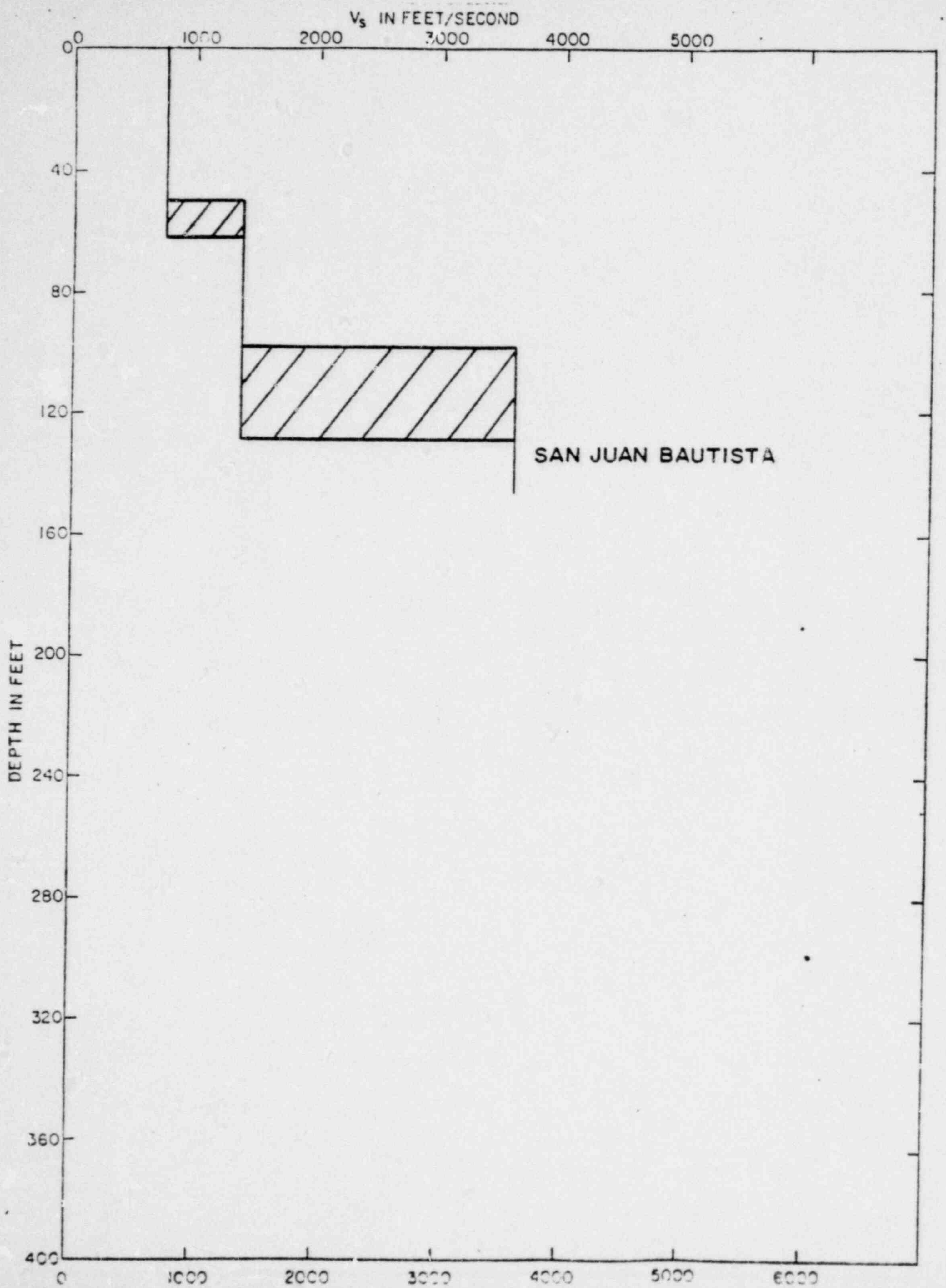


DISPLACEMENT
ACCELERATION
.1 in.
10.0 g
1.0 in.
1.0 g
10.0 in.
.1 g
VELOCITY (IN/SEC)
10^1
10^0
10^{-1}
PERIOD (SEC)
10^{-2}
10^{-1}
10^0
10^1
Magnitude Range : 4.9 - 5.9 M_L
Site Specific Spectrum

5% Damping



Vs IN FEET/SECOND
0
1000
2000
3000
4000
5000
DEPTH IN FEET
40
80
120
160
200
240
280
320
360
400
EUREKA



V_s IN FEET/SECOND
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1000
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DEPTH IN FEET
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80
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2000
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4000
5000
6000

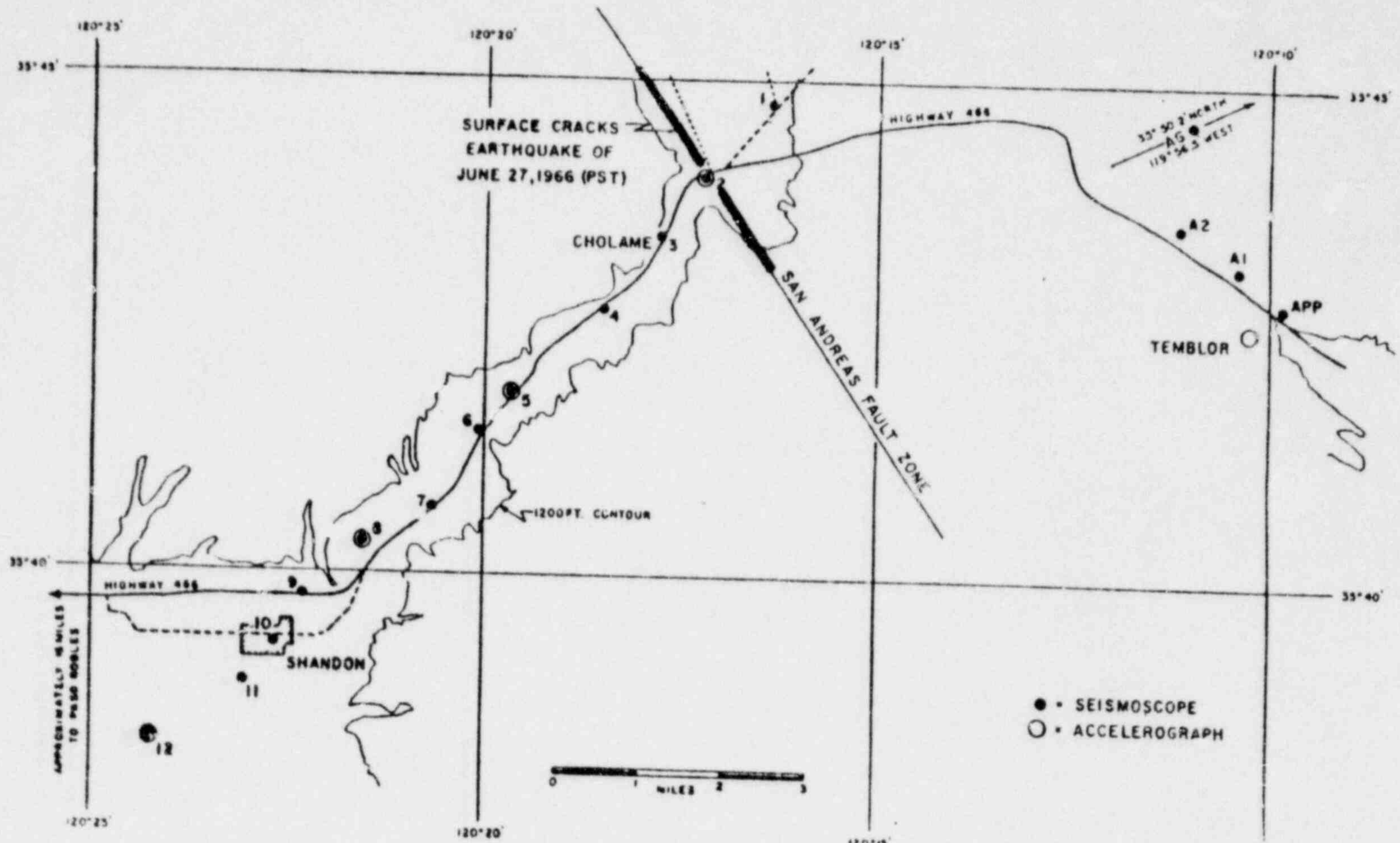

Fig. 1. Strong-motion instrument array across San Andreas fault.

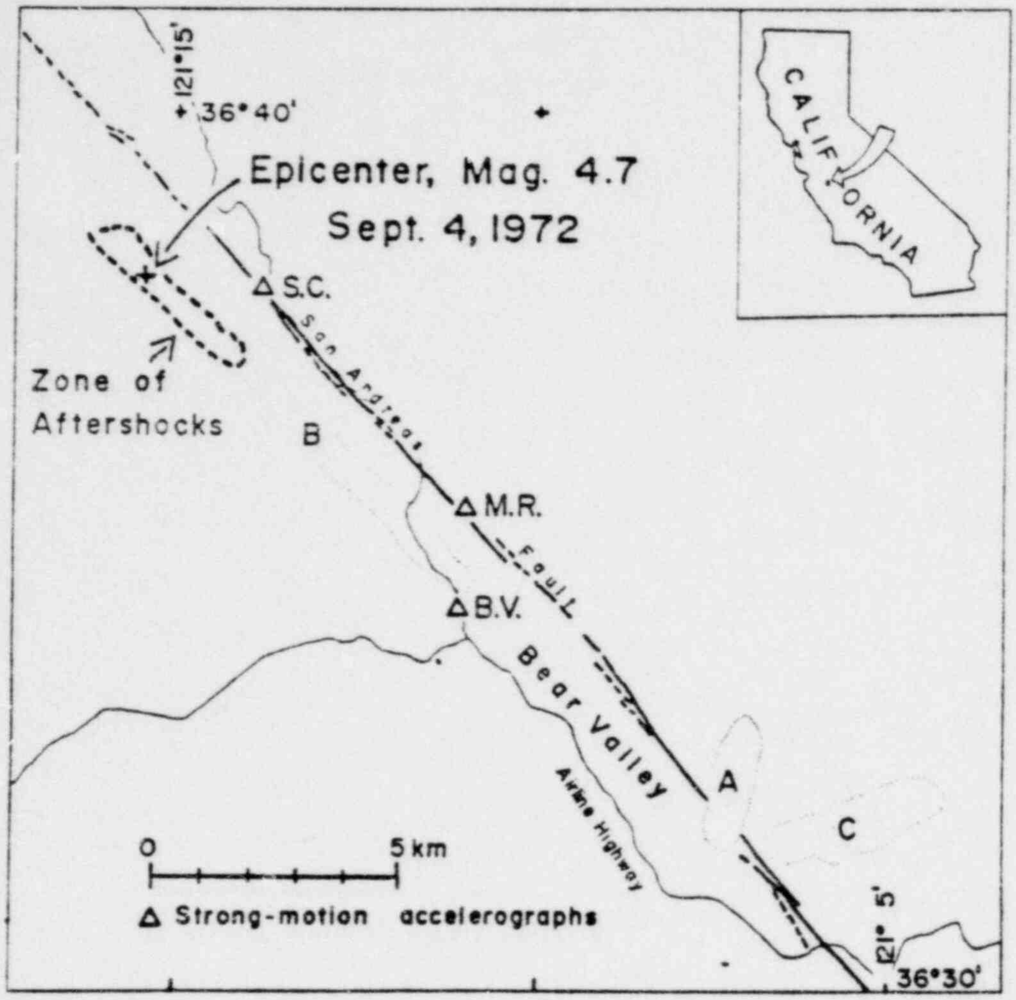

Figure 1

Location of earthquake activity in the Bear Valley area January-September, 1972. Dotted lines enclose: A-Earthquakes, February 22-23; B-Aftershock zone of magnitude 5.0 earthquake of February 24; C-Aftershock zone of magnitude 4.6 earthquake of February 27. Cross and bold dashed line indicate the epicenter of the main shock and the extent of the aftershocks of the earthquake on September 4. The relative precision of epicentral locations within the zones is generally better than 1 km. Systematic errors in the absolute locations as large as 1-2 km may exist (Lee et al., 1972). Triangles indicate strong motion accelerographs operated by the Seismological Field Survey, NOAA, at the time of the September 4 earthquake, S.C. - Stone Canyon, M. R. - Melendy Ranch, B. V. - Bear Valley Fire Control Station.

Origin Time

18:04:40.7

References

Brown, R. D.
Andreas
Cholame
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Ellsworth,
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Healy, J. H.
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Lee, W. H. K.
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Report

Ref. 4

Linda Seekins & Thomas Hanks
BSSA Vol 68 No. 3 pp 677-689, June, 1978

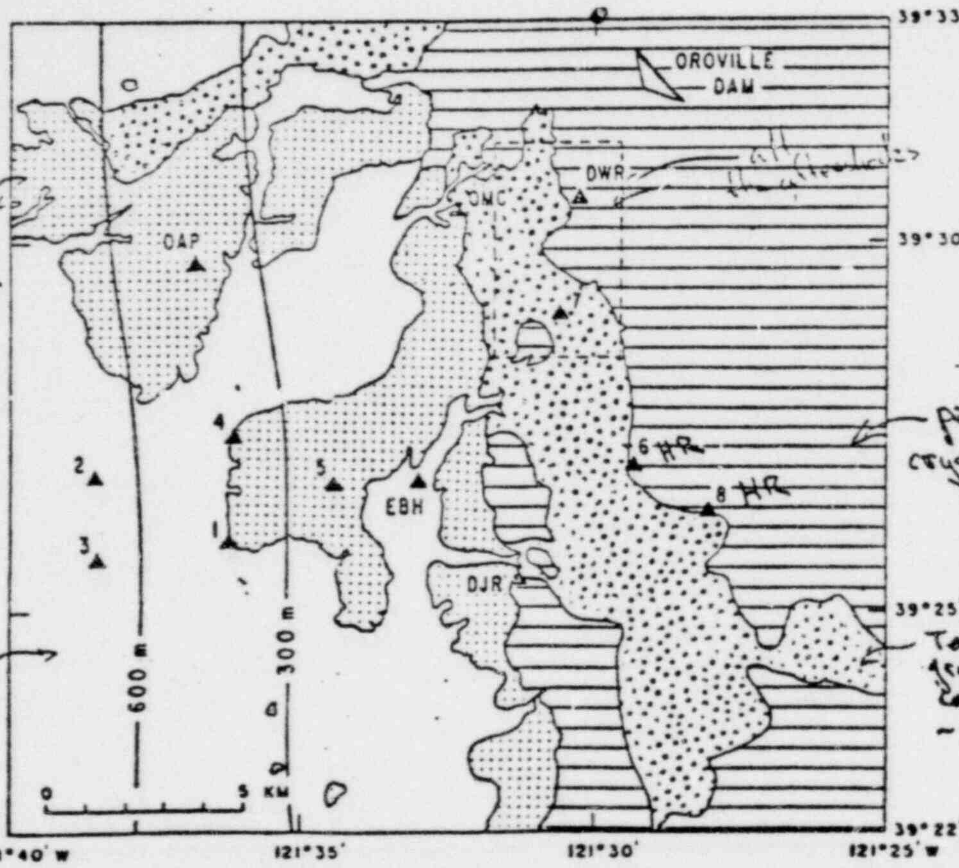


FIG. 1. **Epicentral region** of the Oroville earthquake. Generalized surface geology from Bucholz (1975): ***blank areas*, Recent alluvium**; *dotted areas*, Pleistocene gravels and alluvium; *open circled areas*, mainly Tertiary gravels and conglomerates, with occasional Tertiary volcanic rocks and sandstones; *lined areas*, pre-Tertiary crystalline rocks. Depth-to-basement contours in western part of the region are from Smith (1964). Strong-motion accelerograph sites are indicated as triangles; stations 9 and 10 are off the map at 39°20.13′N, 121°29.03′W, and 39°36.47′N, 121° 65′W, respectively. The box in dashed lines encloses all of the aftershocks in Table 1 except the three allow events 2022 August 2, 2059 August 2 (presumed shallow) and 0611 August 11. Most of the peak acceleration data used in this study are for earthquakes within this box and $5 \le h \le 10$ km.

V_s

Blank Areas = Recent Alluvium = 800-1000 ft/sec at

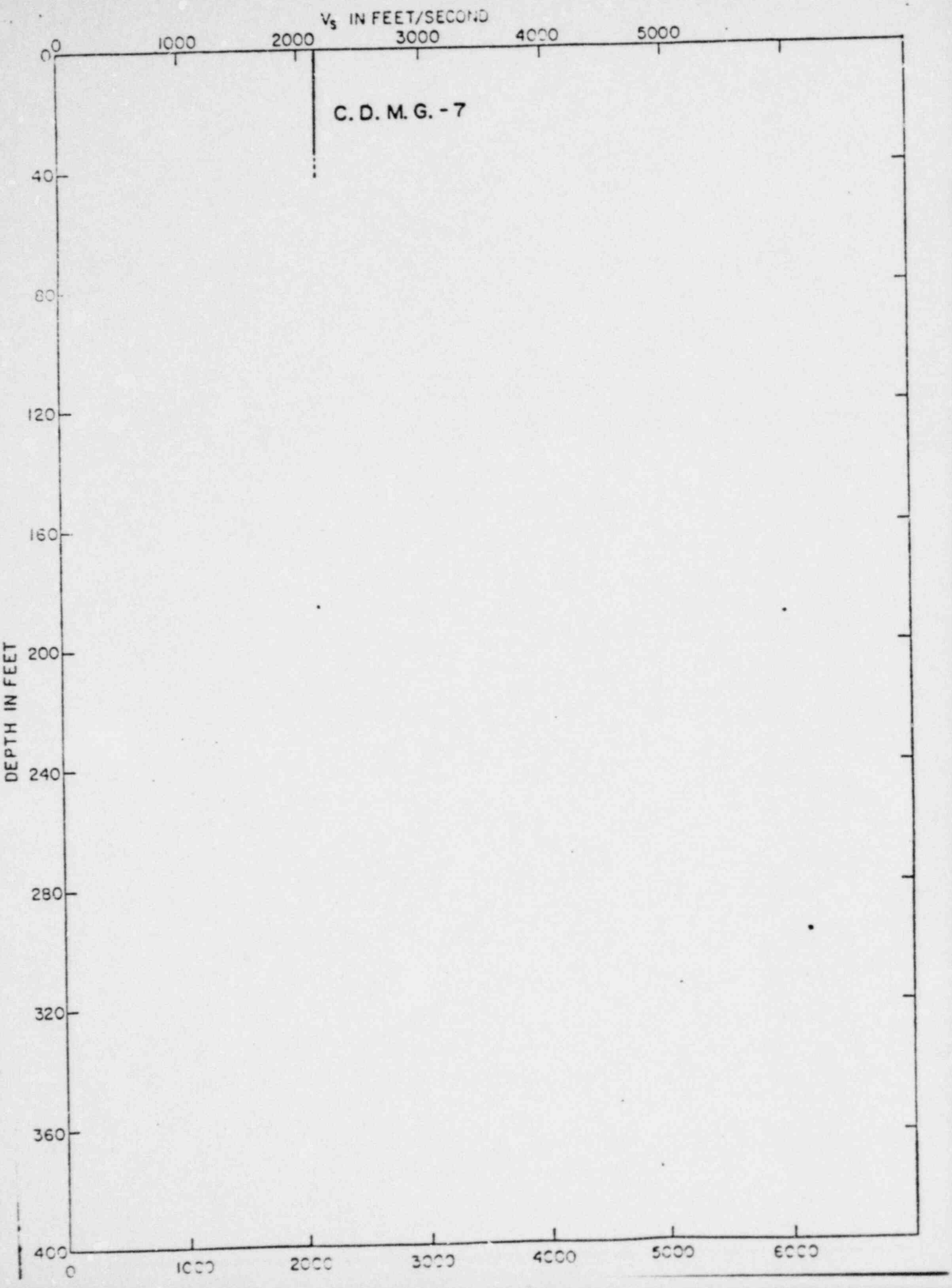
dotted areas = Pleistocene Gravel + Alluvium = 1100 ft/sec

open circle area = Tertiary gravels = " 2165

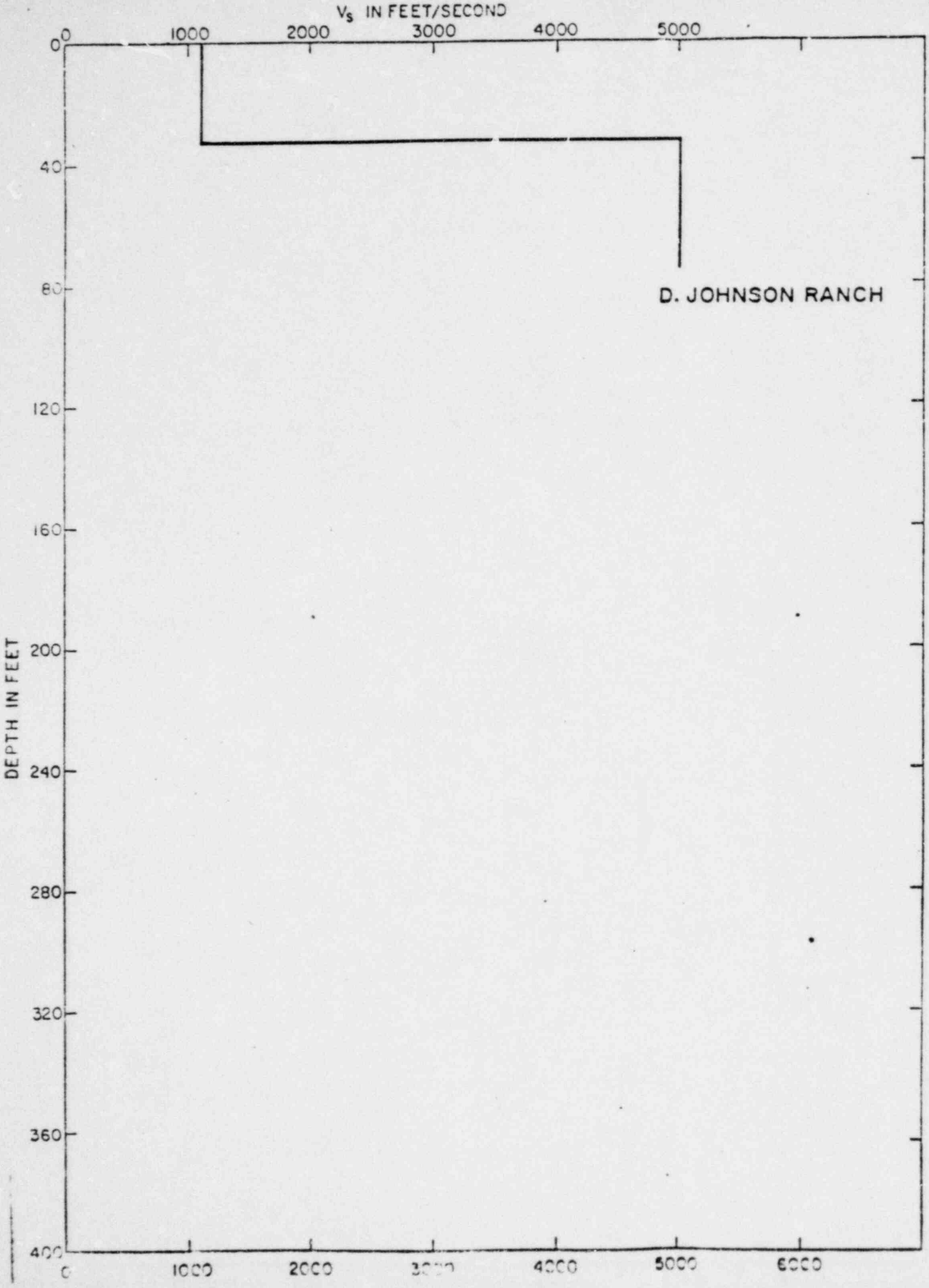
Rock weathered 3000

Hard Rock 4500-5000

POOR ORIGINAL



Vs IN FEET/SECOND
0
1000
2000
3000
4000
5000
C. D. M. G. - 7
DEPTH IN FEET
0
40
80
120
160
200
240
280
320
360
400
0
1000
2000
3000
4000
5000
6000



Vs IN FEET/SECOND
0
1000
2000
3000
4000
5000
DEPTH IN FEET
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D. JOHNSON RANCH
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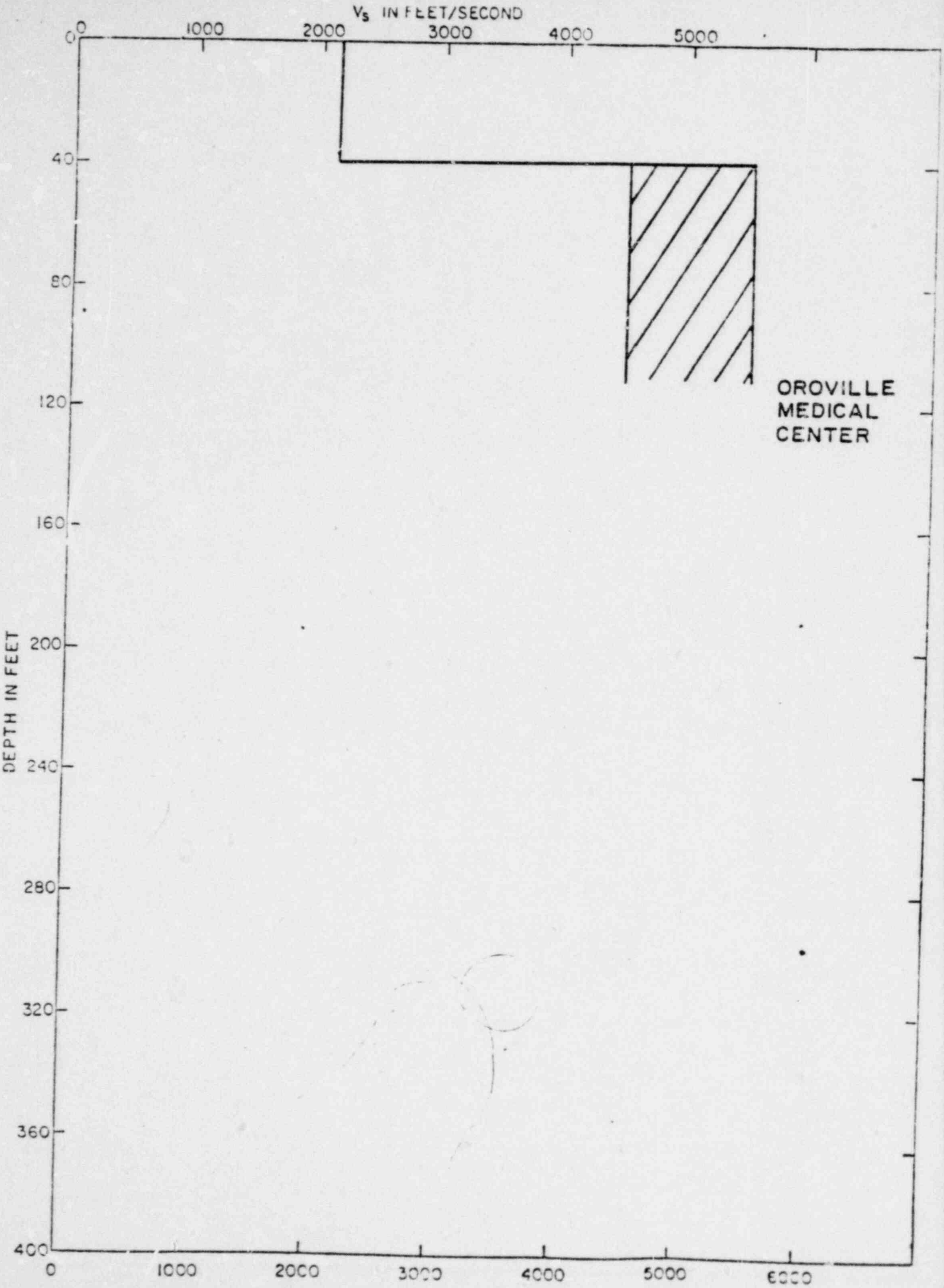
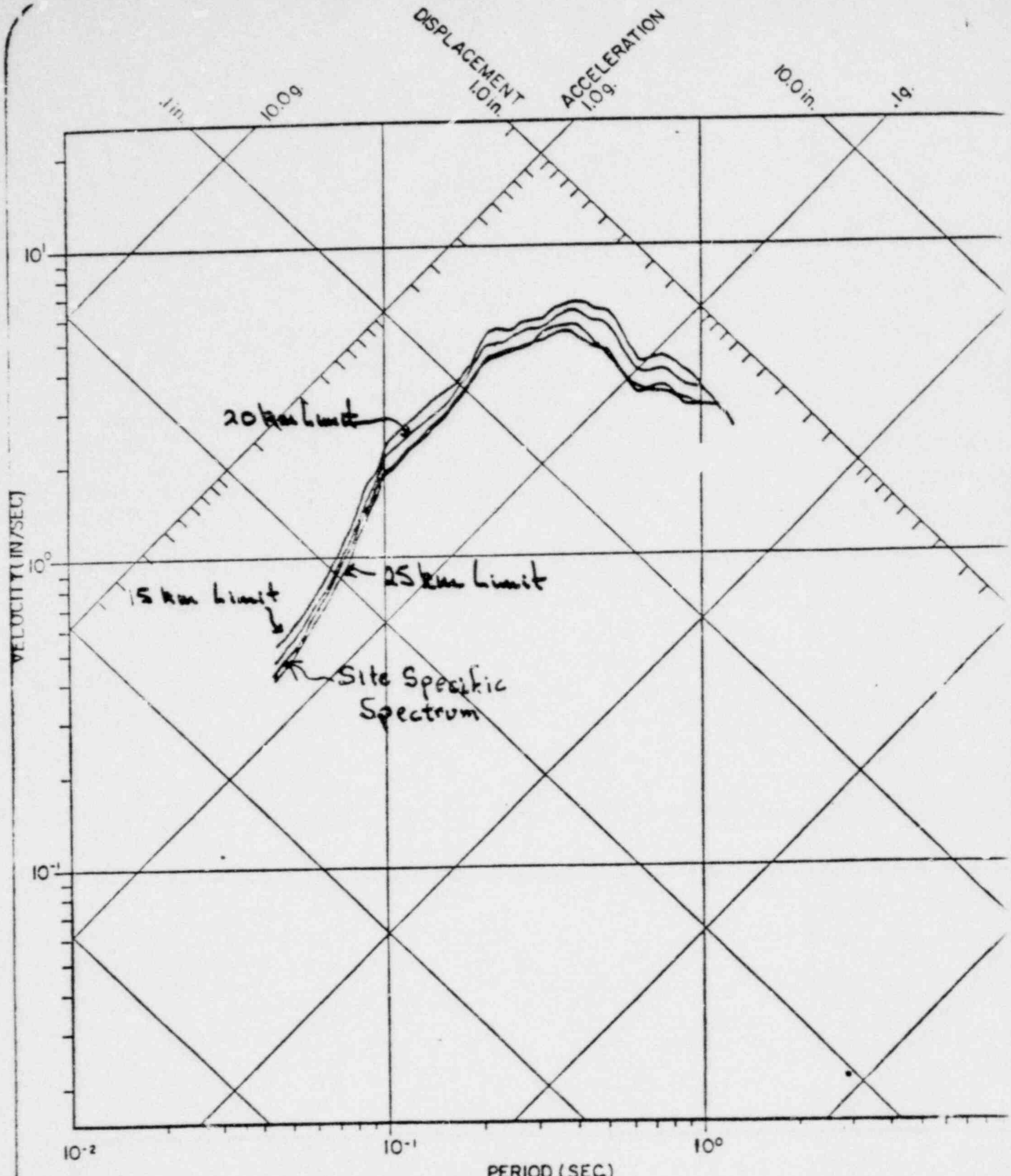
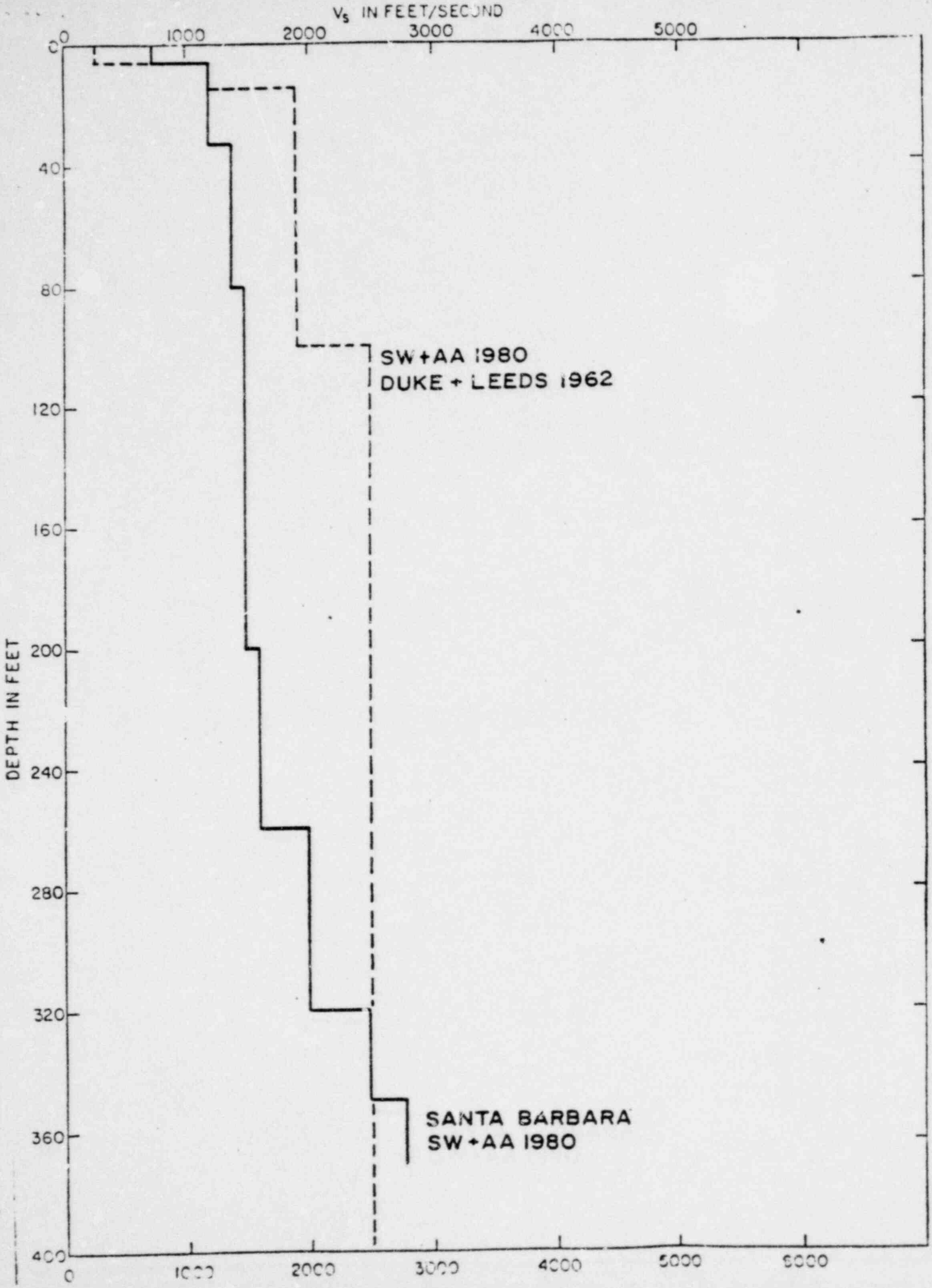


V_s IN FEET/SECOND
0
1000
2000
3000
4000
5000
0
40
80
120
160
200
240
280
320
360
400
DEPTH IN FEET
OROVILLE
MEDICAL
CENTER
0
1000
2000
3000
4000
5000
6000

Epicentral Distance Limit (km)	No. of Components	Mean Epicentral Distance (km)
33	44	17.6
25	36	14.9
20	28	12.4
15	22	11.5


DISPLACEMENT
ACCELERATION
.1 in.
10.0 g
1.0 in.
1.0 g.
10.0 in.
.1 g.
VELOCITY (IN/SEC)
10¹
10⁰
10⁻¹
10⁻²
10⁻¹
10⁰
PERIOD (SEC)
20 km Limit
25 km Limit
15 km Limit
Site Specific Spectrum

5% Damping



Vs IN FEET/SECOND
0
1000
2000
3000
4000
5000
DEPTH IN FEET
40
80
120
160
200
240
280
320
360
400
SW+AA 1980
DUKE + LEEDS 1962
SANTA BARBARA
SW+AA 1980