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BOREHOLE VELOCITY MEASUREMENTS AND GEOLOGICAL CONDITIONS AT THIRTEEN SITES IN THE LOS ANGELES, CALIFORNIA REGION

by

James F. Gibbs, John C. Tinsley, David M. Boore, and William B. Joyner[1]

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U.S. Geological Survey Open-File Report OF 00-470

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INTRODUCTION

The U.S. Geological Survey (USGS), as part of an ongoing program to aquire seismic velocity and geologic data at locations of strong-ground motion in earthquakes (e.g. Gibbs, et al., 1999), has investigated thirteen additional sites in the Los Angeles, California region. The sites are shown in Figure 1 and listed in Table 1, which gives references to information regarding the strong-motion data.

Of the thirteen sites, seven were located near existing strong-motion stations that recorded the Northridge California earthquake of January 17, 1994. These stations are: Brentwood VA (BVA), ETEC (RD7), Obregon Park (OBG), Receiver Station East (RSE), Sylmar Converter East (ESC), Wadsworth VA North (WVAN), and Wadsworth VA South (WVAS).

The boreholes at the other six sites were drilled for various reasons. Colton Interchange East (COE) and Colton Interchange West (COW) were drilled at the intersection of interstate highways I10 and I215, by the California Department of Tranportation, for installation of a seismic array to monitor seismic activity in the area of the highway overpass structure. Potrero Canyon #3 (POT3) was drilled for ROSRINE (a consortium for the collection and dissemination of information on subsurface material properties: see http://geoinfo.usc.edu/rosrine) to obtain site response data and to add borehole instruments. Tarzana (TAR) was drilled by California Division of Mines and Geology strong-motion program to add downhole instruments when it became necessary to relocate the free-field Tarzana strong-motion station. Water Treatment Plant (WTP) was drilled as a cooperative project between the USGS and City of Long Beach for a detailed (continuous core) geologic study and to install borehole instruments for a deep (approximately 440 meters) seismic array. In collaboration with the above organizations the USGS has made velocity measurements at these sites prior to installation of the borehole instruments. Finally, Sylmar Converter East #2 (ESC2), was drilled for the USGS to provide information on local variations in shear-velocity that might explain differences in damage to electrical equipment during the 1994 Northridge earthquake.

GEOLOGIC AND GEOPHYSICAL LOGS

Generalized logs of earth materials underlying the drill sites were prepared from (1) logs of cuttings that were noted during drilling, (2) "undisturbed" samples obtained using a Pitcher sampler (which provided glimpses of the materials encountered at depth), and (3) a suite of geophysical logs (spontaneous potential, resistivity, caliper, and natural gamma ray logs; these logs are not included in this report) obtained prior to installing and grouting the casing in the borehole. From these logs we can delineate the thickness and character of materials penetrated. Electric logs enable findings to be extrapolated to other parts of the basin and to other basins in southern California. Physical properties noted in the abbreviated descriptions include: depth, color, texture or lithology of alluvial deposits, probable geologic age, and correlation with regionally mapped geologic units.

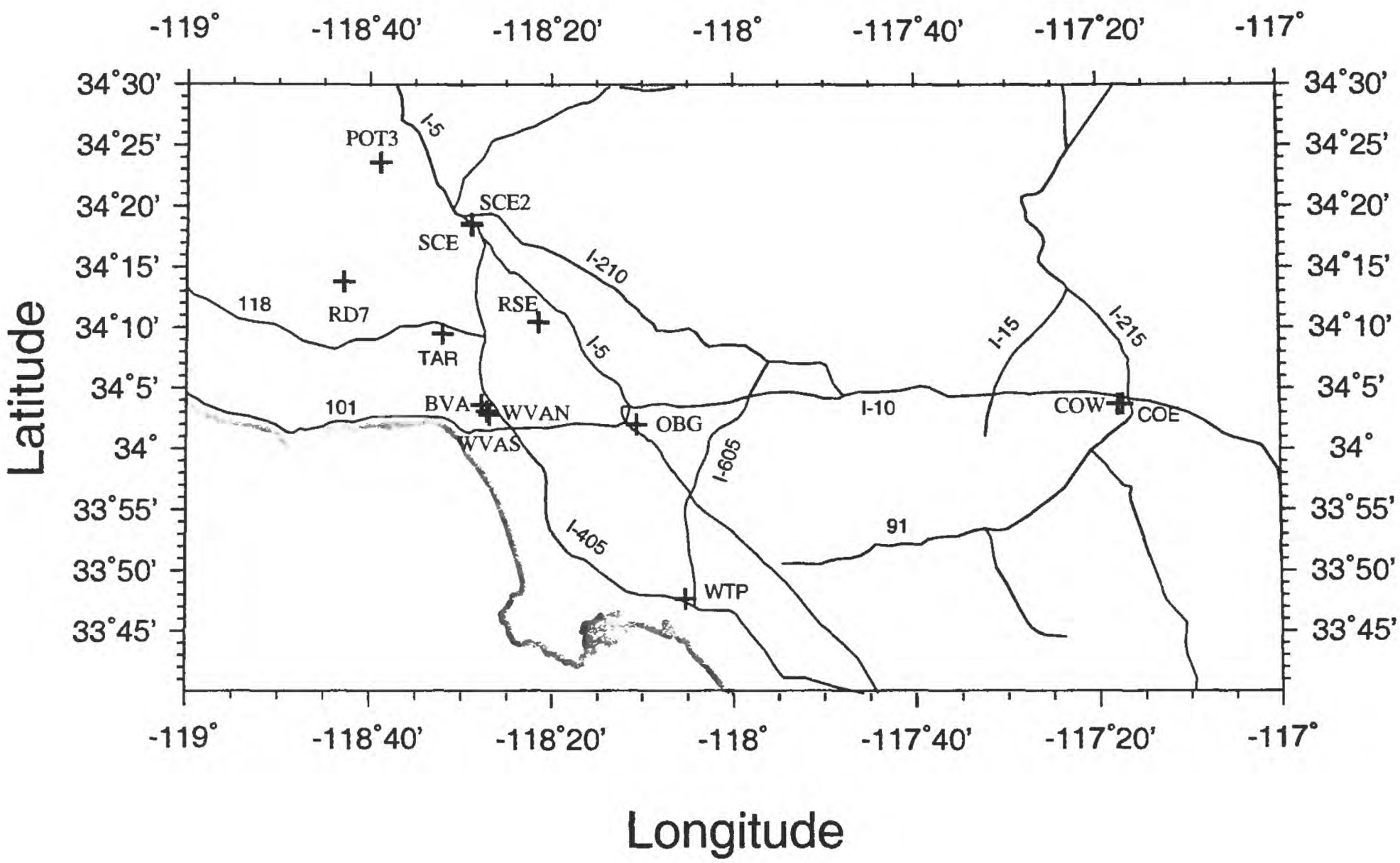

Figure 1. Regional map showing the locations of boreholes (plus symbols) included in this report. Locations of roads shown are approximate.

TABLE 1. Site location and peak acceleration data.

Site No	STATION NAME	Borehole LATITUDE*	Borehole LONGITUDE*	SMA LATITUDE	SMA LONGITUDE	USGS SITE CODE	PEAK ACC HORIZ (g)	PEAK ACC VERT (g)	SOURCE PEAK ACCEL. VALUES
1	Brentwood VA Hospital	34.06315	-118.46229	34.06282	-118.46229	BVA	0.18	0.14	Porcella et al., 1994
2	Colton East	34.06371	-117.28894	34.06371	-117.28894	COE	New station		Downhole Array
3	Colton West	34.06363	-117.29710	34.06363	-117.29710	COW	New station		Downhole Array
4	ETEC-RD7	34.23143	-118.71408	34.23126	-118.71316	RD7	0.29	0.16	Porcella et al., 1994
5	Obregon Park	34.03699	-118.17781	34.03692	-118.17781	OBG	0.42	0.11	Shakal et al., 1994
6	Potrero Canyon #3	34.39522	-118.66317	N/A	N/A	POT3	N/A	N/A	Not an SMA site
7	Receiving Station E	34.17723	-118.35790	34.17623	-118.35890	RSE	0.52	0.36	LRB, 1994
8	Sylmar Converter East #1	34.31077	-118.47986	34.31077	-118.47984	ESC	0.83	0.42	LRB, 1994
9	Sylmar Converter East #2	34.31288	-118.48089	N/A	N/A	ESC2	N/A	N/A	Not an SMA site
10	Tarzana	34.16048	-118.53440	34.160	-118.534	TAR	1.82	1.18	Shakal et al., 1994
11	Wadsworth VA Hospital North	34.05440	-118.45320	34.05440	-118.45313	WVAN	0.26	0.17	Porcella et al., 1994
12	Wadsworth VA Hospital South	34.04968	-118.44855	34.04968	-118.44845	WVAS	0.39	0.14	Porcella et al., 1994
13	Water Treatment Plant (Long Beach)	33.79800	-118.08840	33.79800	-118.08840	WTP	New station		Downhole Array

* Using 1927 North American Datum

P- AND *S*-WAVE TRAVEL-TIME DATA

Shear waves were generated at the ground surface by an air-powered horizontal ram (Liu, *et al.*, 1988) striking an anvil at either end of an aluminum channel 2.3 m long. The ram was driven first in one direction and then in the other to generate pulses of opposite polarity. A switch attached to the shear source triggered the recorder and established the reference for the timing of arrivals. *P*-waves were generated by striking a steel plate with a sledge hammer. The recorder was triggered by a switch attached to the handle of the sledge hammer. *P*- and *S*-wave sources were offset from the borehole (same horizontal distance but different locations) to minimize the effect of waves traveling down the grout surrounding the casing. The source offset was 4 meters at all sites except at the array sites where offsets varied from 2.5 to 5.0 meters depending on available space.

Downhole measurements were made at 2.5 m intervals (starting at 2 meters depth) with a three-component geophone clamped to the casing by an electrically-activated lever arm. A second three-component geophone was placed on the surface 5 to 10 m from the shear source for recording an on-scale reference trace (useful for amplitude studies and timing verification). The data were recorded on diskettes using a 12-channel recording system.

At four sites some of the P- and S-wave signals could not be interpreted because of interference from noise caused by nearby sources. At the COE and COW sites the noise was due to the heavy traffic on the freeway interchange. On the east side of the interchange the fast-moving truck traffic was less than 15 meters from the borehole and caused ground motions at frequencies very near those of the signal. As a result, the COE P-wave signal was lost to the noise at depths below 45 meters. Although the S-wave signals were noisy below 45 meters depth, the signal times could be picked with reasonable accuracy ($\pm 2 - 5msec$) over the entire depth of the borehole. On the west side of the interchange (COW) the heavy traffic was slightly farther from the borehole resulting in lower frequency noise that affected the S signal more than P. The P-wave signals were good, but below 60 meters the S-wave data were noisy making time-picks less certain. The ETEC borehole (RD7) was drilled to monitor ground water and the top 9 meters were cased with $10.5in$ ($26.7cm$) inside diameter steel casing. The first useable data point was obtained at 9.5 meters for P and at 12 meters for S. The velocity for the depth range for which data were missing represents an average velocity over the depth range. Below 9 meters the borehole is uncased exposing the mostly competent rocks of the Chatsworth formation. At Long Beach Water Treatment Plant the hole extended to a depth of 440 meters but unfortunately, local noise sources made it impossible to pick reliable P- and S-arrival times at depths below 100 meters.

DETERMINING VELOCITY PROFILES

The procedure for determining velocities is summarized in Figure 2. Because the orientation of the downhole geophone could not be controlled when moving from one depth to the next, the azimuth of the horizontal geophones relative to the source was unknown and changed with depth. To minimize the effects of those changes, the horizontal components were rotated to the direction that maximized the integral square amplitude within a time interval containing the shear wave (Boatwright *et al.*, 1986). *P*- and *S*-wave first-arrival times were determined from the time series displayed at each depth on a 20-

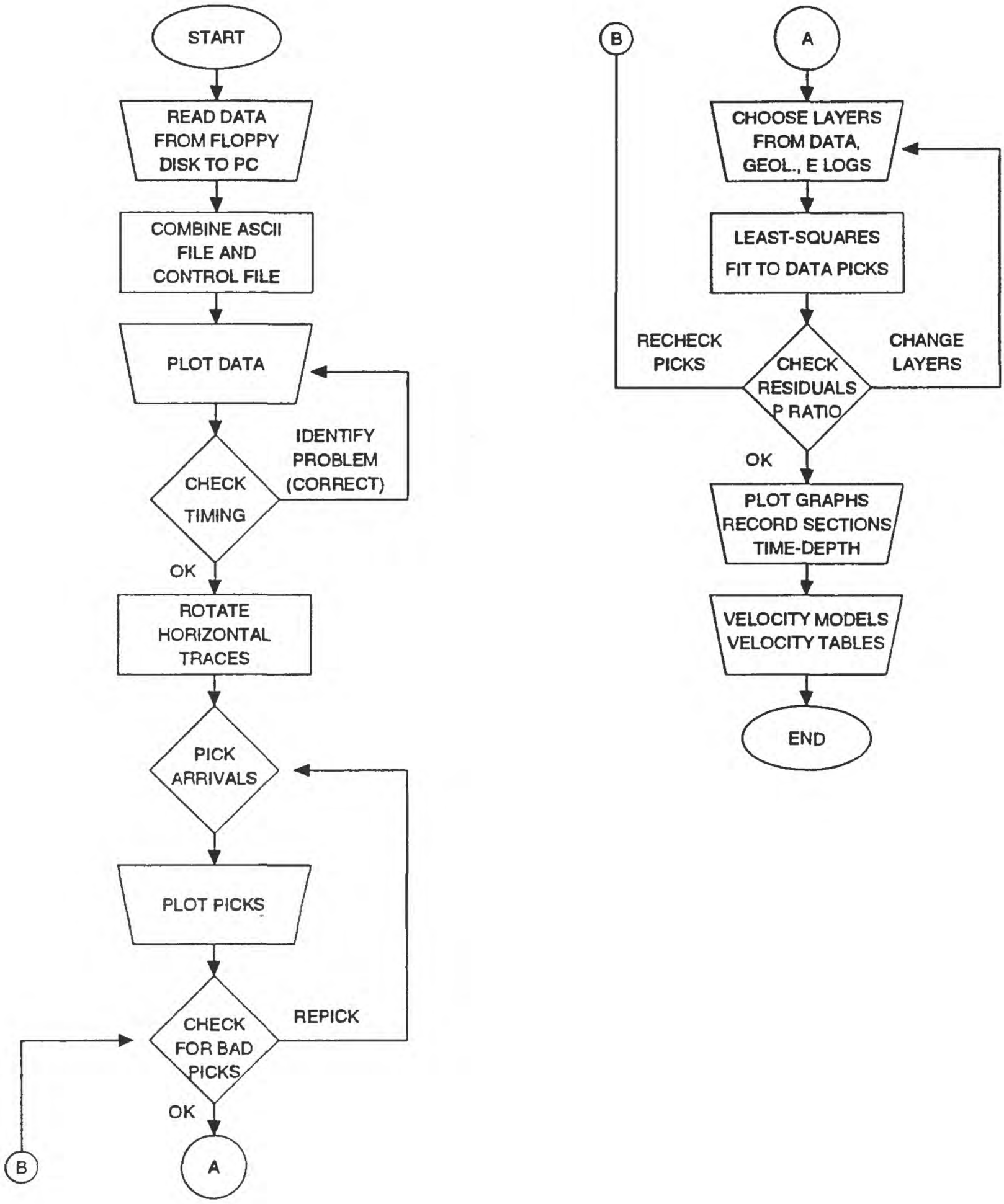

Figure 2. Flow-chart outlining the data processing and steps in the interpretation.

inch computer screen. The P-wave arrival-time was obtained from the vertical trace, and the S-wave arrival-times were obtained from the average of the rotated horizontal traces for ram strikes in opposite directions. The arrivals were timed to the nearest millisecond, probably a realistic precision for clear arrivals uncontaminated by noise.

A trial set of layer boundaries was chosen for the S-wave model, based on the lithologic descriptions and geophysical logs. The travel-time data were fit in a least-squares sense by a model made up of constant velocity layers, taking into account refraction across the interfaces between layers. The travel times were weighted by the inverse of an assigned normalized variance. A normalized standard deviation of 1 was assigned to the clear arrivals and values up to 5 were assigned to the others. The residuals were examined, and layer boundaries were added, if necessary, to reduce large residuals or to remove systematic trends in the residuals. This was an iterative process conducted by the team of authors of this report. The process continued until the team was satisfied that the interfaces were consistent with the borehole seismic data as well as the geological and geophysical logs. The P-wave travel time data were analyzed initially with the set of layer boundaries finally determined for the S-wave data. Layer boundaries were then added if needed to fit the data and deleted if not needed. Commonly, an additional layer boundary corresponding to the top of the zone of water saturation was needed to fit the P-wave data.

Some of the dynamic Poisson's ratios σ, calculated with initial velocity models, resulted in ratios that were out of the accepted range of values (0.0–0.5). To obtain a value in the acceptable range we made minor adjustments to the velocities using one or more of the following procedures: repicking shallow arrivals (usually P arrivals because small changes in P travel-times have greater effect on σ), adding a shallow layer, and/or adjusting layer thickness to ensure that Poisson's ratio was in the range 0.0–0.5. In most cases the small changes were made in the P-wave velocities at shallow depths (for more details see, Gibbs, et al., 1999). Overall, the changes in velocity required to produce acceptable values of σ were small and were only in a few layers.

SUMMARY VELOCITY PROFILES

Figures 3-5 show the S-wave velocity profiles determined from the borehole measurements at the thirteen sites. The velocity profiles are plotted at the same scale for ease of comparison. Figures 6-8 show the P-wave velocity profiles for the same sites as Figures 3-5, respectively.

DESCRIPTION OF APPENDICES

Appendix A contains for each site: a location map, S- and P-wave time-series records, a time-depth plot, velocity profiles with a generalized geologic log, and tables giving arrival times and velocity values. The upper and lower bounds on the velocity plots show approximate 68 percent confidence limits. The bounds are not symmetrical because they are based on the inverse velocities in the layers. Appendix B contains tables of P- and S-wave velocity models and the Poisson's ratios obtained from those models.

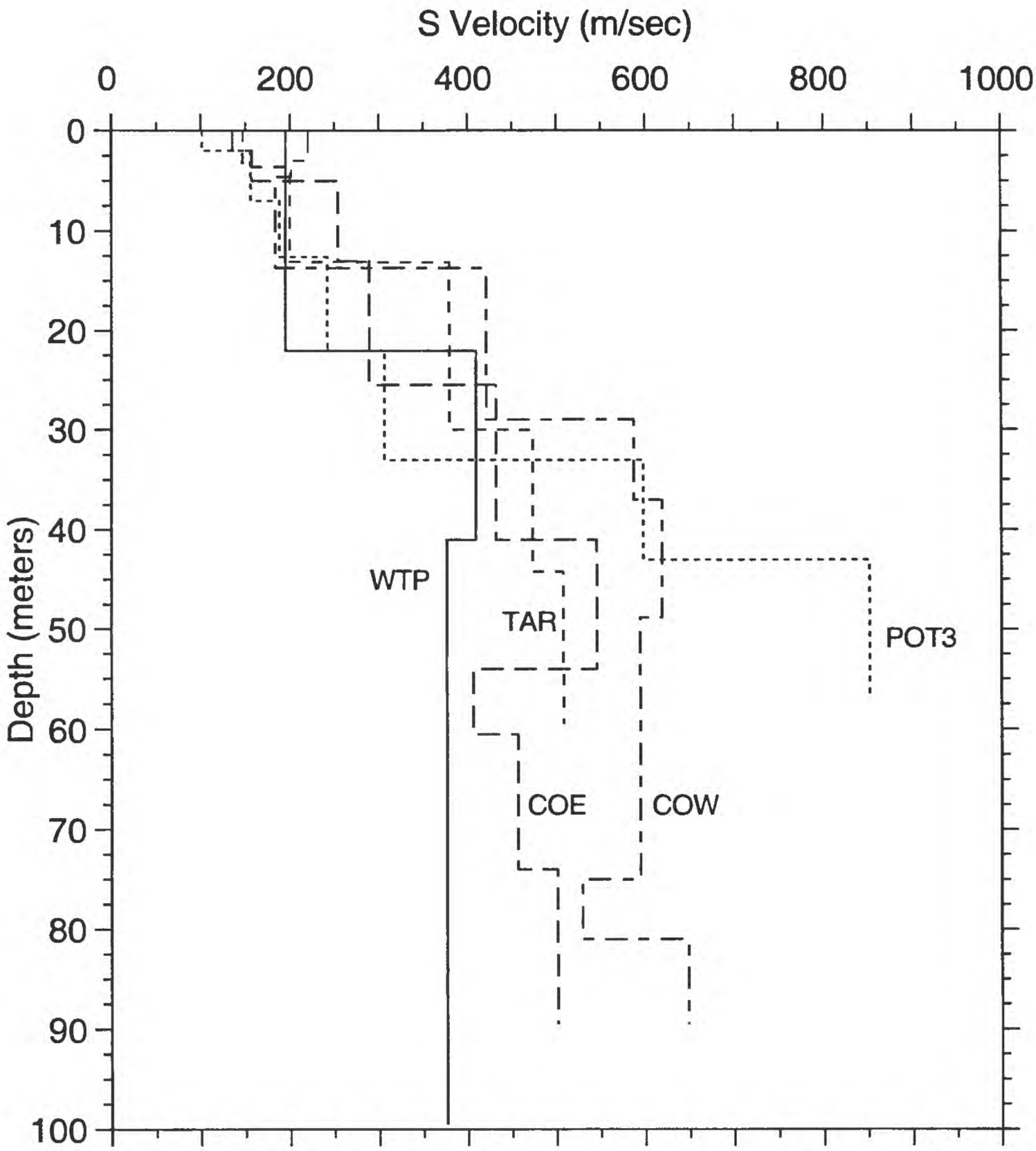

Figure 3. S-wave velocity models shown on the same figure for comparison.

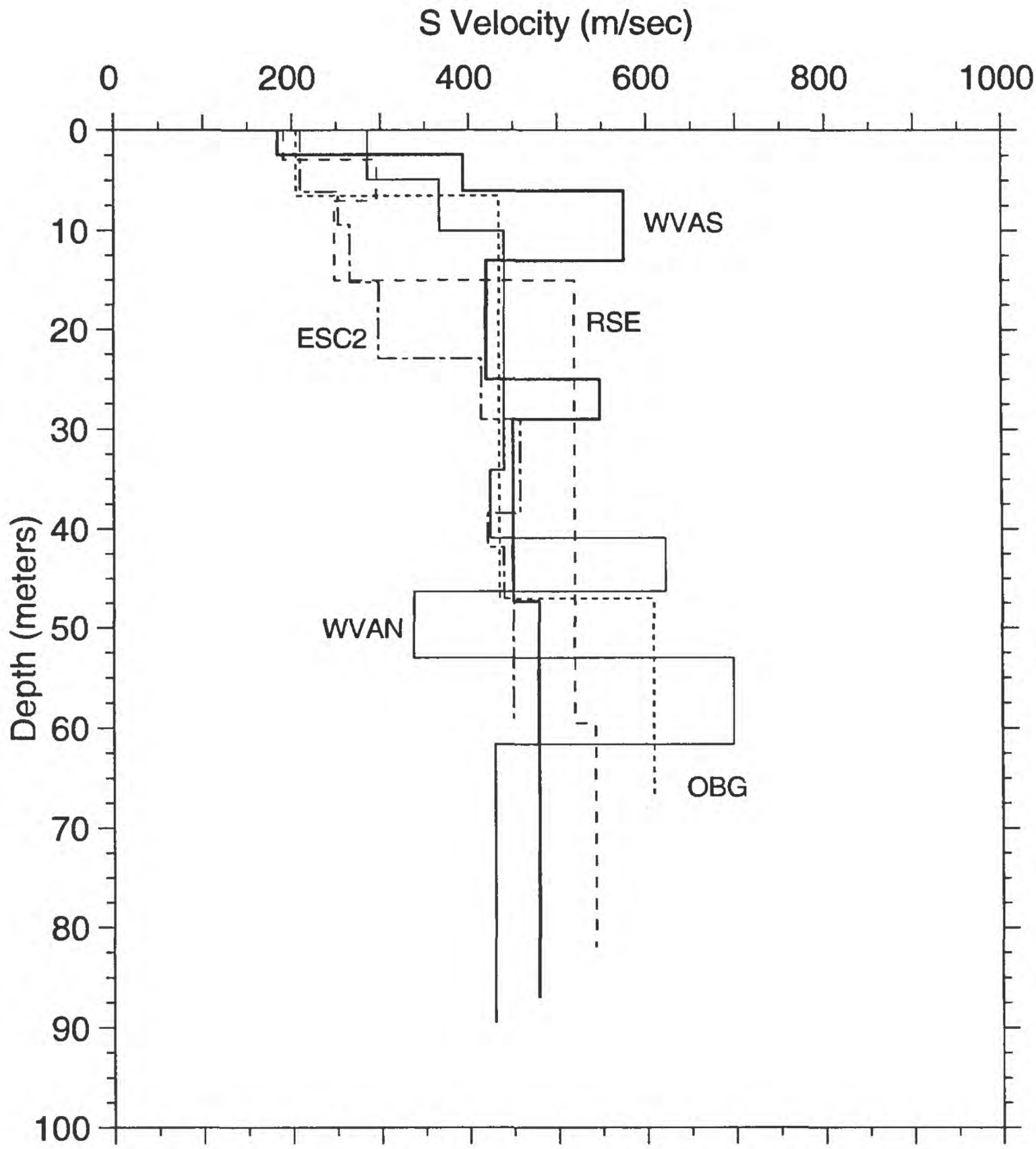

Figure 4. S-wave velocity models shown on the same figure for comparison.

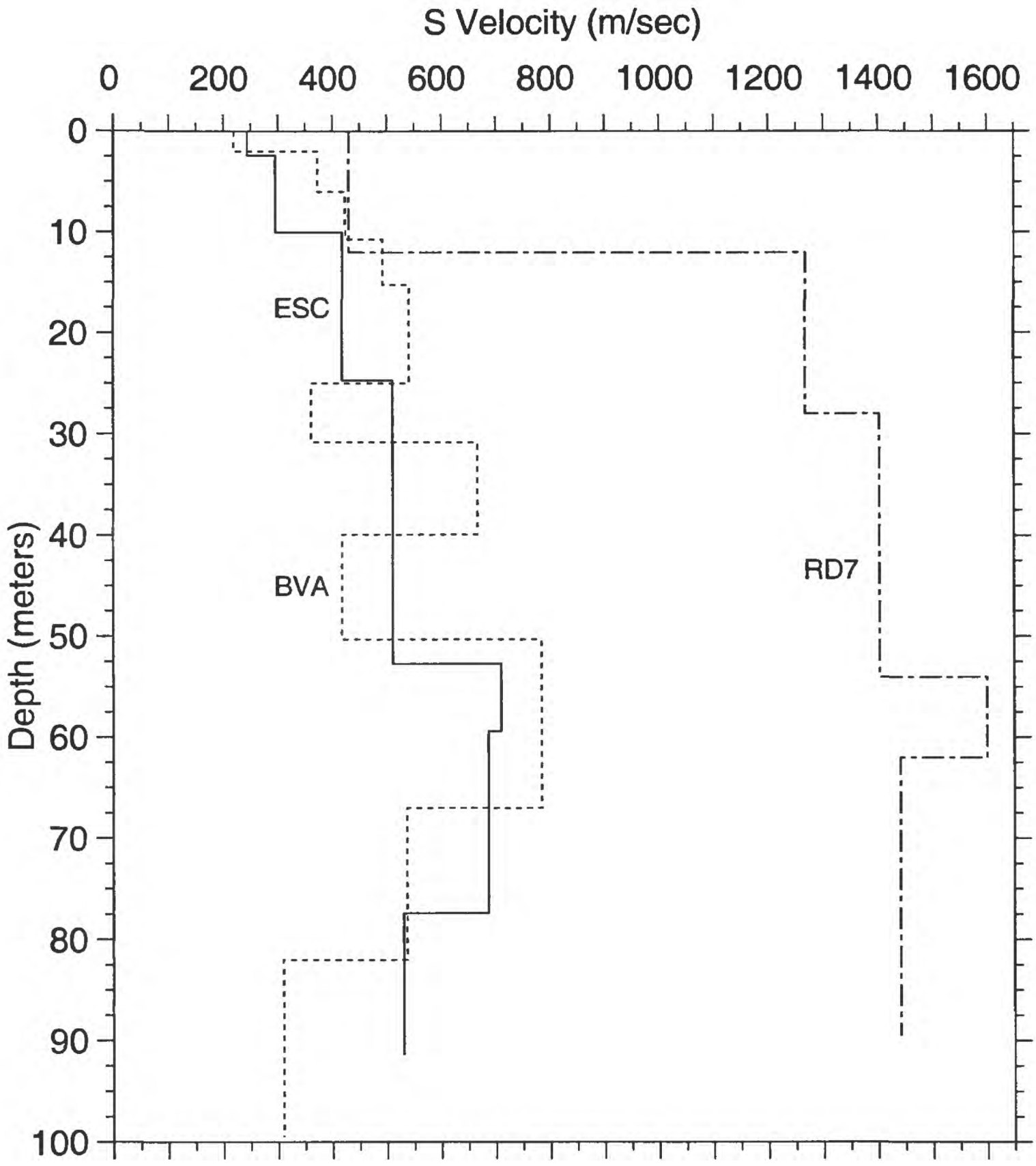

Figure 5. S-wave velocity models for sites ESC, BVA, and RD7.

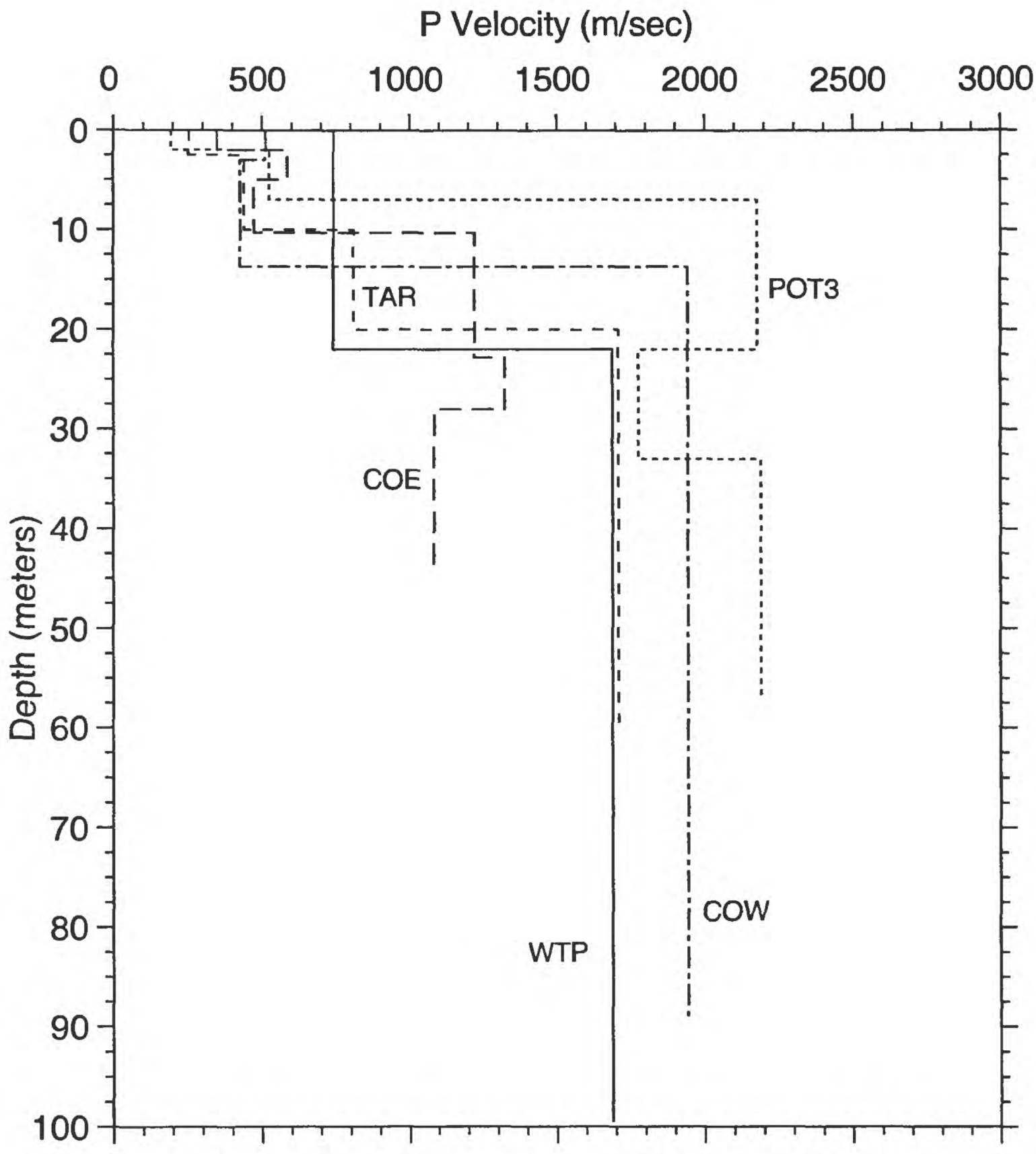

Figure 6. P-wave velocity models shown on the same figure for comparison.

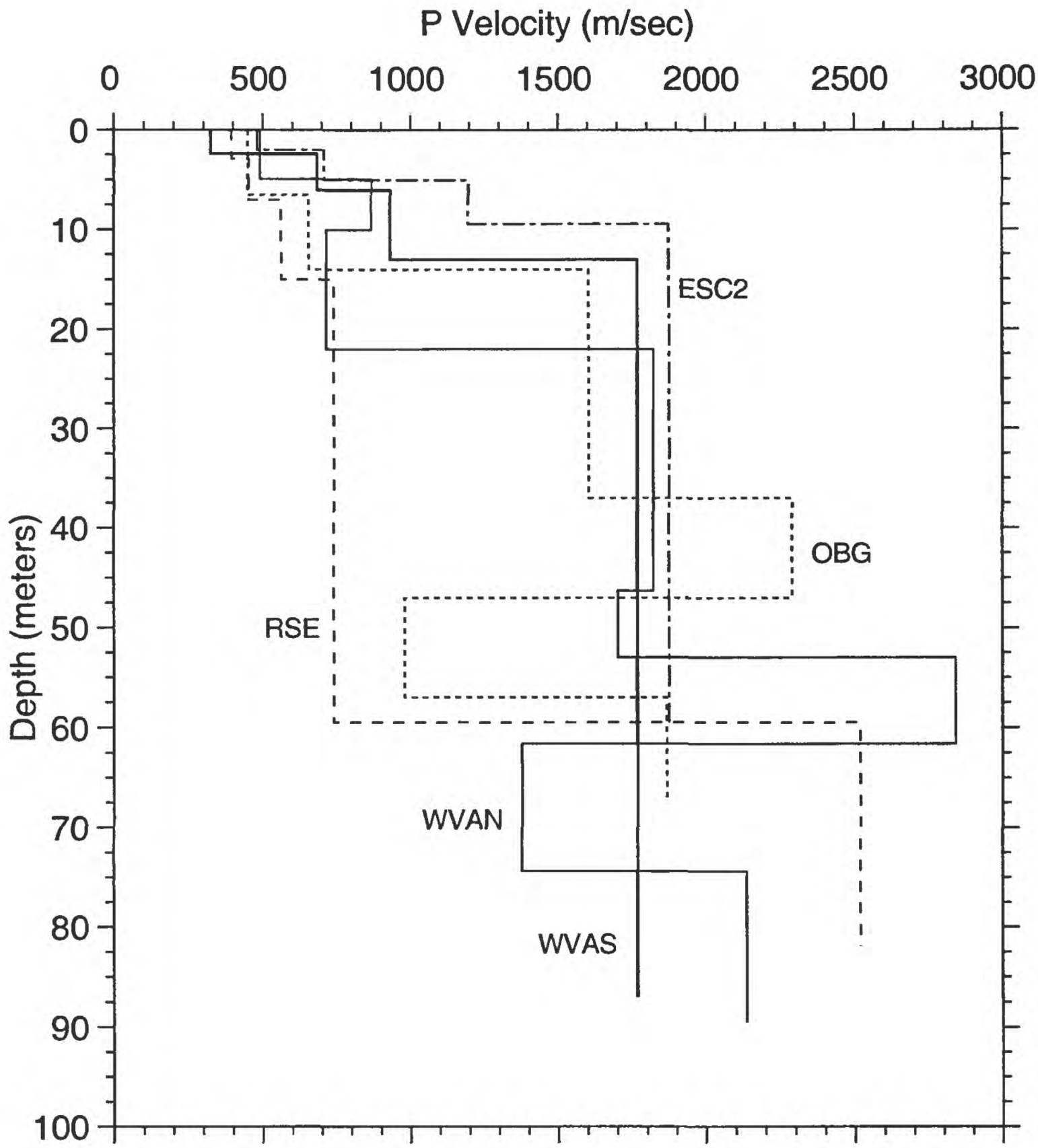

Figure 7. P-wave velocity models shown on the same figure for comparison.

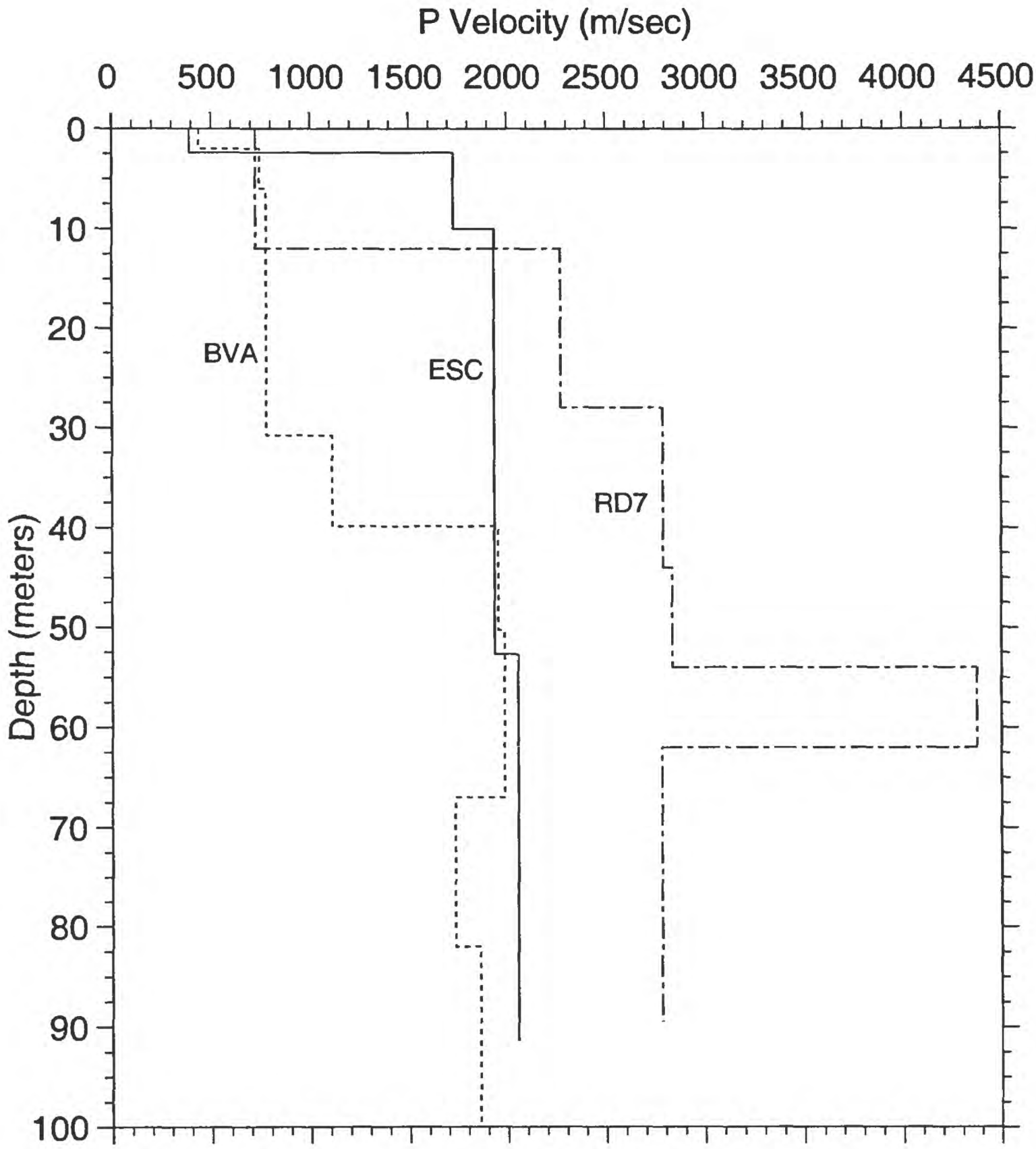

Figure 8. P-wave velocity models shown on the same figure for comparison.

ACKNOWLEDGMENTS

We could not have completed these studies without the assistance of many individuals who helped us to gain access to the sites, assisted with utilities clearances and granted permission to conduct the studies. These people include Michael Lambert and John Fitzgerald of the Veterans Administration (Brentwood and Wadsworth VA Hospital sites); Ron Tognazzini and Jeffrey Owen of the Los Angeles Department of Water and Power (Receiving Station E and both East Sylmar Converter sites); Eric Hipley and Cliff Roblee of the California Department of Transportation (Colton East, Colton West); Jamison Steidl of the University of California, Santa Barbara (Obregon Park); Anthony Shakal and Vladimir Graizer of the California Division of Mines and Geology (Tarzana); Kendall S. Robinson, Michael W. McDowell and Neil Mukherjee of the Rocketdyne Division of Boeing Corporation (ETEC, RD-7); Daniel Ponti and Eric Reichard of the USGS for facilitating access to the Long Beach Water Treatment Plant FOQUS core hole through their contacts at the City of Long Beach. Robert Nigbor, Robert Steller, and Alexander Jack supplied logs of boreholes and related geophysical data from sites explored jointly with the ROSRINE (Resolution of Site Response Issues in the Northridge Earthquake) consortium and Pacific Gas and Electric (Potrero Canyon 3). Drilling and sampling services were provided by California Department of Transportation (Colton sites and Obregon Park); California Division of Mines and Geology (Tarzana); and the U.S. Geological Survey (Steve Crawford) at the Water Treatment Plant.

We also thank Robert Westerlund of the U.S. Geological Survey for his help with the S- and P-wave velocity logging and Ronald Porcella of the U.S. Geological Survey for assistance with obtaining peak ground motion parameters at Northridge earthquake sites. All ROSRINE data are available on the ROSRINE web site at: [http://geoinfo.usc.edu/rosrine].

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APPENDIX—A

Detailed Results

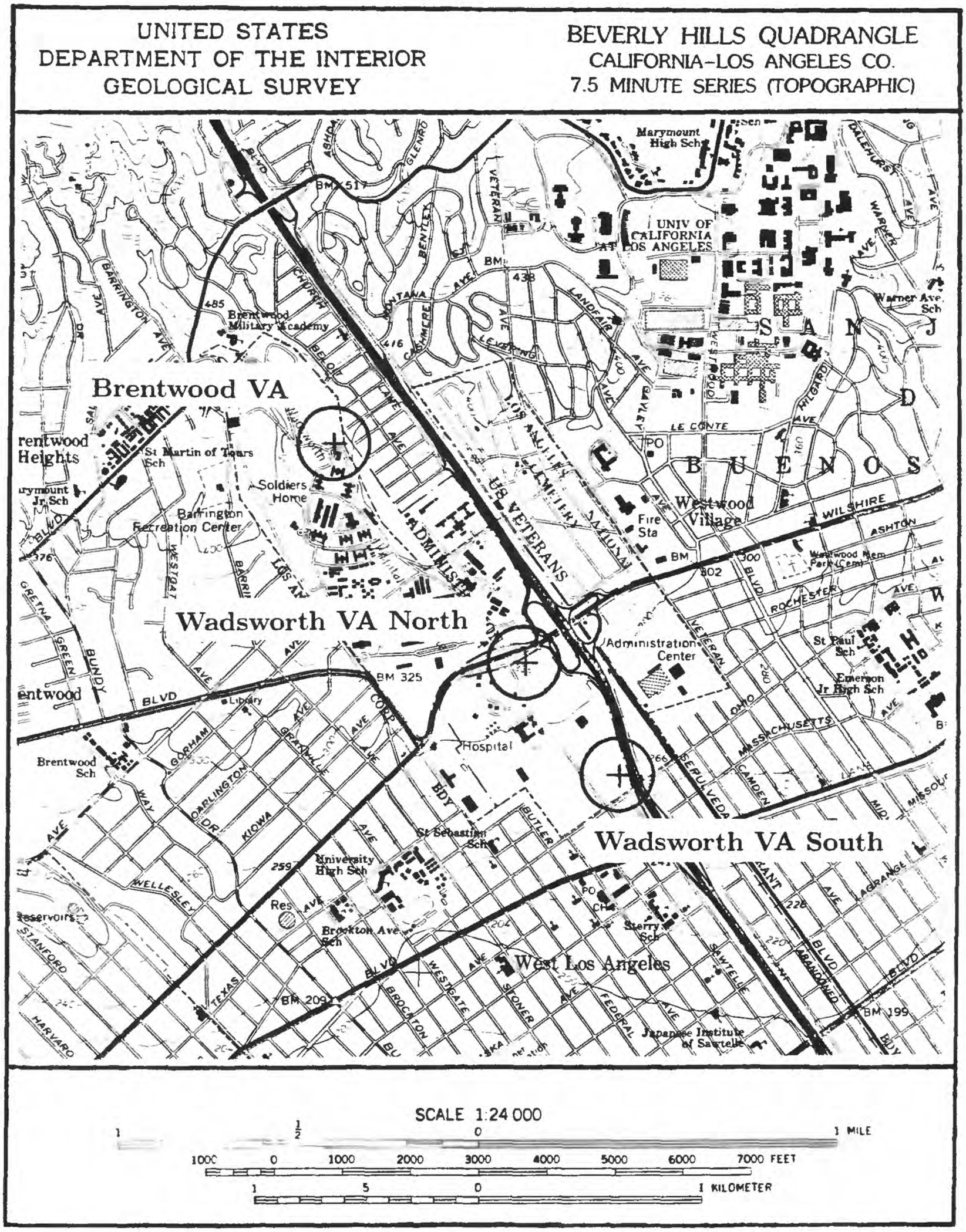

Figure A-1. Site location map for the borehole at Brentwood VA Hospital. The accelerograph is located approximately 40 meters from the borehole.

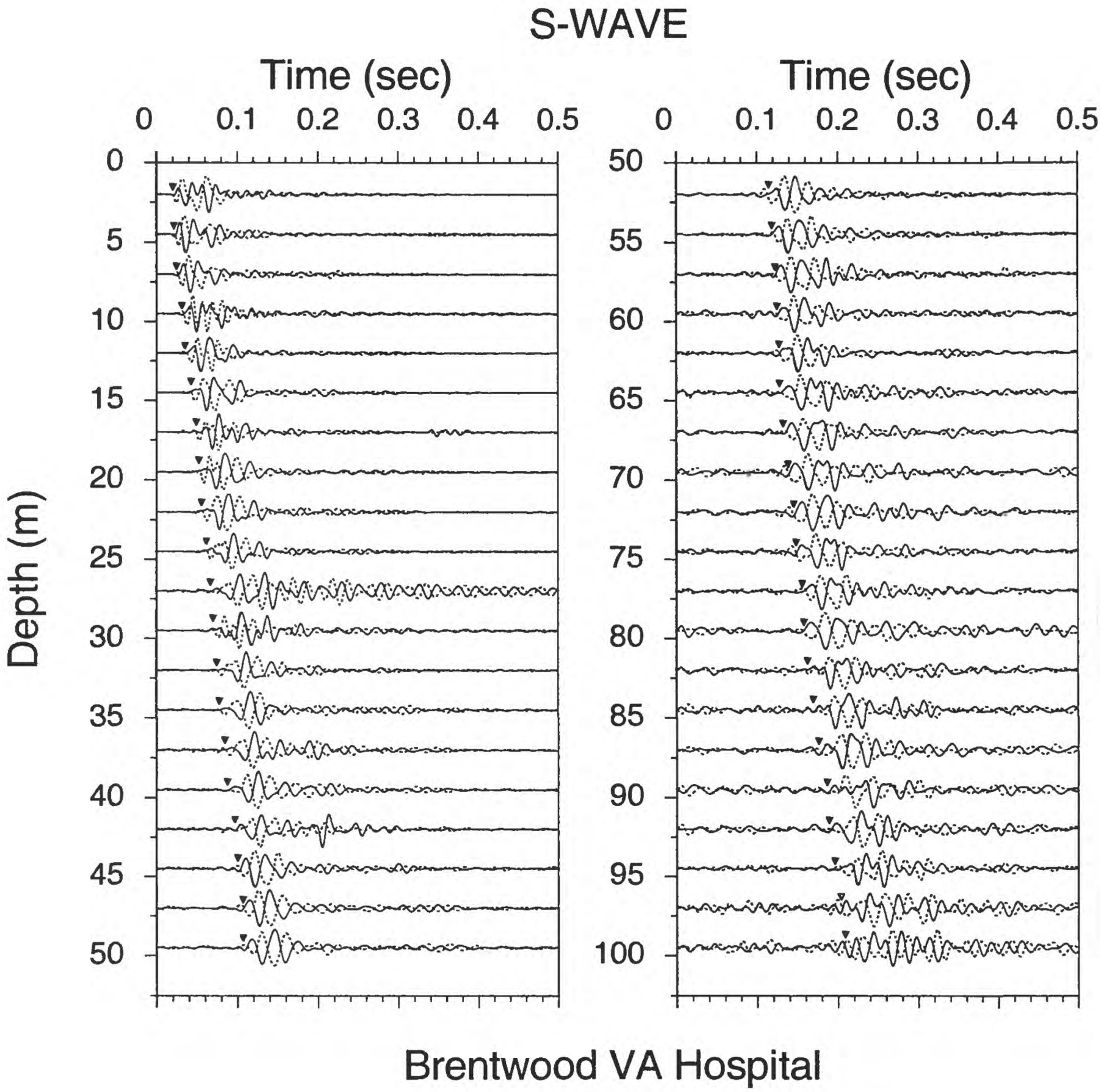

Figure A-2. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles. Time picks with assigned weight of 5 are shown with unfilled triangles.

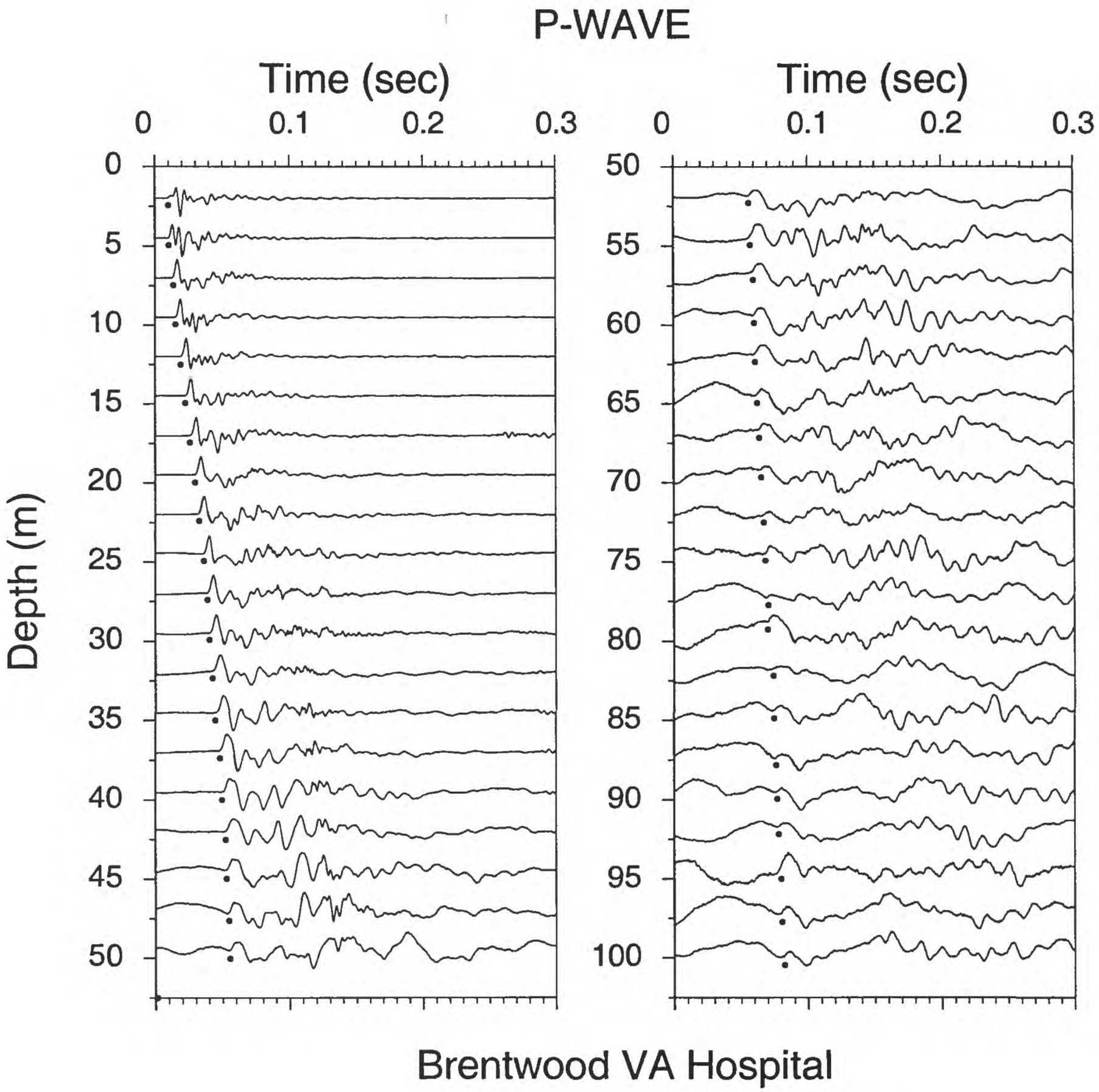

Figure A-3. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

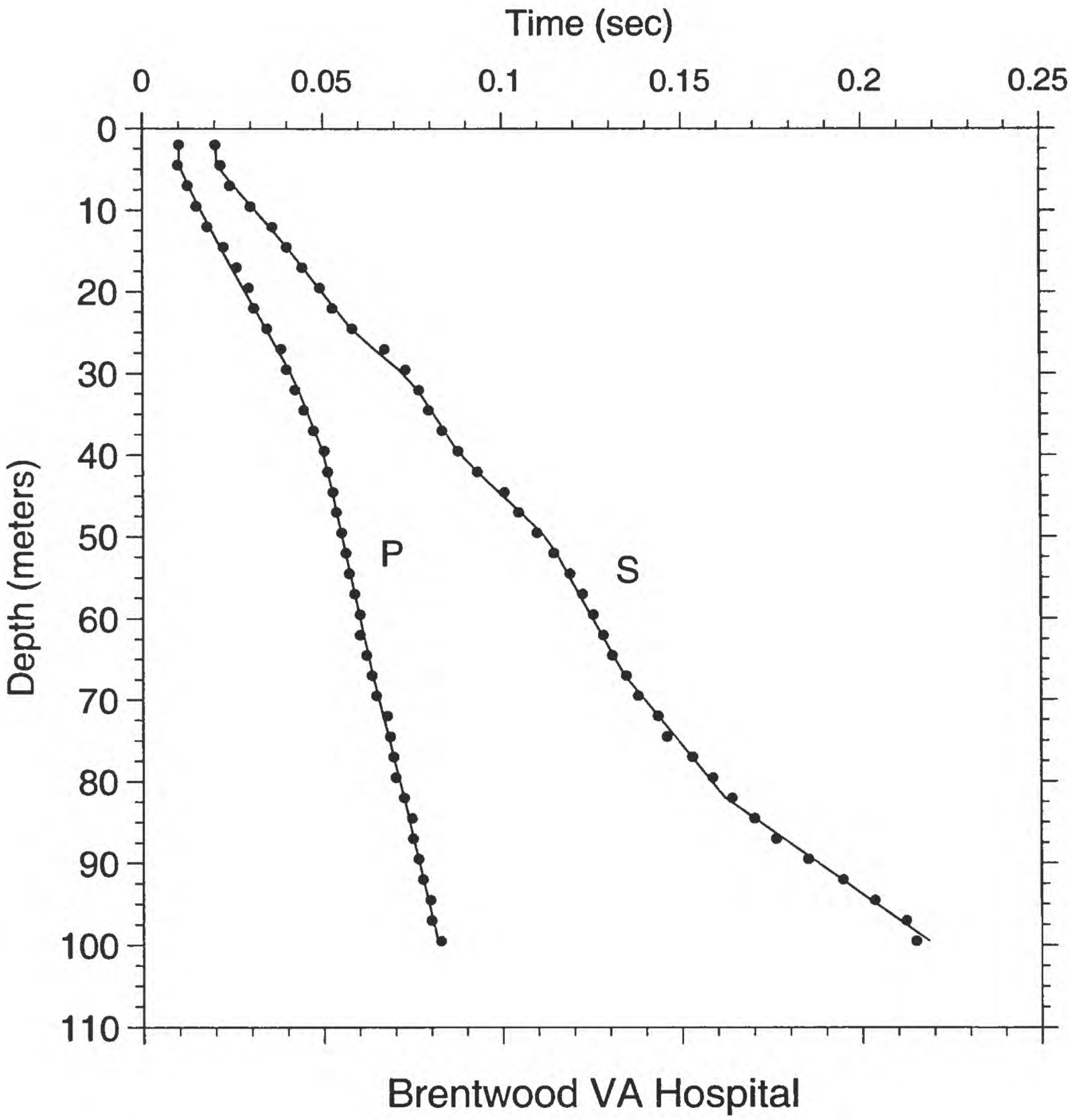

Figure A-4. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

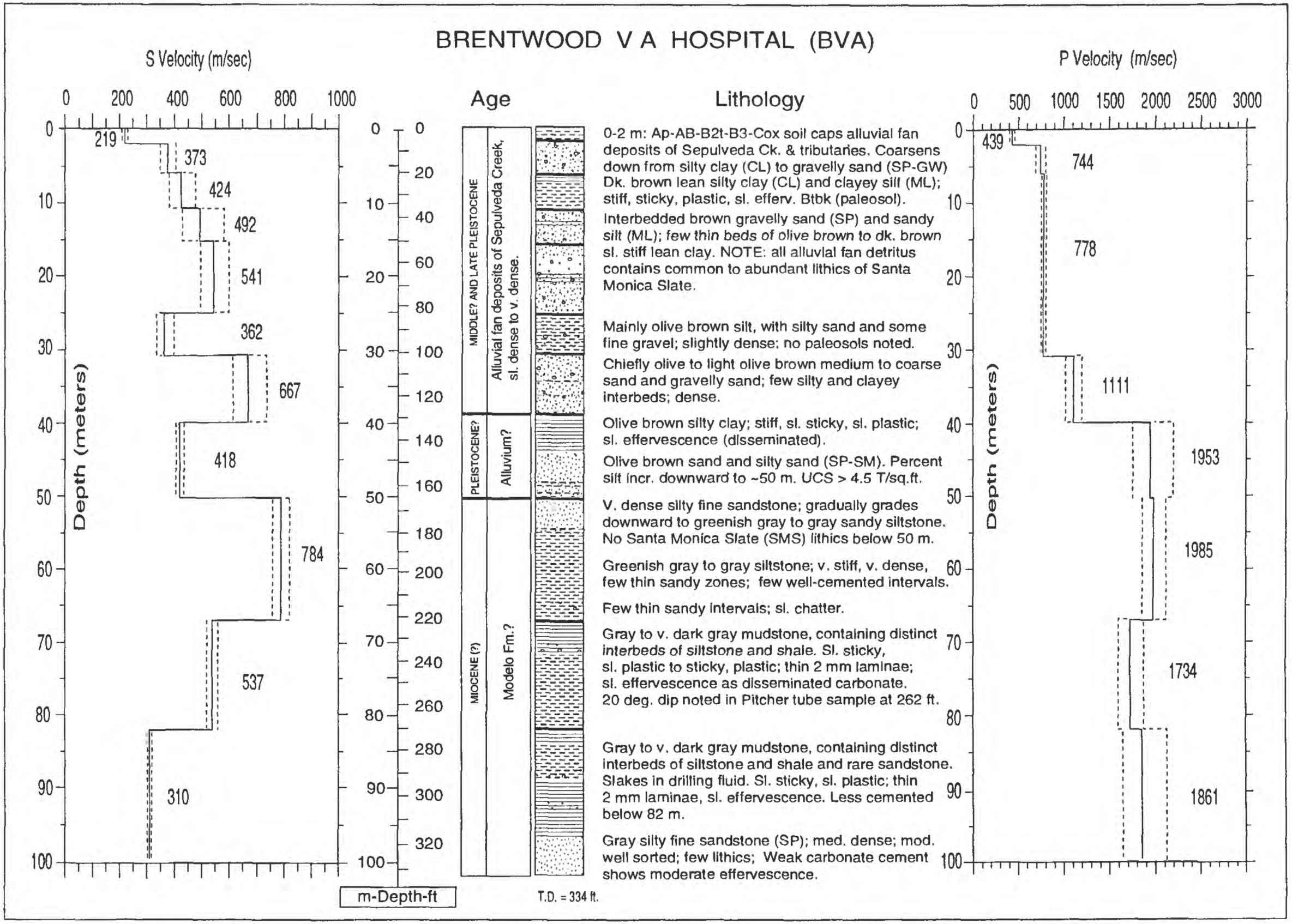

Figure A-5. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-1. S-wave arrival times and velocity summaries.

Location: Brentwood VA Hospital: S Coordinates: 34.06320 -118.46240 Hole_Code: 290
hoffset = 4.00 travel-time file: D:\BVA\BVAS.TT
nlayers = 11

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0203	0.0091	219	1	-0.0001	2.0	2.0	219	210	229	6.6	6.6	720	690	753
4.5	14.8	0.0217	0.0158	284	1	0.0011	6.0	4.0	373	347	403	19.7	13.1	1225	1140	1324
7.0	23.0	0.0243	0.0222	315	1	-0.0011	10.7	4.7	424	382	476	35.1	15.4	1390	1252	1563
9.5	31.2	0.0300	0.0281	338	1	-0.0003	15.2	4.5	492	428	579	49.9	14.8	1615	1405	1899
12.0	39.4	0.0360	0.0336	357	1	0.0007	25.0	9.8	541	494	598	82.0	32.2	1776	1622	1962
14.5	47.6	0.0400	0.0387	375	2	0.0000	30.8	5.8	362	333	396	101.0	19.0	1188	1093	1300
17.0	55.8	0.0443	0.0434	392	1	-0.0002	39.9	9.1	667	612	733	130.9	29.9	2189	2008	2406
19.5	64.0	0.0492	0.0480	406	1	0.0003	50.3	10.4	418	403	434	165.0	34.1	1372	1322	1425
22.0	72.2	0.0527	0.0527	418	1	-0.0007	67.0	16.7	784	754	817	219.8	54.8	2574	2475	2680
24.5	80.4	0.0582	0.0573	428	2	0.0003	82.0	15.0	537	517	558	269.0	49.2	1761	1697	1830
27.0	88.6	0.0672	0.0637	424	3	0.0029	99.5	17.5	310	300	320	326.4	57.4	1016	985	1050
29.5	96.8	0.0730	0.0706	418	2	0.0018										
32.0	105.0	0.0768	0.0760	421	1	0.0002										
34.5	113.2	0.0795	0.0798	432	1	-0.0007										
37.0	121.4	0.0833	0.0835	443	1	-0.0007										
39.5	129.6	0.0878	0.0873	453	1	0.0001										
42.0	137.8	0.0932	0.0929	452	2	0.0000										
44.5	146.0	0.1007	0.0989	450	1	0.0016										
47.0	154.2	0.1047	0.1049	448	1	-0.0004										
49.5	162.4	0.1098	0.1108	447	1	-0.0014										
52.0	170.6	0.1145	0.1149	453	1	-0.0007										
54.5	178.8	0.1190	0.1181	461	1	0.0007										
57.0	187.0	0.1225	0.1213	470	1	0.0010										
59.5	195.2	0.1255	0.1245	478	1	0.0008										
62.0	203.4	0.1283	0.1277	486	2	0.0004										
64.5	211.6	0.1308	0.1309	493	2	-0.0003										
67.0	219.8	0.1347	0.1340	500	1	0.0005										
69.5	228.0	0.1380	0.1387	501	1	-0.0009										
72.0	236.2	0.1435	0.1434	502	1	0.0000										
74.5	244.4	0.1460	0.1480	503	1	-0.0022										
77.0	252.6	0.1530	0.1527	504	1	0.0002										
79.5	260.8	0.1587	0.1573	505	1	0.0013										
82.0	269.0	0.1640	0.1620	506	3	0.0019										
84.5	277.2	0.1702	0.1700	497	2	0.0001										
87.0	285.4	0.1762	0.1781	488	2	-0.0020										
89.5	293.6	0.1850	0.1862	481	4	-0.0013										
92.0	301.8	0.1947	0.1942	474	1	0.0004										
94.5	310.0	0.2035	0.2023	467	4	0.0011										
97.0	318.2	0.2122	0.2104	461	5	0.0017										
99.5	326.4	0.2150	0.2184	456	5	-0.0036										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-2. P-wave arrival times and velocity summaries.

Location: Brentwood VA Hospital: P Coordinates: 34.06320 -118.46240 Hole_Code: 290
hoffset = 4.00 travel-time file: D:\BVA\BVAP.TT
nlayers = 8

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0102	0.0046	439	1	0.0000	2.0	2.0	439	415	465	6.6	6.6	1440	1363	1526
4.5	14.8	0.0099	0.0079	568	1	-0.0004	6.0	4.0	744	695	802	19.7	13.1	2442	2279	2630
7.0	23.0	0.0126	0.0112	624	1	-0.0002	30.8	24.8	778	764	792	101.0	81.4	2552	2507	2598
9.5	31.2	0.0150	0.0144	658	1	-0.0006	39.9	9.1	1111	1029	1206	130.9	29.9	3644	3377	3957
12.0	39.4	0.0180	0.0176	680	1	-0.0006	50.3	10.4	1953	1760	2195	165.0	34.1	6409	5774	7201
14.5	47.6	0.0225	0.0209	695	2	0.0009	67.0	16.7	1985	1864	2122	219.8	54.8	6512	6116	6962
17.0	55.8	0.0261	0.0241	706	1	0.0014	82.0	15.0	1734	1607	1883	269.0	49.2	5689	5273	6177
19.5	64.0	0.0294	0.0273	715	1	0.0016	99.5	17.5	1861	1654	2127	326.4	57.4	6106	5427	6980
22.0	72.2	0.0309	0.0305	721	1	-0.0001										
24.5	80.4	0.0345	0.0337	727	2	0.0003										
27.0	88.6	0.0384	0.0369	731	3	0.0011										
29.5	96.8	0.0399	0.0401	735	2	-0.0006										
32.0	105.0	0.0423	0.0429	746	1	-0.0009										
34.5	113.2	0.0447	0.0451	764	1	-0.0007										
37.0	121.4	0.0474	0.0474	781	1	-0.0003										
39.5	129.6	0.0504	0.0496	796	1	0.0005										
42.0	137.8	0.0513	0.0511	822	2	0.0000										
44.5	146.0	0.0528	0.0524	850	1	0.0002										
47.0	154.2	0.0537	0.0536	876	1	-0.0001										
49.5	162.4	0.0552	0.0549	901	1	0.0001										
52.0	170.6	0.0564	0.0562	926	1	0.0001										
54.5	178.8	0.0573	0.0574	949	1	-0.0003										
57.0	187.0	0.0588	0.0587	971	1	0.0000										
59.5	195.2	0.0603	0.0600	992	1	0.0002										
62.0	203.4	0.0603	0.0612	1013	2	-0.0010										
64.5	211.6	0.0621	0.0625	1032	2	-0.0005										
67.0	219.8	0.0636	0.0637	1051	1	-0.0002										
69.5	228.0	0.0648	0.0652	1066	1	-0.0005										
72.0	236.2	0.0678	0.0666	1081	1	0.0011										
74.5	244.4	0.0687	0.0681	1095	1	0.0005										
77.0	252.6	0.0696	0.0695	1108	1	0.0000										
79.5	260.8	0.0702	0.0709	1121	1	-0.0008										
82.0	269.0	0.0725	0.0724	1133	3	0.0000										
84.5	277.2	0.0747	0.0737	1146	2	0.0009										
87.0	285.4	0.0750	0.0751	1159	2	-0.0001										
89.5	293.6	0.0765	0.0764	1171	4	0.0000										
92.0	301.8	0.0777	0.0778	1183	1	-0.0001										
94.5	310.0	0.0798	0.0791	1195	4	0.0006										
97.0	318.2	0.0801	0.0804	1206	5	-0.0004										
99.5	326.4	0.0828	0.0818	1217	5	0.0009										

Explanation:

- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

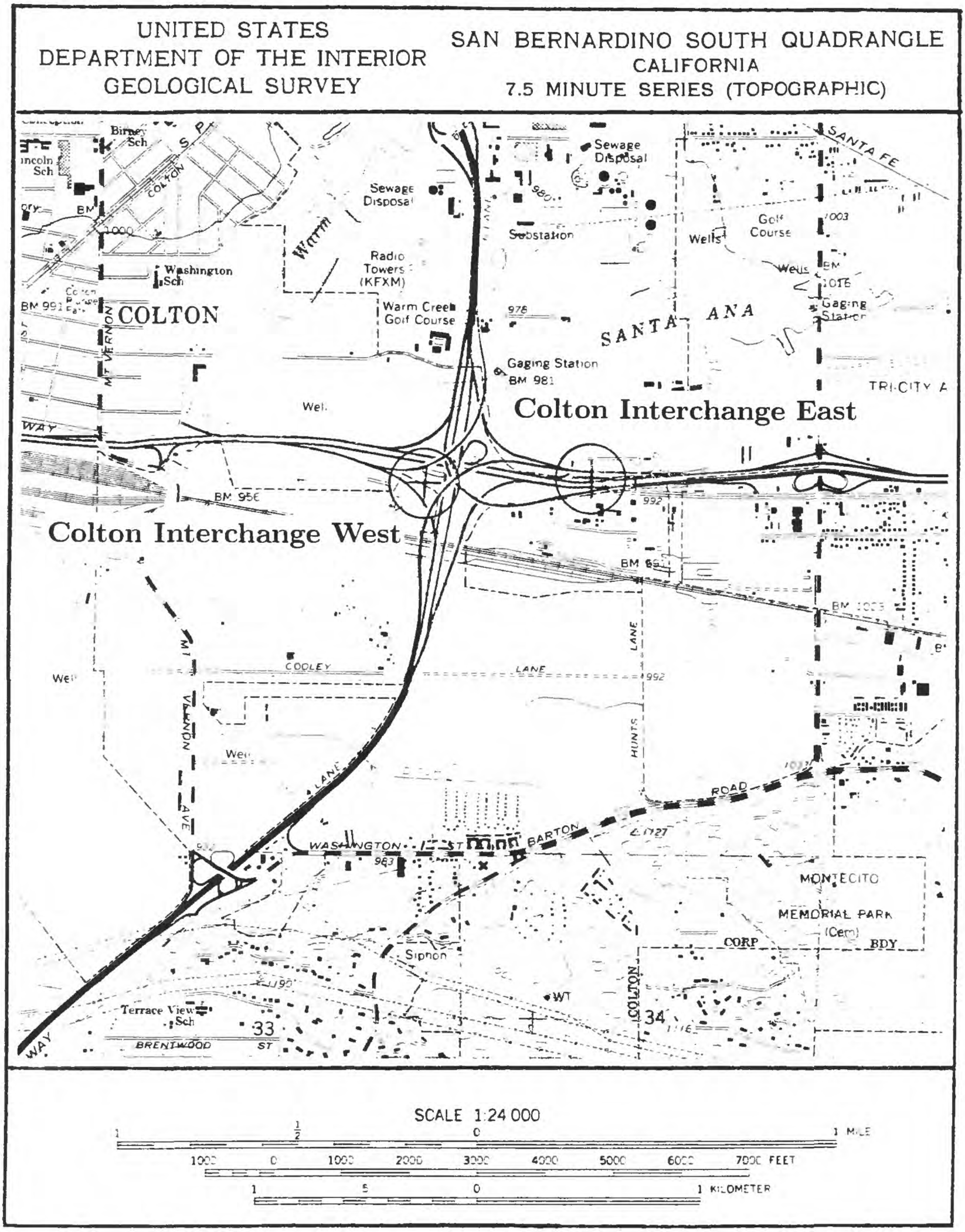

Figure A-6. Site location map for the borehole at Colton Interchange East. The boreholes at this site will be instrumented at several depths and at the surface to monitor future seismic activity.

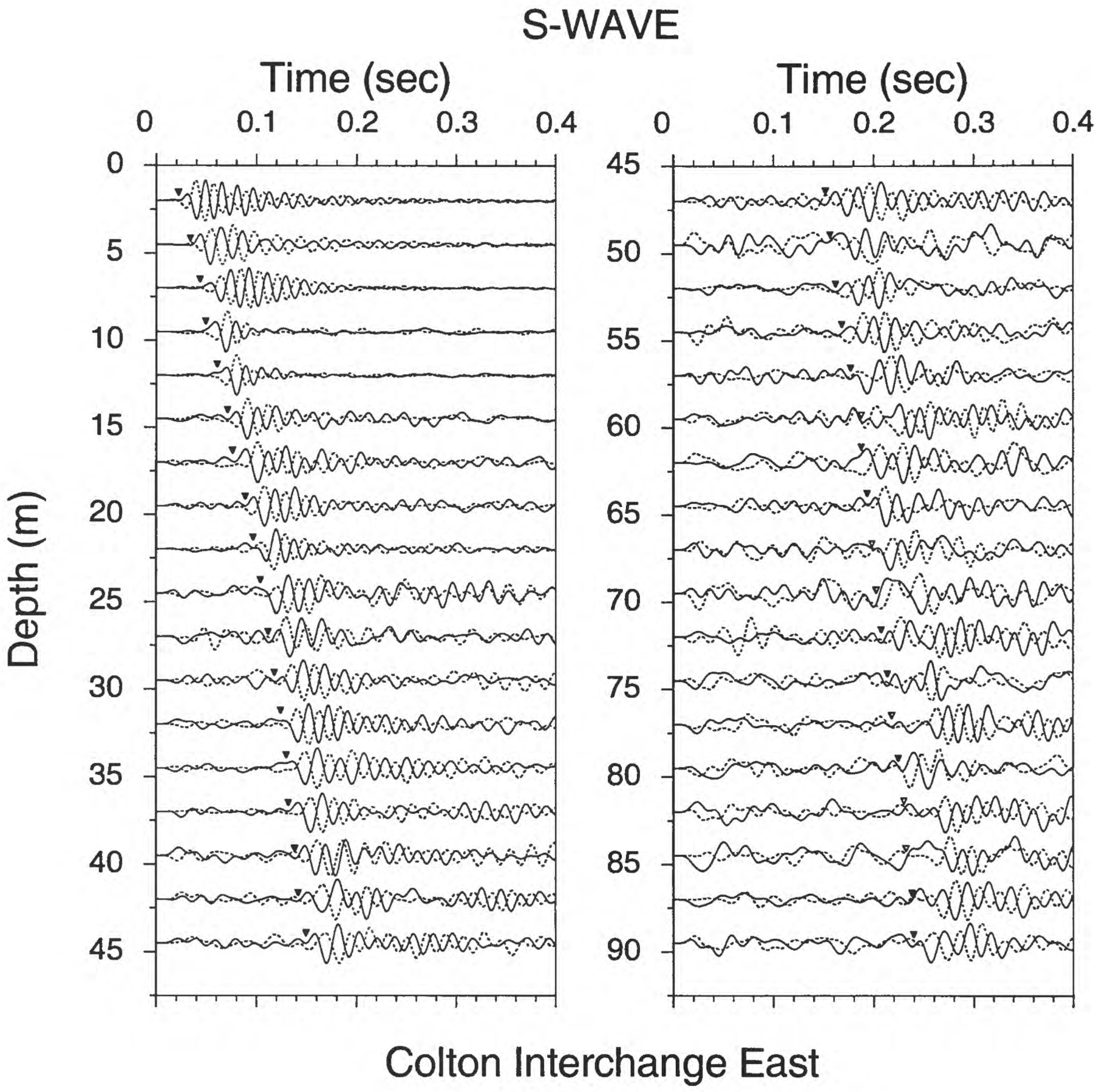

Figure A-7. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles. Time picks with assigned weight of 4 or 5 are shown with unfilled triangles.

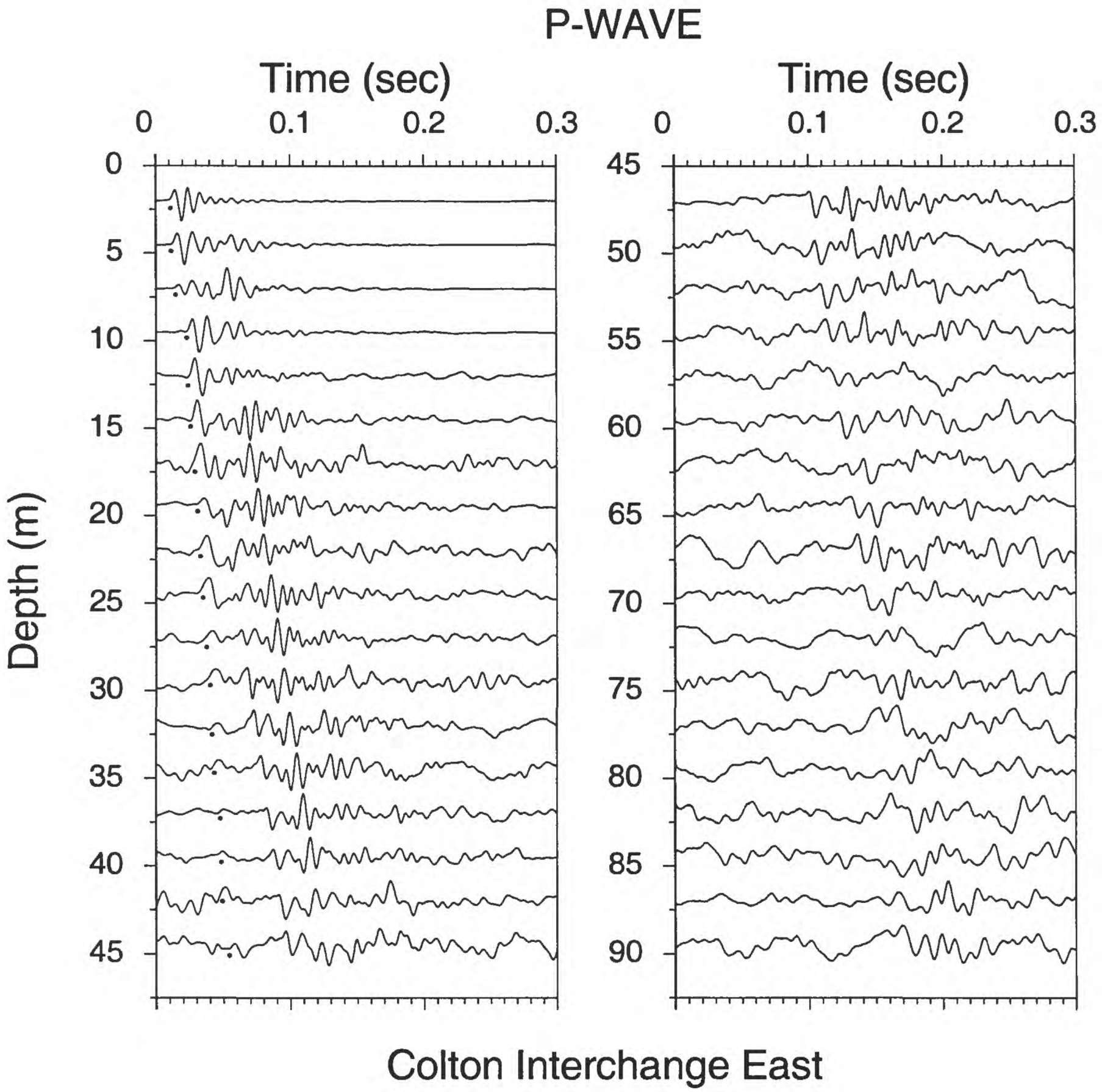

Figure A-8. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles. Lost signal to the noise at 47 meters depth.

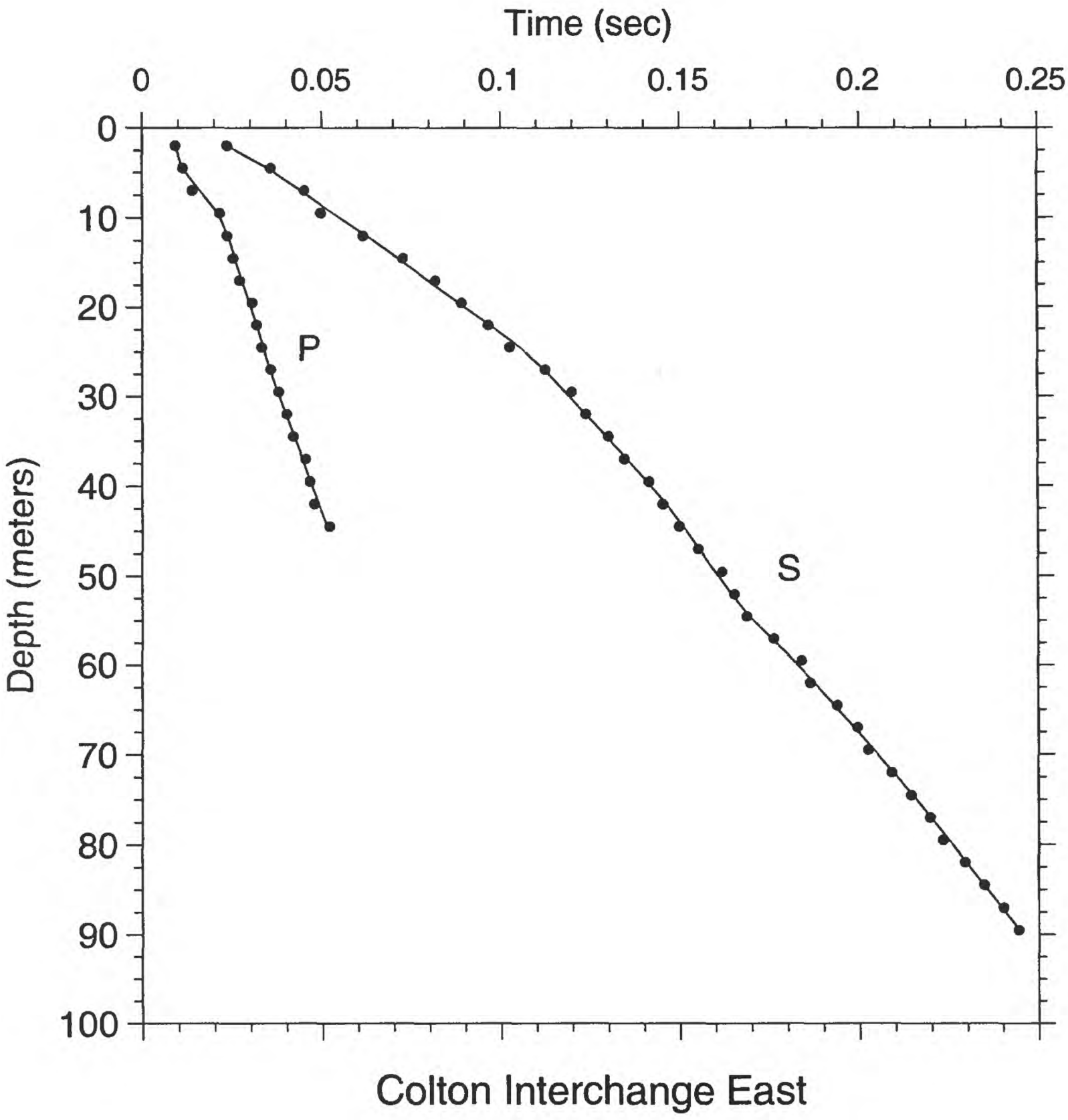

Figure A-9. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

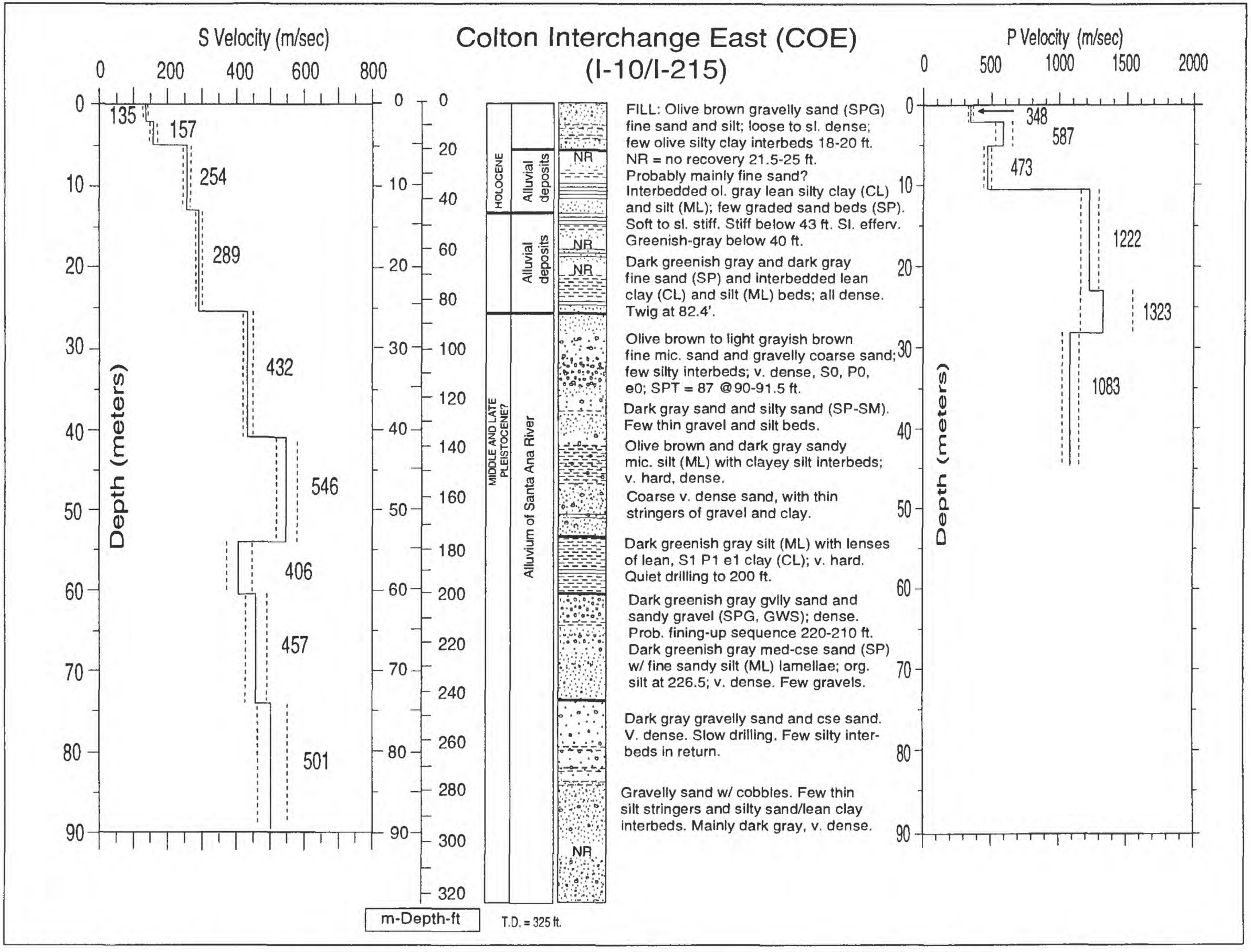

Figure A-10. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-3. S-wave arrival times and velocity summaries.

Location: Colton Interchange East: S Coordinates: 34.06371 -117.28894 Hole_Code: 292
hoffset = 2.50 travel-time file: E:\COLTON_E\COES.TT
nlayers = 9

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0236	0.0148	135	1	-0.0001	2.0	2.0	135	129	143	6.6	6.6	444	422	468
4.5	14.8	0.0358	0.0307	146	1	0.0008	5.0	3.0	157	148	169	16.4	9.8	517	484	553
7.0	23.0	0.0452	0.0418	167	1	0.0011	13.0	8.0	254	244	266	42.7	26.2	835	799	873
9.5	31.2	0.0498	0.0516	184	1	-0.0034	25.5	12.5	289	282	297	83.7	41.0	949	924	976
12.0	39.4	0.0616	0.0615	195	1	-0.0010	41.0	15.5	432	419	447	134.5	50.9	1419	1374	1466
14.5	47.6	0.0728	0.0706	205	1	0.0014	54.0	13.0	546	518	577	177.2	42.7	1792	1700	1893
17.0	55.8	0.0818	0.0793	214	1	0.0019	60.5	6.5	406	372	448	198.5	21.3	1333	1220	1469
19.5	64.0	0.0892	0.0879	222	1	0.0008	74.0	13.5	457	429	490	242.8	44.3	1500	1406	1609
22.0	72.2	0.0966	0.0966	228	1	-0.0004	89.5	15.5	501	462	547	293.6	50.9	1643	1516	1794
24.5	80.4	0.1026	0.1052	233	1	-0.0029										
27.0	88.6	0.1126	0.1121	241	1	0.0002										
29.5	96.8	0.1200	0.1179	250	1	0.0019										
32.0	105.0	0.1240	0.1237	259	1	0.0001										
34.5	113.2	0.1302	0.1295	266	1	0.0006										
37.0	121.4	0.1348	0.1353	273	1	-0.0006										
39.5	129.6	0.1416	0.1411	280	1	0.0005										
42.0	137.8	0.1454	0.1464	287	1	-0.0010										
44.5	146.0	0.1500	0.1510	295	2	-0.0010										
47.0	154.2	0.1552	0.1555	302	3	-0.0003										
49.5	162.4	0.1620	0.1601	309	3	0.0019										
52.0	170.6	0.1654	0.1647	316	1	0.0008										
54.5	178.8	0.1688	0.1696	321	1	-0.0007										
57.0	187.0	0.1762	0.1758	324	3	0.0005										
59.5	195.2	0.1840	0.1819	327	4	0.0022										
62.0	203.4	0.1864	0.1877	330	1	-0.0012										
64.5	211.6	0.1938	0.1931	334	1	0.0008										
67.0	219.8	0.1994	0.1986	337	1	0.0009										
69.5	228.0	0.2024	0.2041	341	4	-0.0015										
72.0	236.2	0.2090	0.2095	344	1	-0.0004										
74.5	244.4	0.2144	0.2149	347	3	-0.0004										
77.0	252.6	0.2196	0.2199	350	4	-0.0002										
79.5	260.8	0.2232	0.2249	354	3	-0.0015										
82.0	269.0	0.2294	0.2299	357	4	-0.0003										
84.5	277.2	0.2348	0.2349	360	4	0.0001										
87.0	285.4	0.2402	0.2399	363	2	0.0005										
89.5	293.6	0.2444	0.2448	366	3	-0.0003										

Explanation:

- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-4. P-wave arrival times and velocity summaries.

Location: Colton Interchange East: P Coordinates: 34.06371 -117.28894 Hole_Code: 292
hoffset = 2.50 travel-time file: E:\COLTON_E\VERT\COEP.TT
nlayers = 6

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0092	0.0057	348	1	0.0000	2.0	2.0	348	331	366	6.6	6.6	1141	1086	1202
4.5	14.8	0.0114	0.0100	450	1	0.0001	5.0	3.0	587	531	655	16.4	9.8	1925	1742	2150
7.0	23.0	0.0140	0.0151	464	3	-0.0020	10.3	5.3	473	449	499	33.8	17.4	1551	1473	1638
9.5	31.2	0.0216	0.0204	466	1	0.0005	22.8	12.5	1222	1159	1292	74.8	41.0	4009	3802	4239
12.0	39.4	0.0236	0.0235	512	1	-0.0003	28.0	5.2	1323	1157	1545	91.9	17.1	4342	3797	5069
14.5	47.6	0.0254	0.0255	569	1	-0.0004	44.5	16.5	1083	1024	1148	146.0	54.1	3552	3359	3768
17.0	55.8	0.0272	0.0275	617	2	-0.0006										
19.5	64.0	0.0306	0.0296	659	1	0.0008										
22.0	72.2	0.0318	0.0316	695	1	0.0000										
24.5	80.4	0.0332	0.0336	730	1	-0.0005										
27.0	88.6	0.0358	0.0355	761	1	0.0002										
29.5	96.8	0.0380	0.0376	784	2	0.0003										
32.0	105.0	0.0402	0.0399	802	1	0.0002										
34.5	113.2	0.0420	0.0422	817	1	-0.0003										
37.0	121.4	0.0456	0.0445	831	3	0.0010										
39.5	129.6	0.0468	0.0468	843	2	-0.0001										
42.0	137.8	0.0480	0.0491	855	3	-0.0012										
44.5	146.0	0.0522	0.0515	865	2	0.0007										

Explanation:
d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

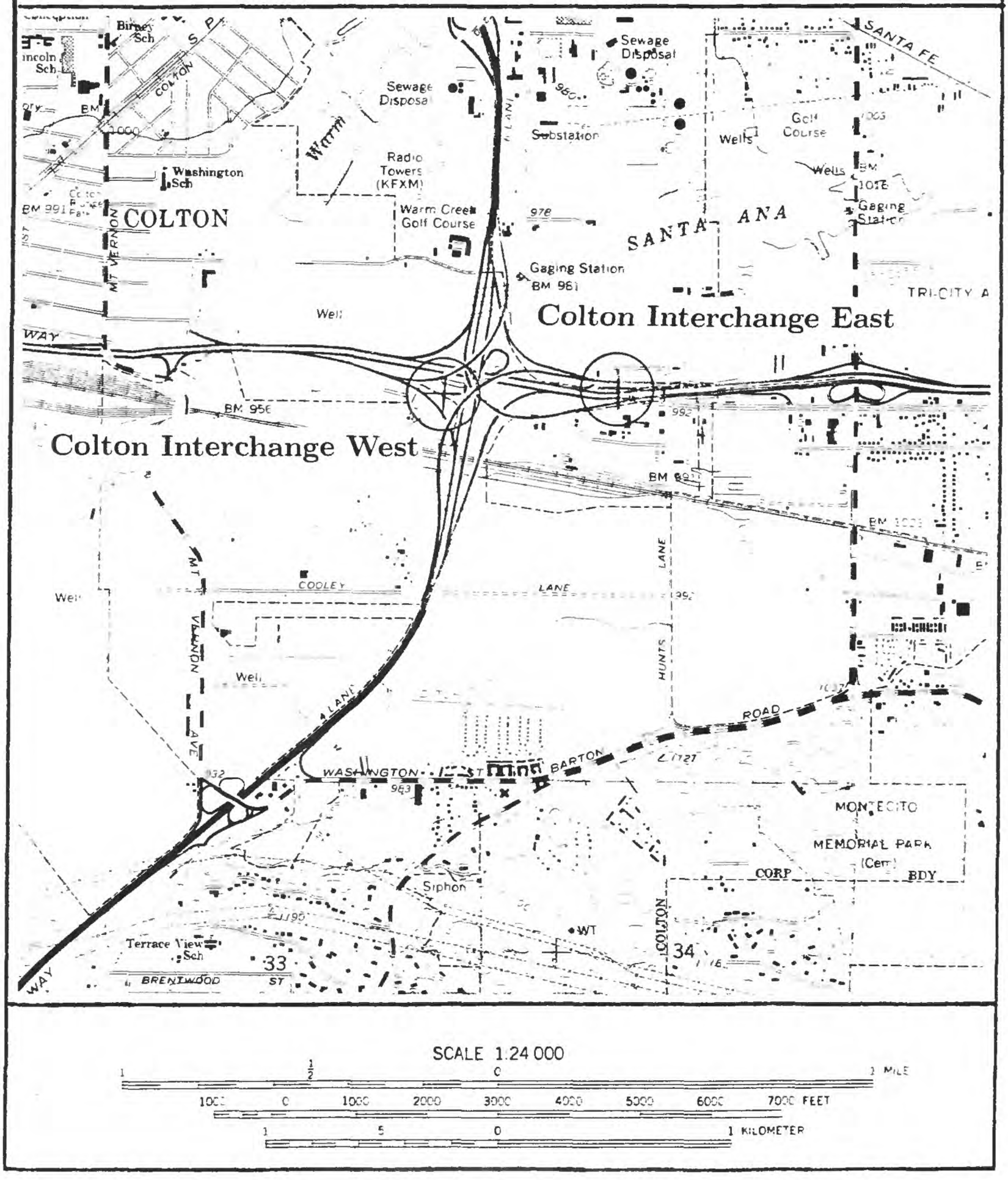

Figure A-11. Site location map for the borehole at Colton Interchange West. The boreholes at this site will be instrumented at several depths and at the surface to monitor future seismic activity.

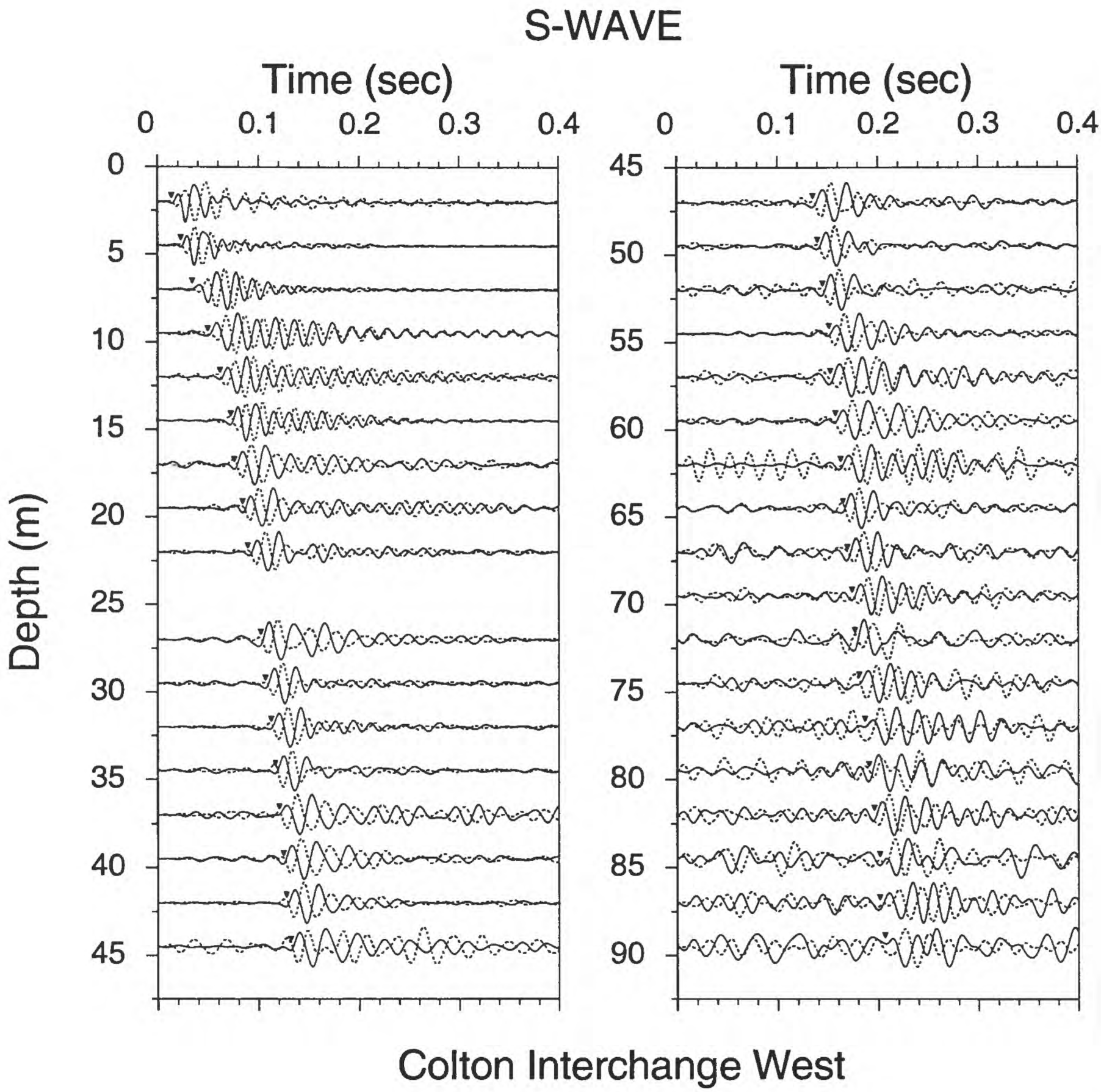

Figure A-12. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

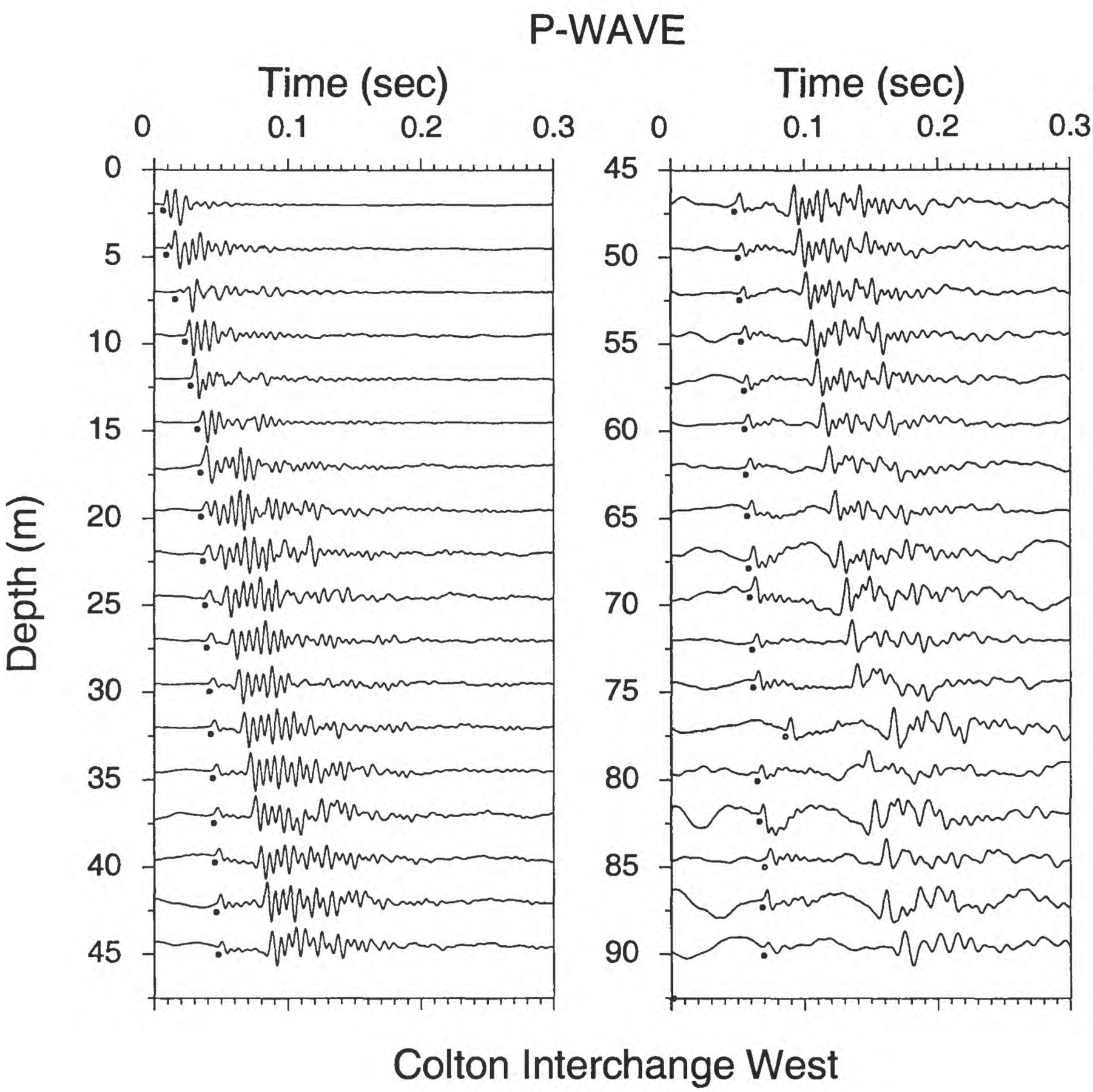

Figure A-13. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles. Early triggers of the recorder occured at depths 77 and 84.5 meters. A correction factor was applied by timing the difference between a normal reference trace and the early triggered reference trace.

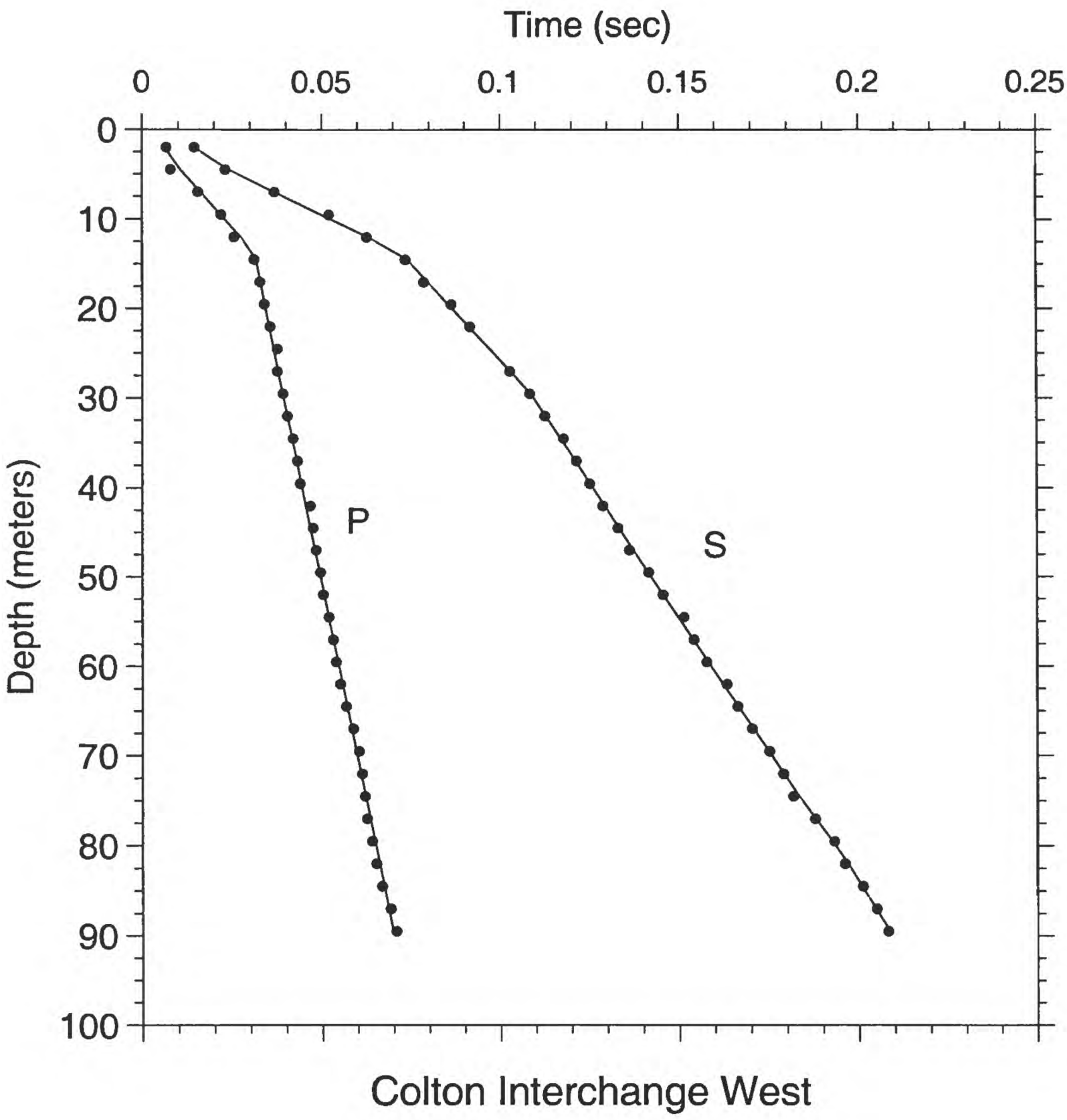

Figure A-14. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

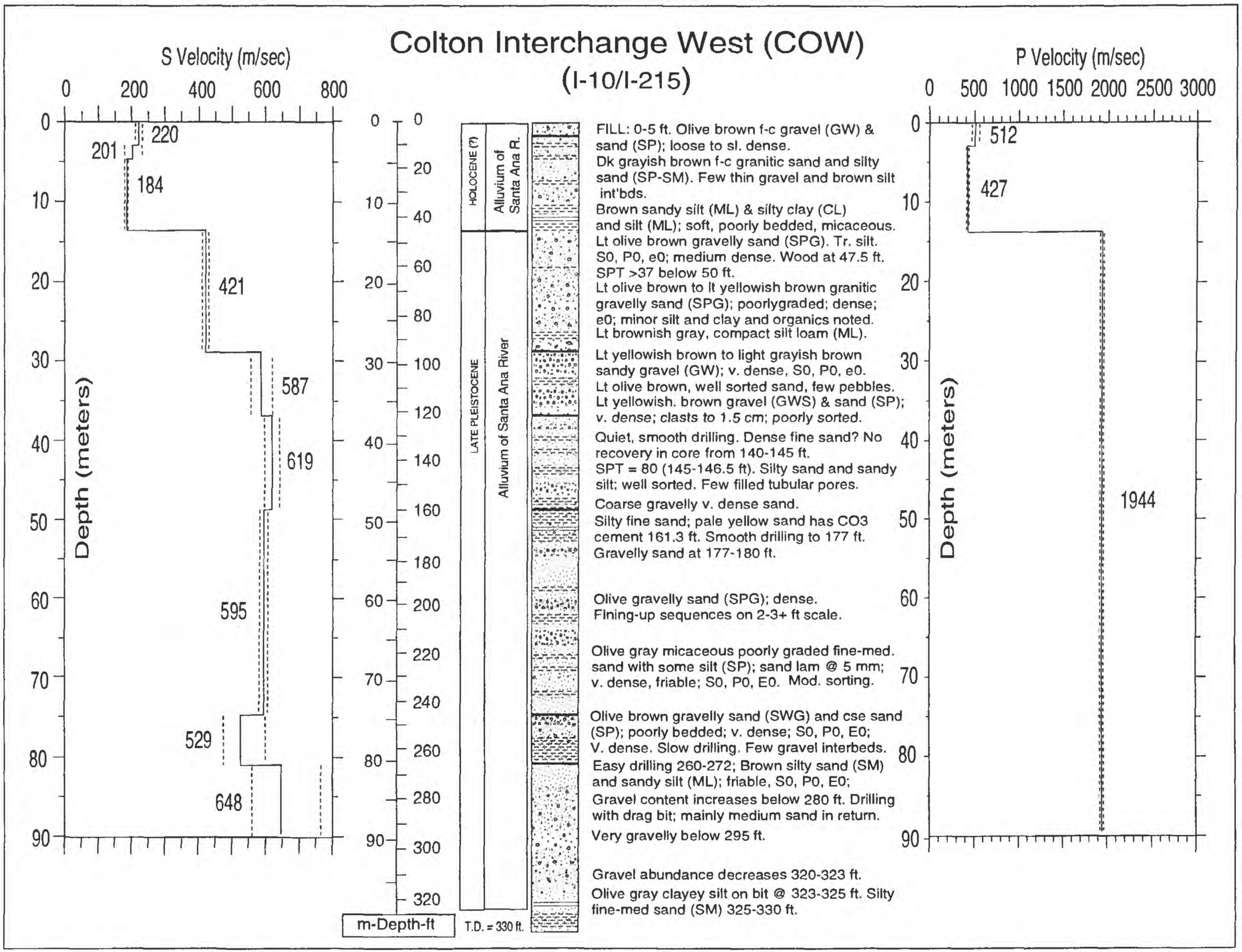

Figure A-15. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-5. S-wave arrival times and velocity summaries.

Location: Colton Interchange West: S Coordinates: 34.06363 -117.29710 Hole_Code: 293
hoffset = 2.50 travel-time file: E:\COLTON_W\COWS.TT
nlayers = 9

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0146	0.0091	220	1	0.0001	3.0	3.0	220	210	232	9.8	9.8	723	688	762
4.5	14.8	0.0232	0.0211	213	1	-0.0009	4.6	1.6	201	179	230	15.1	5.2	661	588	753
7.0	23.0	0.0368	0.0346	202	2	0.0001	13.7	9.1	184	181	187	44.9	29.9	603	593	613
9.5	31.2	0.0520	0.0482	197	1	0.0021	29.0	15.3	421	413	430	95.1	50.2	1382	1354	1411
12.0	39.4	0.0626	0.0618	194	1	-0.0005	37.0	8.0	587	557	622	121.4	26.2	1927	1827	2039
14.5	47.6	0.0734	0.0730	199	1	-0.0006	48.8	11.8	619	598	642	160.1	38.7	2032	1962	2108
17.0	55.8	0.0786	0.0789	215	1	-0.0011	75.0	26.2	595	583	606	246.1	86.0	1951	1914	1989
19.5	64.0	0.0864	0.0848	230	1	0.0009	81.0	6.0	529	476	597	265.7	19.7	1737	1560	1959
22.0	72.2	0.0916	0.0908	242	1	0.0003	89.5	8.5	648	561	767	293.6	27.9	2127	1841	2517
27.0	88.6	0.1028	0.1026	263	1	-0.0002										
29.5	96.8	0.1084	0.1082	273	1	-0.0002										
32.0	105.0	0.1126	0.1125	284	1	-0.0002										
34.5	113.2	0.1178	0.1168	295	1	0.0008										
37.0	121.4	0.1214	0.1210	306	1	0.0002										
39.5	129.6	0.1252	0.1251	316	1	-0.0001										
42.0	137.8	0.1288	0.1291	325	1	-0.0005										
44.5	146.0	0.1330	0.1331	334	1	-0.0003										
47.0	154.2	0.1362	0.1372	343	1	-0.0011										
49.5	162.4	0.1416	0.1413	350	1	0.0002										
52.0	170.6	0.1456	0.1455	357	1	0.0000										
54.5	178.8	0.1514	0.1497	364	1	0.0016										
57.0	187.0	0.1542	0.1539	370	1	0.0002										
59.5	195.2	0.1578	0.1581	376	1	-0.0004										
62.0	203.4	0.1634	0.1623	382	2	0.0010										
64.5	211.6	0.1664	0.1665	387	1	-0.0002										
67.0	219.8	0.1704	0.1707	393	1	-0.0004										
69.5	228.0	0.1752	0.1749	397	1	0.0002										
72.0	236.2	0.1790	0.1791	402	3	-0.0002										
74.5	244.4	0.1818	0.1833	406	3	-0.0016										
77.0	252.6	0.1878	0.1879	410	3	-0.0002										
79.5	260.8	0.1932	0.1926	413	3	0.0005										
82.0	269.0	0.1962	0.1970	416	2	-0.0009										
84.5	277.2	0.2012	0.2009	421	1	0.0003										
87.0	285.4	0.2050	0.2047	425	2	0.0002										
89.5	293.6	0.2082	0.2086	429	2	-0.0005										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-6. P-wave arrival times and velocity summaries.

Location: Colton Interchange West: P Coordinates: 34.06363 -117.29710 Hole_Code: 293
hoffset = 2.50 travel-time file: E:\COLTON_W\COWP.TT
nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0068	0.0039	512	1	0.0005	3.0	3.0	512	472	560	9.8	9.8	1680	1549	1836
4.5	14.8	0.0080	0.0094	480	3	-0.0027	13.7	10.7	427	418	437	44.9	35.1	1401	1371	1434
7.0	23.0	0.0156	0.0152	460	3	-0.0006	89.5	75.8	1944	1924	1964	293.6	248.7	6377	6313	6443
9.5	31.2	0.0220	0.0211	451	1	0.0002										
12.0	39.4	0.0256	0.0269	445	1	-0.0019										
14.5	47.6	0.0312	0.0313	463	1	-0.0005										
17.0	55.8	0.0328	0.0326	521	1	-0.0001										
19.5	64.0	0.0340	0.0339	575	1	-0.0001										
22.0	72.2	0.0356	0.0352	625	1	0.0003										
24.5	80.4	0.0376	0.0365	672	1	0.0010										
27.0	88.6	0.0376	0.0378	715	1	-0.0002										
29.5	96.8	0.0392	0.0390	756	1	0.0001										
32.0	105.0	0.0404	0.0403	793	1	0.0000										
34.5	113.2	0.0420	0.0416	829	1	0.0003										
37.0	121.4	0.0432	0.0429	862	1	0.0002										
39.5	129.6	0.0440	0.0442	894	1	-0.0002										
42.0	137.8	0.0468	0.0455	924	1	0.0013										
44.5	146.0	0.0476	0.0468	952	1	0.0008										
47.0	154.2	0.0484	0.0480	978	1	0.0003										
49.5	162.4	0.0496	0.0493	1003	1	0.0002										
52.0	170.6	0.0504	0.0506	1027	1	-0.0003										
54.5	178.8	0.0520	0.0519	1050	1	0.0001										
57.0	187.0	0.0532	0.0532	1072	1	0.0000										
59.5	195.2	0.0540	0.0545	1092	1	-0.0005										
62.0	203.4	0.0552	0.0558	1112	1	-0.0006										
64.5	211.6	0.0568	0.0570	1131	1	-0.0003										
67.0	219.8	0.0588	0.0583	1149	1	0.0004										
69.5	228.0	0.0604	0.0596	1166	2	0.0008										
72.0	236.2	0.0612	0.0609	1182	1	0.0003										
74.5	244.4	0.0620	0.0622	1198	1	-0.0002										
77.0	252.6	0.0626	0.0635	1213	4	-0.0009										
79.5	260.8	0.0640	0.0648	1228	1	-0.0008										
82.0	269.0	0.0652	0.0661	1241	1	-0.0009										
84.5	277.2	0.0668	0.0673	1255	4	-0.0006										
87.0	285.4	0.0692	0.0686	1268	1	0.0006										
89.5	293.6	0.0708	0.0699	1280	2	0.0009										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec)= residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

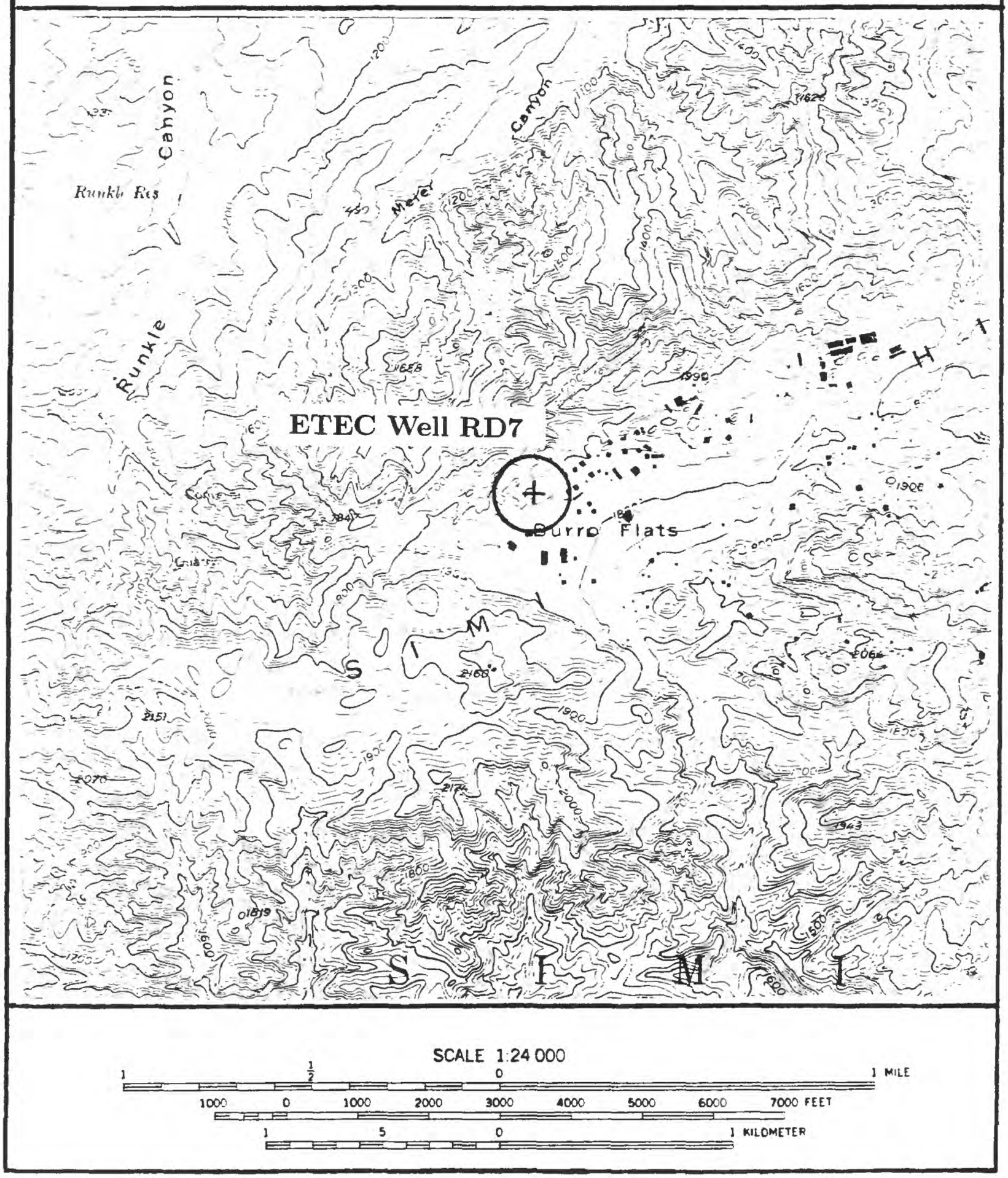

Figure A-16. Site location map for the borehole at ETEC (RD7). The accelerograph is located approximately 90 meters from the borehole.

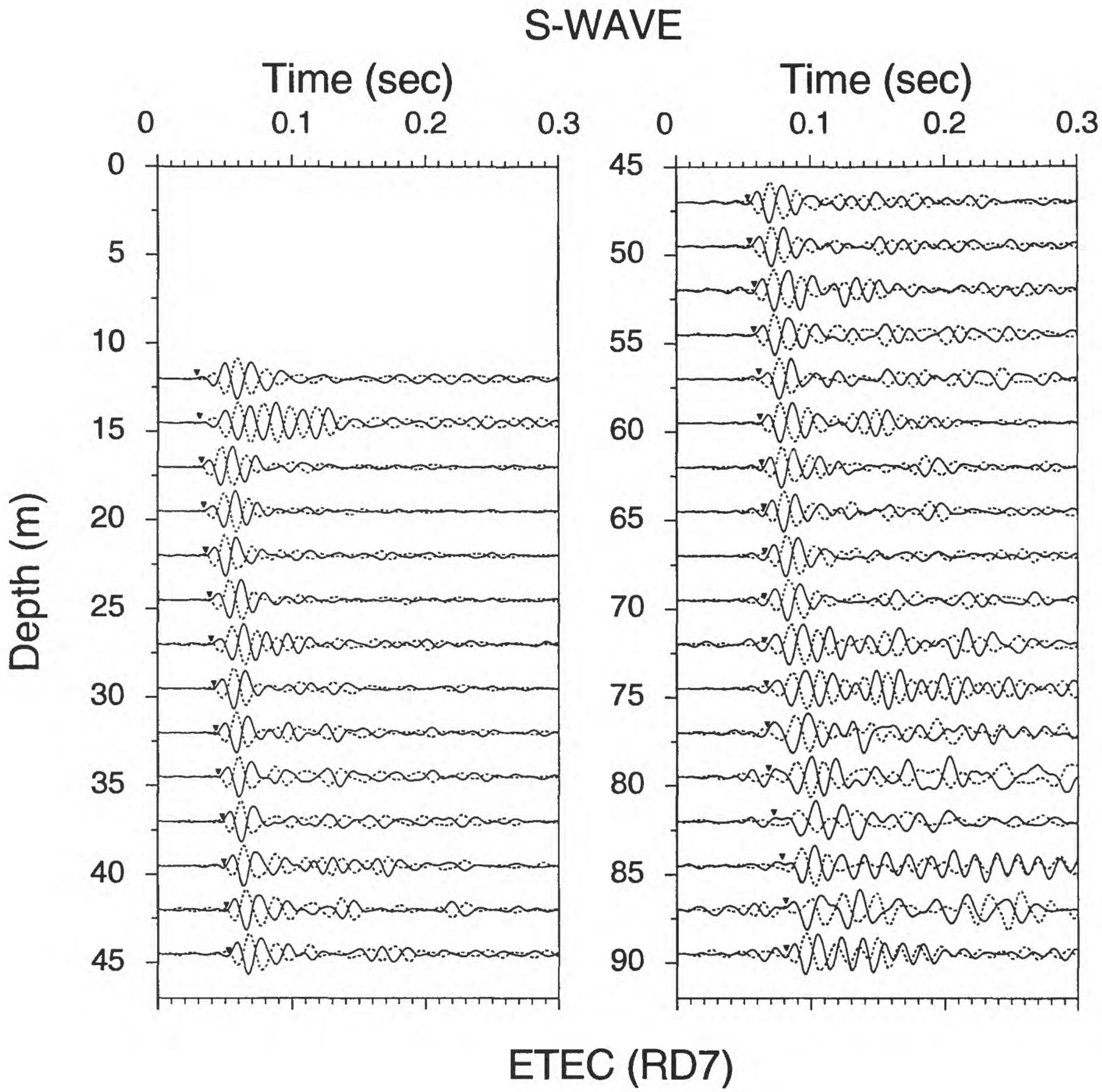

Figure A-17. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles. These measurements were made in an existing borehole used to monitor ground water. The top 9 meters of the borehole are cased with 10-inch diameter steel casing, so that our first usable data point was obtained at 12 meters depth in the uncased portion of the hole in fairly competent rock of the Chatsworth formation.

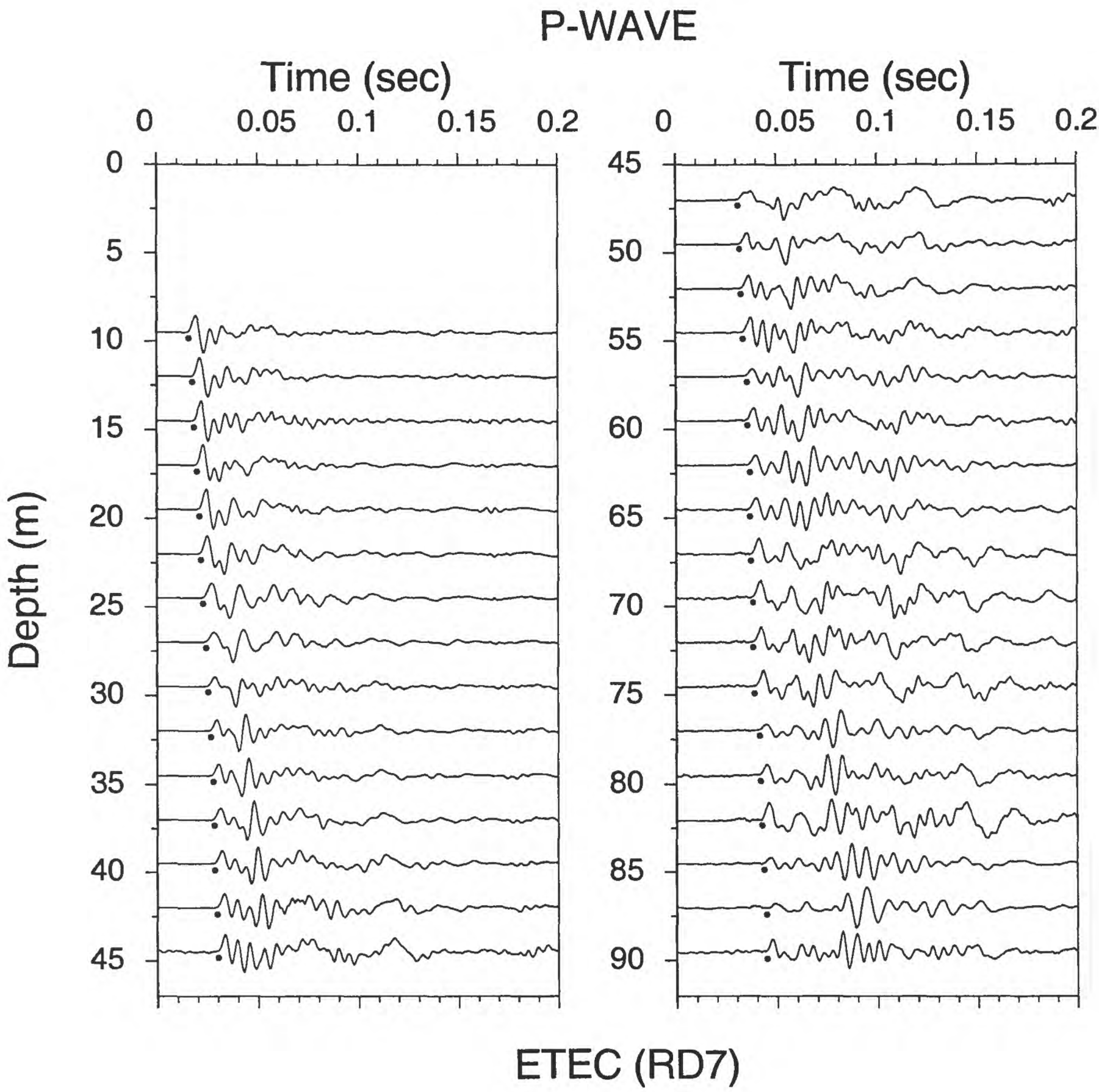

Figure A-18. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

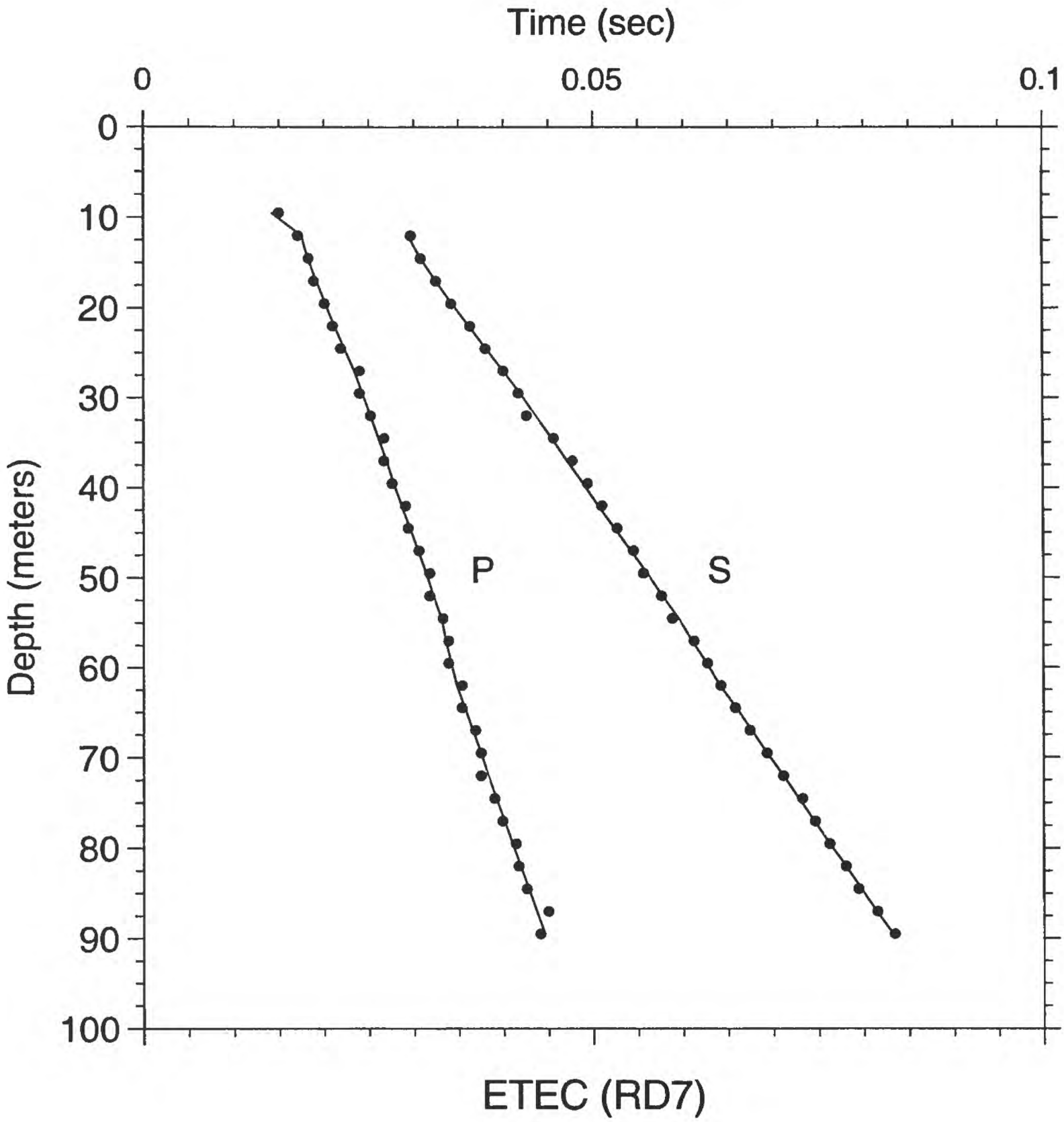

Figure A-19. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

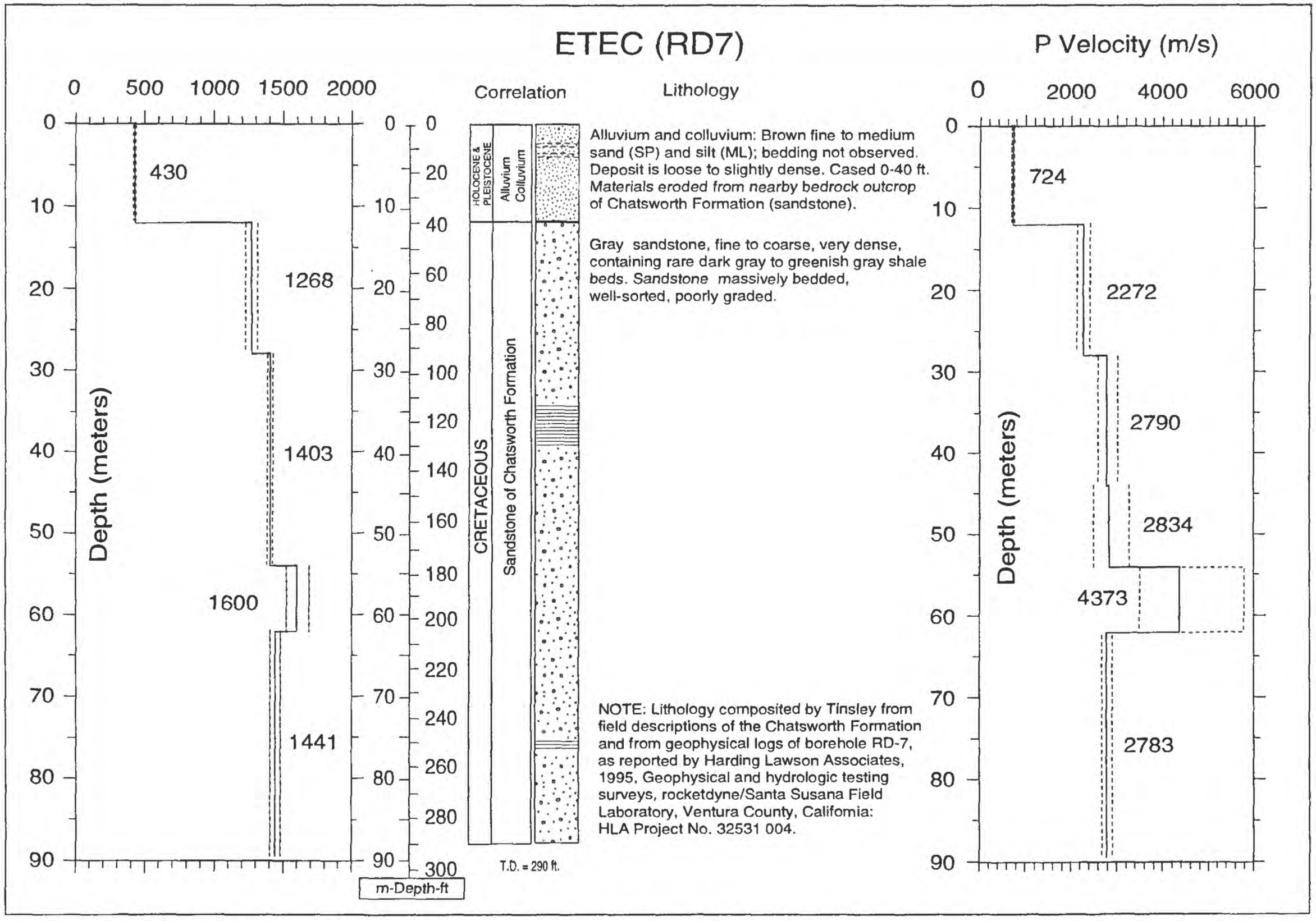

Figure A-20. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-7. S-wave arrival times and velocity summaries.

Location: ETEC (RD7): S Coordinates: 34.23143 -118.71408 Hole_Code: 285
hoffset = 4.00 travel-time file: D:\RD7\RD7S.TT
nlayers = 5

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
12.0	39.4	0.0297	0.0279	430	4	0.0003
14.5	47.6	0.0308	0.0299	485	4	0.0000
17.0	55.8	0.0325	0.0319	534	1	0.0001
19.5	64.0	0.0342	0.0338	577	1	-0.0001
22.0	72.2	0.0363	0.0358	615	1	0.0001
24.5	80.4	0.0380	0.0378	649	1	-0.0002
27.0	88.6	0.0400	0.0397	679	1	0.0000
29.5	96.8	0.0417	0.0416	709	1	-0.0002
32.0	105.0	0.0426	0.0434	738	1	-0.0010
34.5	113.2	0.0456	0.0452	764	1	0.0002
37.0	121.4	0.0477	0.0469	788	1	0.0006
39.5	129.6	0.0494	0.0487	811	1	0.0005
42.0	137.8	0.0510	0.0505	832	1	0.0004
44.5	146.0	0.0527	0.0523	851	1	0.0002
47.0	154.2	0.0545	0.0541	869	1	0.0003
49.5	162.4	0.0556	0.0558	886	1	-0.0003
52.0	170.6	0.0576	0.0576	902	1	-0.0001
54.5	178.8	0.0588	0.0594	918	1	-0.0007
57.0	187.0	0.0612	0.0609	935	1	0.0002
59.5	195.2	0.0627	0.0625	952	1	0.0001
62.0	203.4	0.0642	0.0641	968	1	0.0001
64.5	211.6	0.0658	0.0658	980	1	0.0000
67.0	219.8	0.0674	0.0675	992	1	-0.0002
69.5	228.0	0.0693	0.0693	1003	3	0.0000
72.0	236.2	0.0711	0.0710	1014	3	0.0000
74.5	244.4	0.0732	0.0727	1024	3	0.0004
77.0	252.6	0.0746	0.0745	1034	4	0.0000
79.5	260.8	0.0762	0.0762	1043	4	0.0000
82.0	269.0	0.0780	0.0779	1052	3	0.0000
84.5	277.2	0.0794	0.0797	1061	3	-0.0004
87.0	285.4	0.0815	0.0814	1069	3	0.0000
89.5	293.6	0.0834	0.0831	1076	2	0.0002

dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
12.0	12.0	430	425	436	39.4	39.4	1412	1395	1430
28.0	16.0	1268	1226	1313	91.9	52.5	4160	4024	4307
54.0	26.0	1403	1384	1423	177.2	85.3	4604	4540	4669
62.0	8.0	1600	1521	1687	203.4	26.2	5249	4991	5535
89.5	27.5	1441	1404	1479	293.6	90.2	4727	4606	4854

Explanation:
d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

TABLE A-8. P-wave arrival times and velocity summaries.

Location: ETEC (RD7): P Coordinates: 34.23143 -118.71408 Hole_Code: 285
hoffset = 4.00 travel-time file: D:\RD7\RD7P.TT
nlayers = 6

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
9.5	31.2	0.0150	0.0131	724	1	0.0008	12.0	12.0	724	712	736	39.4	39.4	2375	2337	2415
12.0	39.4	0.0171	0.0166	724	1	-0.0004	28.0	16.0	2272	2145	2416	91.9	52.5	7455	7038	7925
14.5	47.6	0.0183	0.0177	820	1	0.0001	44.0	16.0	2790	2589	3024	144.4	52.5	9152	8494	9921
17.0	55.8	0.0189	0.0188	905	1	-0.0003	54.0	10.0	2834	2496	3279	177.2	32.8	9299	8188	10759
19.5	64.0	0.0201	0.0199	981	1	-0.0001	62.0	8.0	4373	3511	5795	203.4	26.2	14346	11519	19013
22.0	72.2	0.0210	0.0210	1049	1	-0.0002	89.5	27.5	2783	2669	2906	293.6	90.2	9129	8757	9534
24.5	80.4	0.0219	0.0221	1110	1	-0.0004										
27.0	88.6	0.0240	0.0232	1165	1	0.0006										
29.5	96.8	0.0240	0.0242	1221	1	-0.0003										
32.0	105.0	0.0252	0.0251	1277	1	0.0000										
34.5	113.2	0.0267	0.0259	1330	1	0.0006										
37.0	121.4	0.0267	0.0268	1378	1	-0.0003										
39.5	129.6	0.0276	0.0277	1424	1	-0.0002										
42.0	137.8	0.0291	0.0286	1467	1	0.0004										
44.5	146.0	0.0294	0.0295	1507	1	-0.0002										
47.0	154.2	0.0306	0.0304	1546	3	0.0001										
49.5	162.4	0.0318	0.0313	1582	2	0.0004										
52.0	170.6	0.0318	0.0322	1616	1	-0.0004										
54.5	178.8	0.0333	0.0330	1652	1	0.0002										
57.0	187.0	0.0339	0.0336	1698	1	0.0003										
59.5	195.2	0.0339	0.0341	1743	1	-0.0003										
62.0	203.4	0.0354	0.0347	1786	1	0.0006										
64.5	211.6	0.0354	0.0356	1811	1	-0.0003										
67.0	219.8	0.0369	0.0365	1835	1	0.0003										
69.5	228.0	0.0375	0.0374	1858	1	0.0000										
72.0	236.2	0.0375	0.0383	1880	1	-0.0008										
74.5	244.4	0.0390	0.0392	1900	1	-0.0002										
77.0	252.6	0.0399	0.0401	1920	1	-0.0002										
79.5	260.8	0.0414	0.0410	1939	1	0.0004										
82.0	269.0	0.0417	0.0419	1957	1	-0.0002										
84.5	277.2	0.0426	0.0428	1975	1	-0.0002										
87.0	285.4	0.0450	0.0437	1991	1	0.0013										
89.5	293.6	0.0441	0.0446	2007	1	-0.0005										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

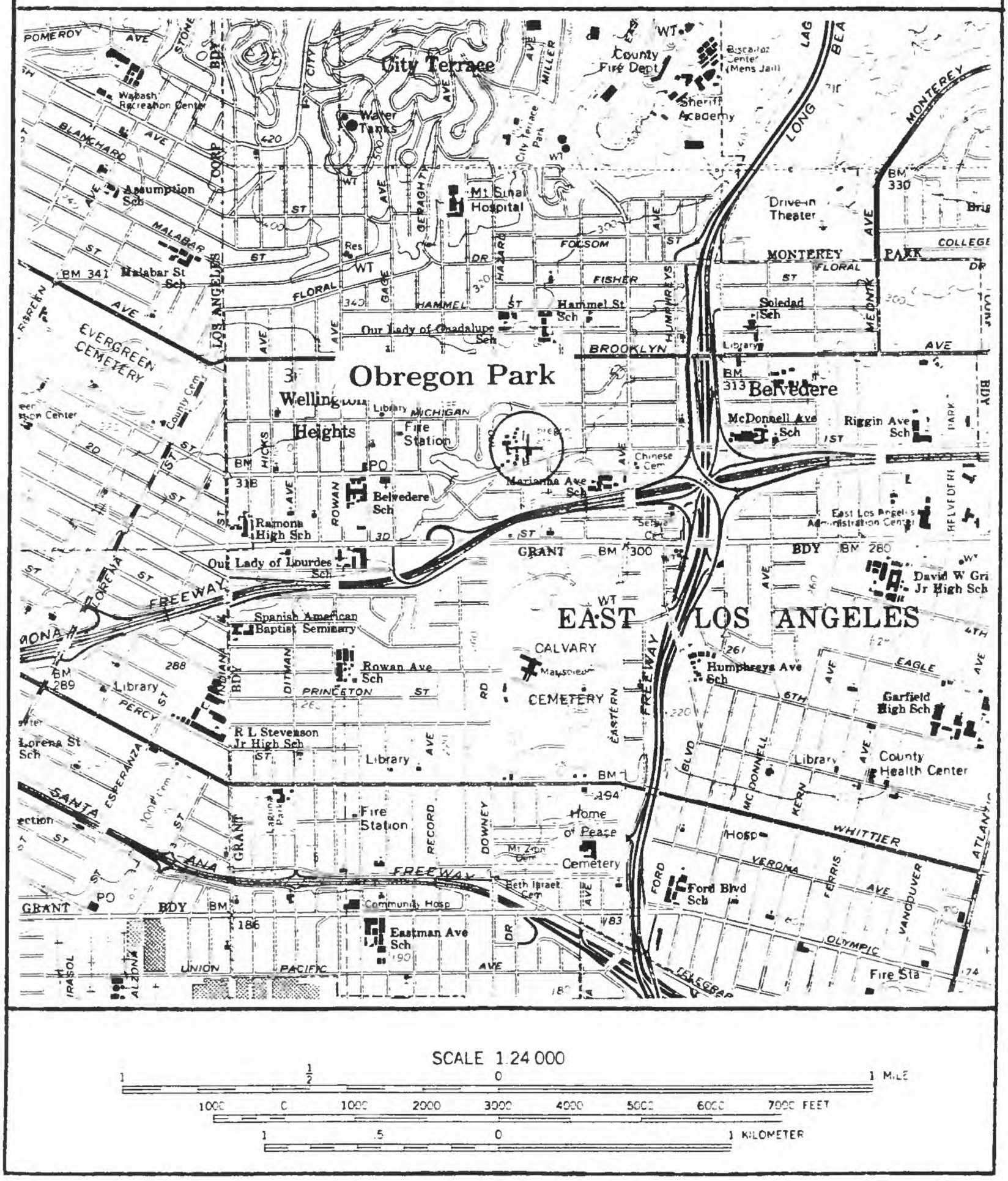

Figure A-21. Site location map for the borehole at Obregon Park. The borehole is located approximately 10 meters from the accelerograph.

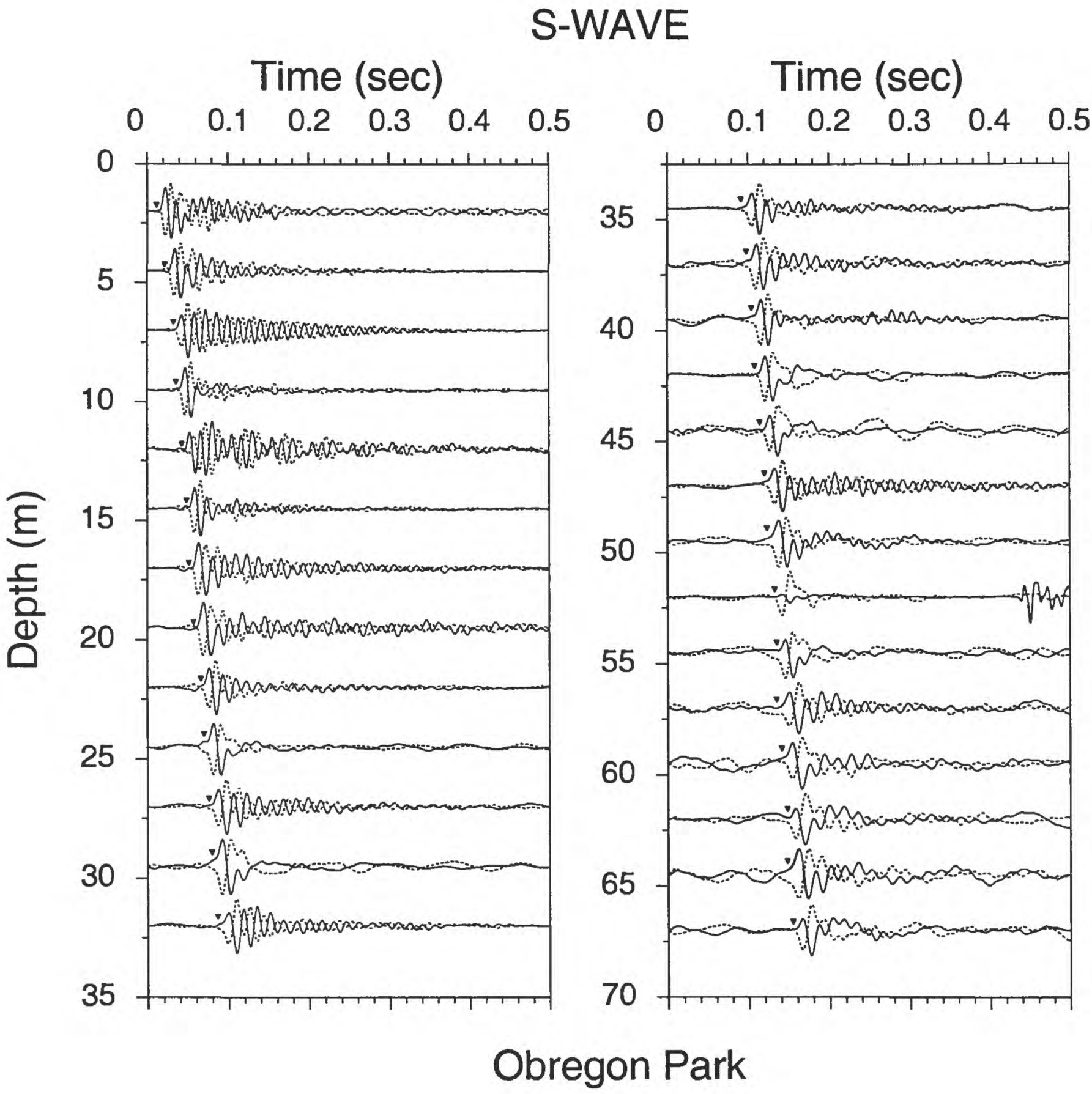

Figure A-22. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

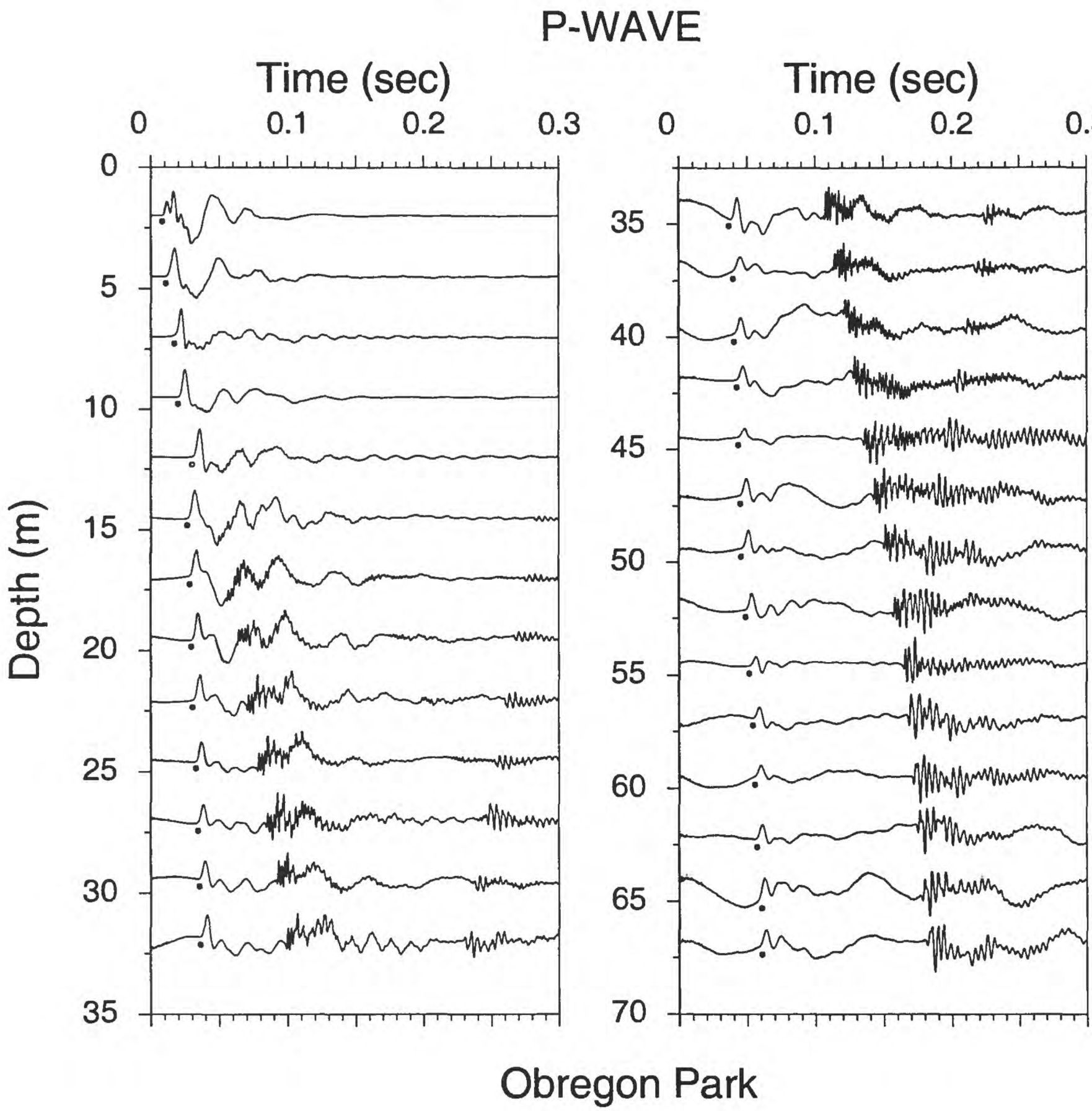

Figure A-23. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

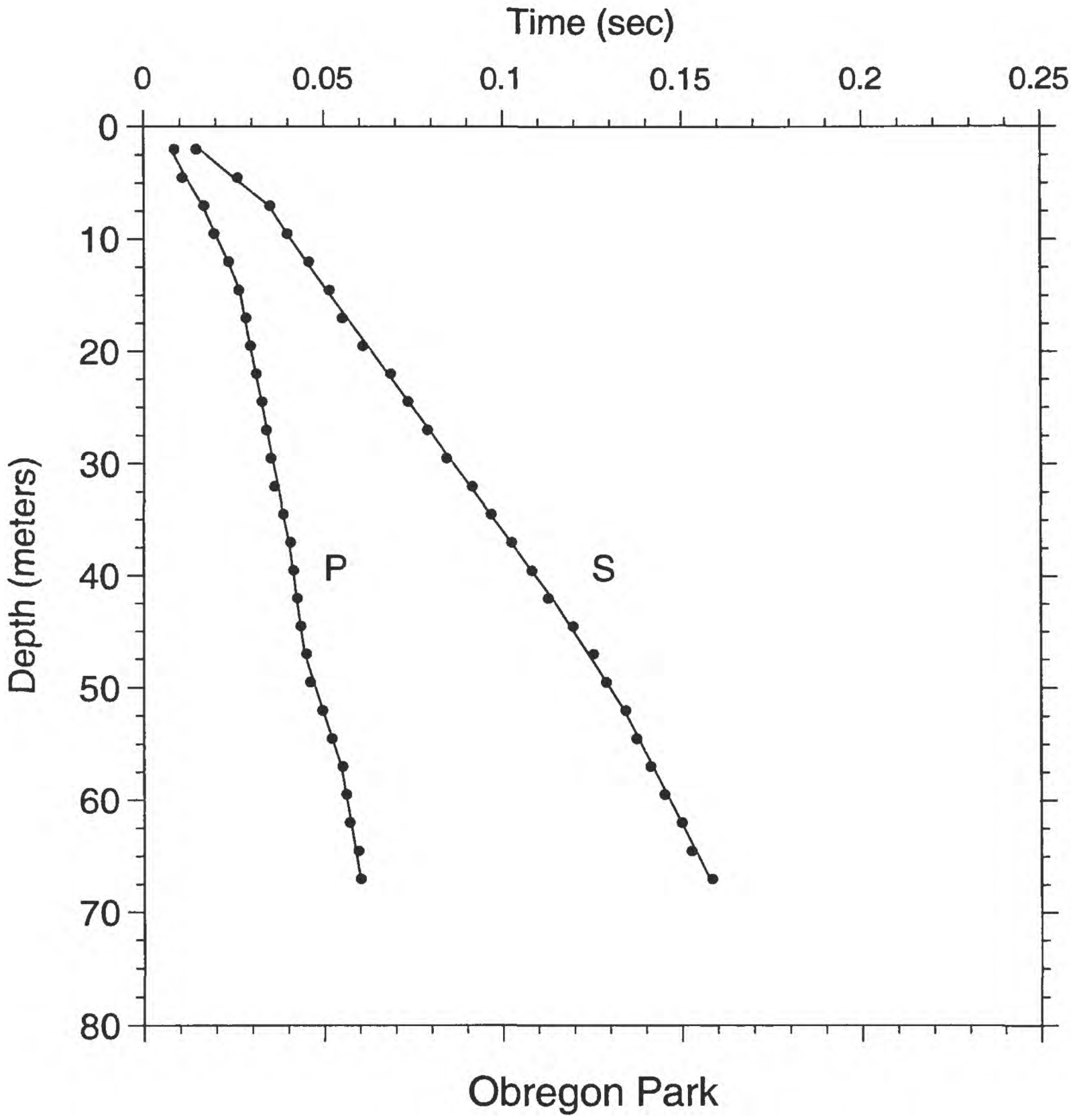

Figure A-24. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

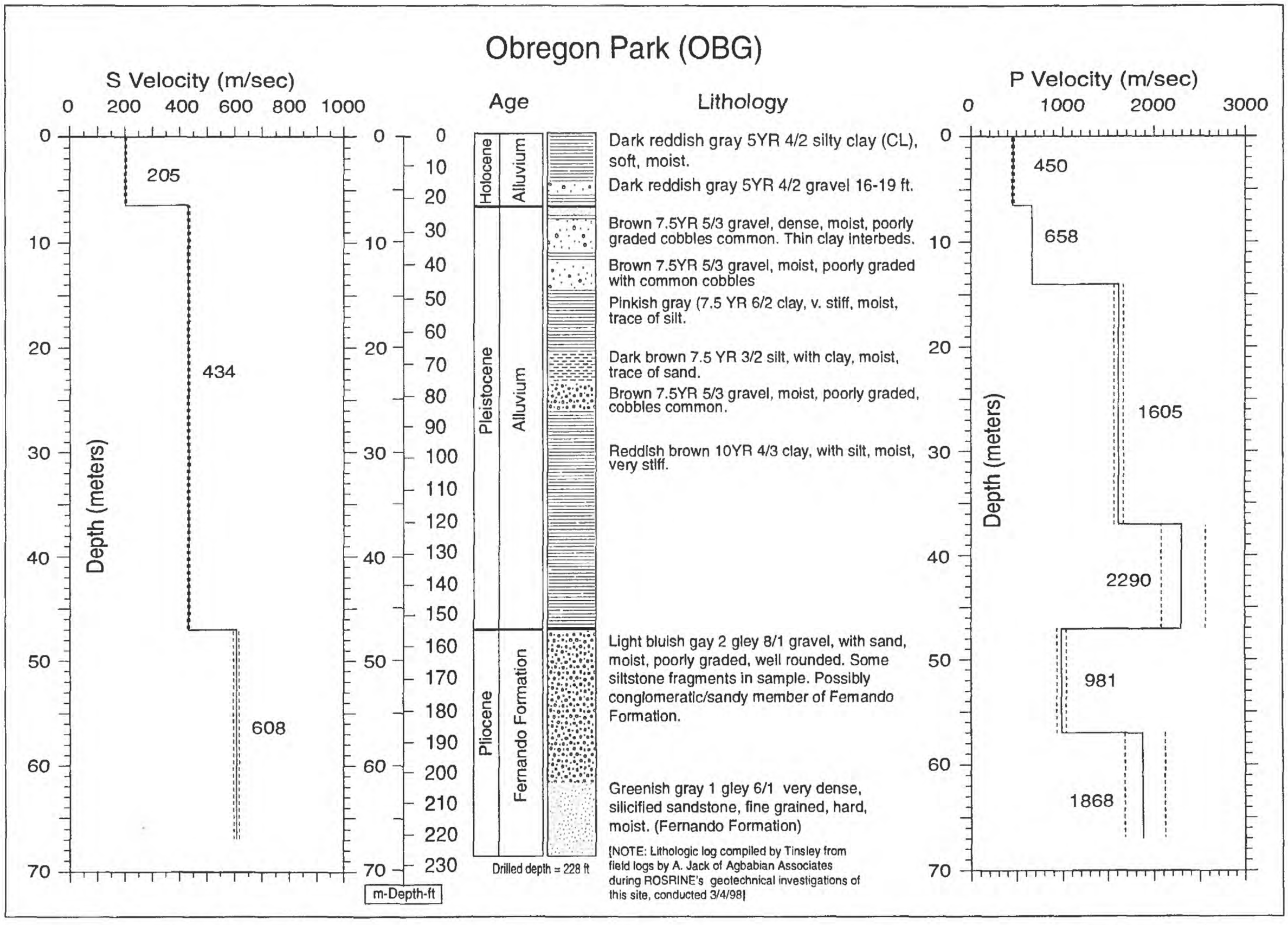

Figure A-25. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-9. S-wave arrival times and velocity summaries.

Location: Obregon Park: S Coordinates: 34.03699 -118.17781 Hole_Code: 294
hoffset = 2.50 travel-time file: E:\OBREGON\OBGS.TT
nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.0	6.6	0.0147	0.0098	205	1	-0.0009
4.5	14.8	0.0261	0.0220	205	1	0.0009
7.0	23.0	0.0351	0.0329	213	1	0.0003
9.5	31.2	0.0399	0.0386	246	1	0.0001
12.0	39.4	0.0459	0.0444	270	2	0.0006
14.5	47.6	0.0516	0.0501	289	1	0.0008
17.0	55.8	0.0552	0.0559	304	1	-0.0013
19.5	64.0	0.0609	0.0617	316	1	-0.0013
22.0	72.2	0.0687	0.0674	326	1	0.0008
24.5	80.4	0.0735	0.0732	335	1	-0.0001
27.0	88.6	0.0789	0.0789	342	1	-0.0004
29.5	96.8	0.0843	0.0847	348	1	-0.0007
32.0	105.0	0.0915	0.0905	354	1	0.0007
34.5	113.2	0.0969	0.0962	359	1	0.0004
37.0	121.4	0.1026	0.1020	363	1	0.0004
39.5	129.6	0.1083	0.1077	367	1	0.0003
42.0	137.8	0.1128	0.1135	370	1	-0.0009
44.5	146.0	0.1197	0.1193	373	1	0.0002
47.0	154.2	0.1254	0.1250	376	1	0.0002
49.5	162.4	0.1290	0.1291	383	1	-0.0003
52.0	170.6	0.1344	0.1332	390	1	0.0010
54.5	178.8	0.1374	0.1374	397	1	-0.0001
57.0	187.0	0.1413	0.1415	403	1	-0.0003
59.5	195.2	0.1452	0.1456	409	1	-0.0005
62.0	203.4	0.1500	0.1497	414	1	0.0002
64.5	211.6	0.1527	0.1538	419	3	-0.0012
67.0	219.8	0.1584	0.1579	424	1	0.0003

dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
6.5	6.5	205	203	207	21.3	21.3	671	665	678
47.0	40.5	434	432	436	154.2	132.9	1424	1417	1431
67.0	20.0	608	598	619	219.8	65.6	1995	1961	2031

Explanation:
d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

TABLE A-10. P-wave arrival times and velocity summaries.

Location: Obregon Park: P Coordinates: 34.03699 -118.17781 Hole_Code: 294
hoffset = 2.80 travel-time file: E:\OBREGON\VERT\OBGP.TT
nlayers = 6

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0086	0.0044	450	1	0.0009	6.5	6.5	450	439	460	21.3	21.3	1475	1441	1510
4.5	14.8	0.0108	0.0100	450	1	-0.0010	14.0	7.5	658	632	687	45.9	24.6	2159	2073	2253
7.0	23.0	0.0168	0.0152	460	1	0.0004	37.0	23.0	1605	1554	1659	121.4	75.5	5265	5100	5441
9.5	31.2	0.0196	0.0190	500	1	-0.0002	47.0	10.0	2290	2074	2557	154.2	32.8	7514	6804	8389
12.0	39.4	0.0236	0.0228	526	3	0.0002	57.0	10.0	981	934	1033	187.0	32.8	3218	3063	3389
14.5	47.6	0.0264	0.0262	554	1	-0.0002	67.0	10.0	1868	1674	2112	219.8	32.8	6127	5492	6928
17.0	55.8	0.0284	0.0277	613	1	0.0004										
19.5	64.0	0.0296	0.0293	666	1	0.0001										
22.0	72.2	0.0312	0.0308	714	1	0.0002										
24.5	80.4	0.0328	0.0324	757	1	0.0002										
27.0	88.6	0.0340	0.0339	795	1	-0.0001										
29.5	96.8	0.0352	0.0355	831	1	-0.0004										
32.0	105.0	0.0362	0.0371	864	1	-0.0010										
34.5	113.2	0.0388	0.0386	893	1	0.0001										
37.0	121.4	0.0408	0.0402	921	1	0.0005										
39.5	129.6	0.0416	0.0413	957	1	0.0002										
42.0	137.8	0.0426	0.0424	992	1	0.0002										
44.5	146.0	0.0436	0.0434	1024	1	0.0001										
47.0	154.2	0.0452	0.0445	1055	1	0.0006										
49.5	162.4	0.0462	0.0471	1051	1	-0.0010										
52.0	170.6	0.0496	0.0496	1048	1	-0.0001										
54.5	178.8	0.0522	0.0522	1044	1	-0.0001										
57.0	187.0	0.0552	0.0547	1041	1	0.0004										
59.5	195.2	0.0562	0.0561	1061	1	0.0001										
62.0	203.4	0.0572	0.0574	1080	1	-0.0003										
64.5	211.6	0.0596	0.0587	1098	3	0.0008										
67.0	219.8	0.0602	0.0601	1115	1	0.0001										

Explanation:

- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

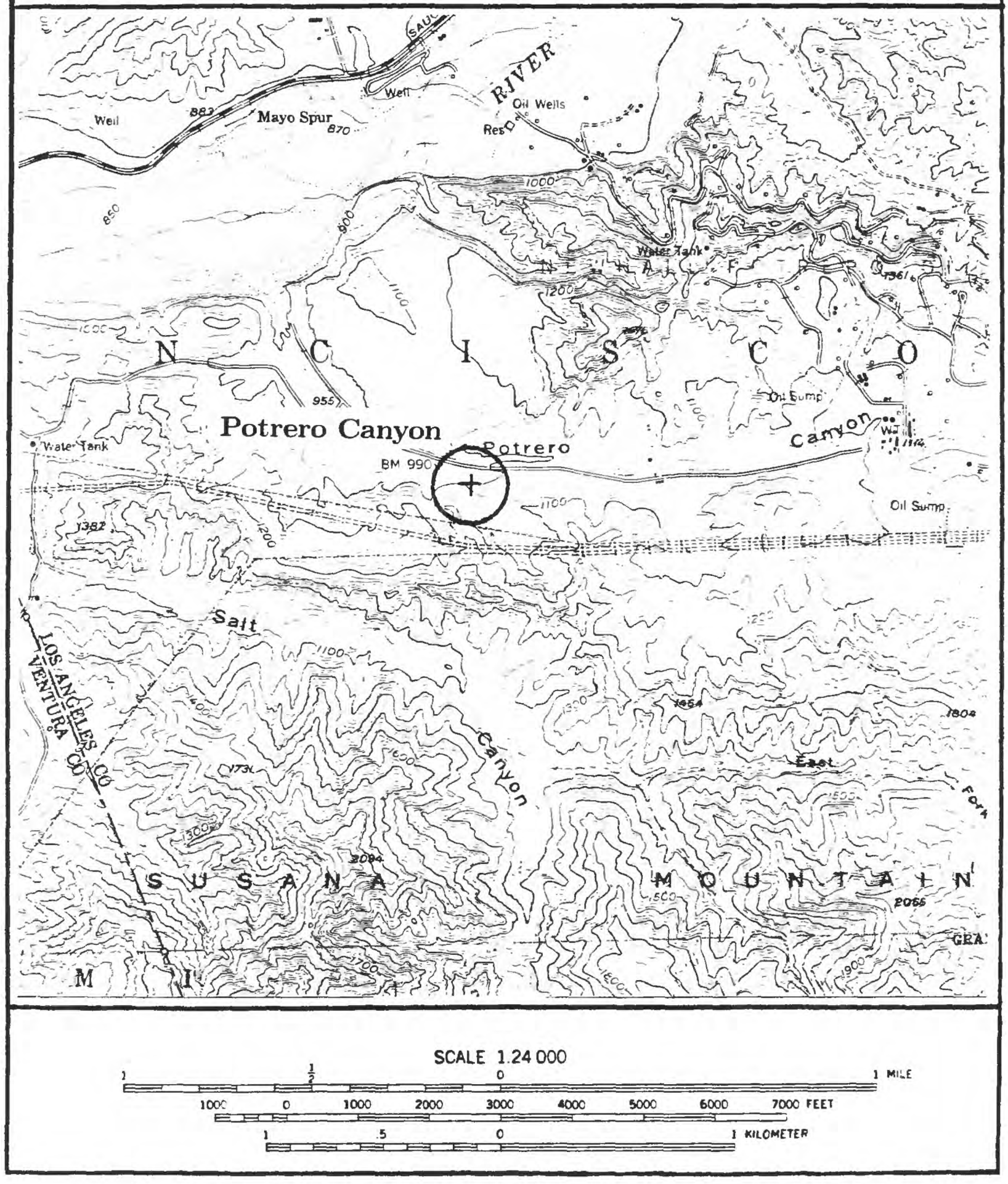

Figure A-26. Site location map for borehole Potrero Canyon #3 near the center of the valley. No permanent strong-motion instruments were located at this site.

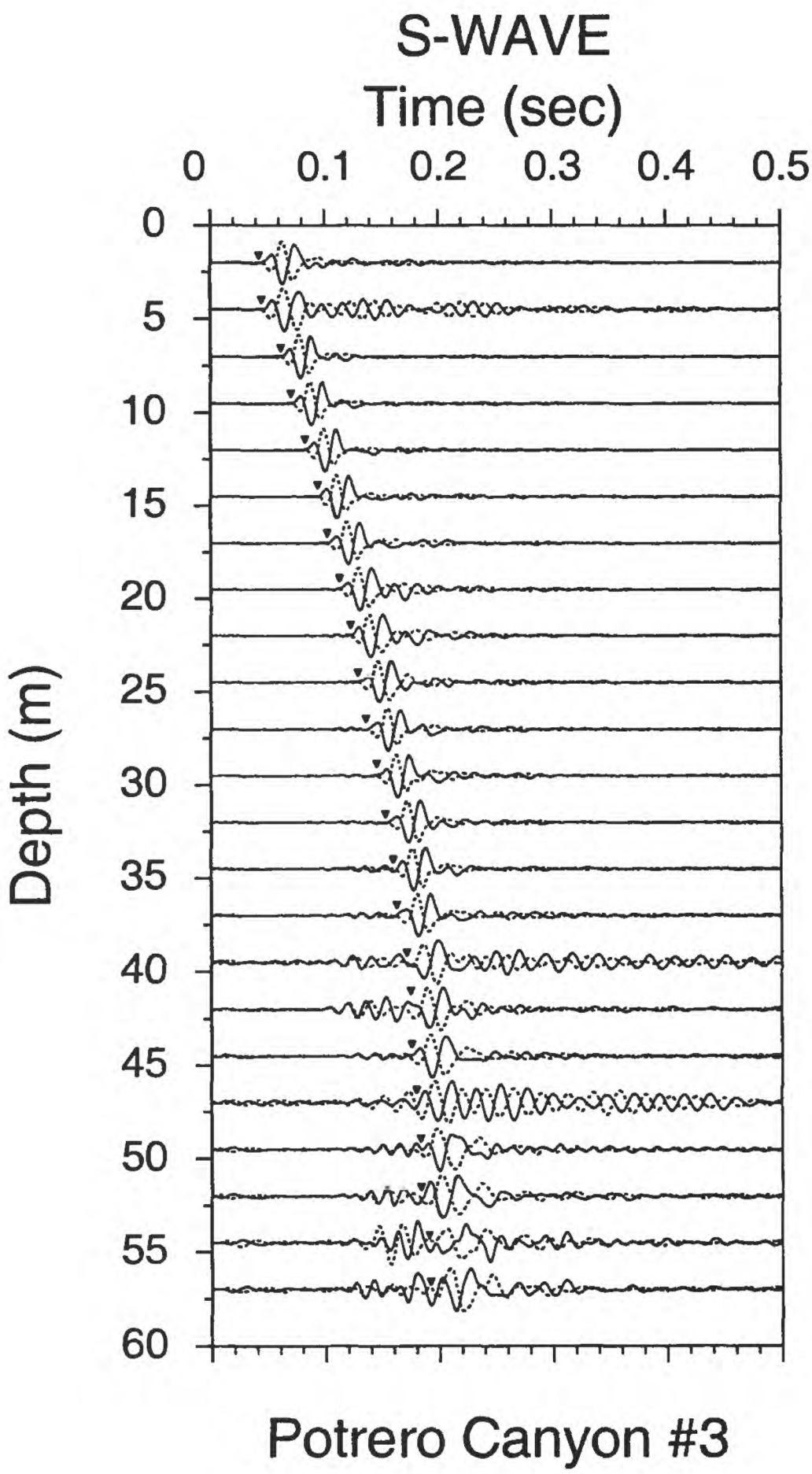

Figure A-27. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

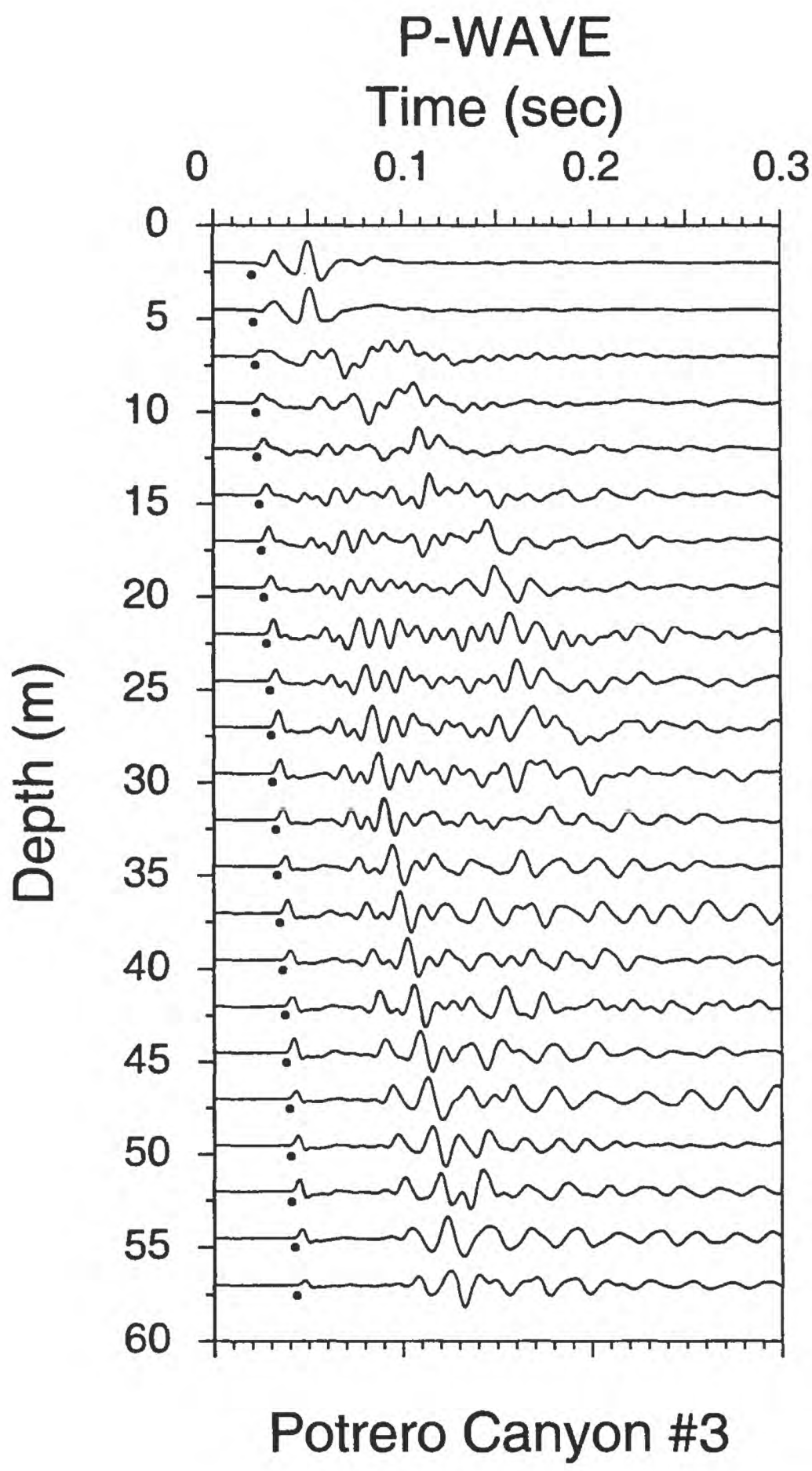

Figure A-28. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

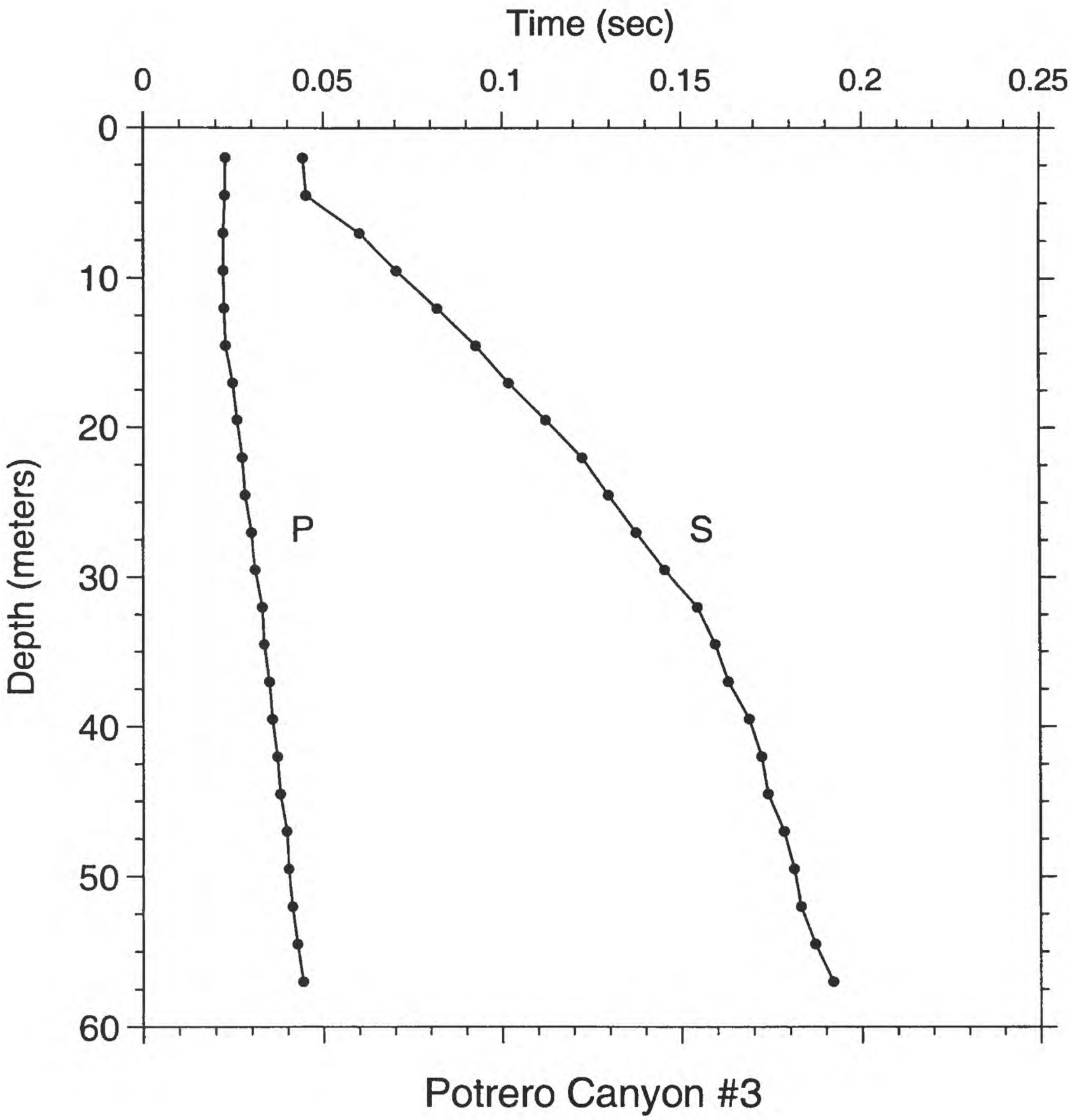

Figure A-29. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

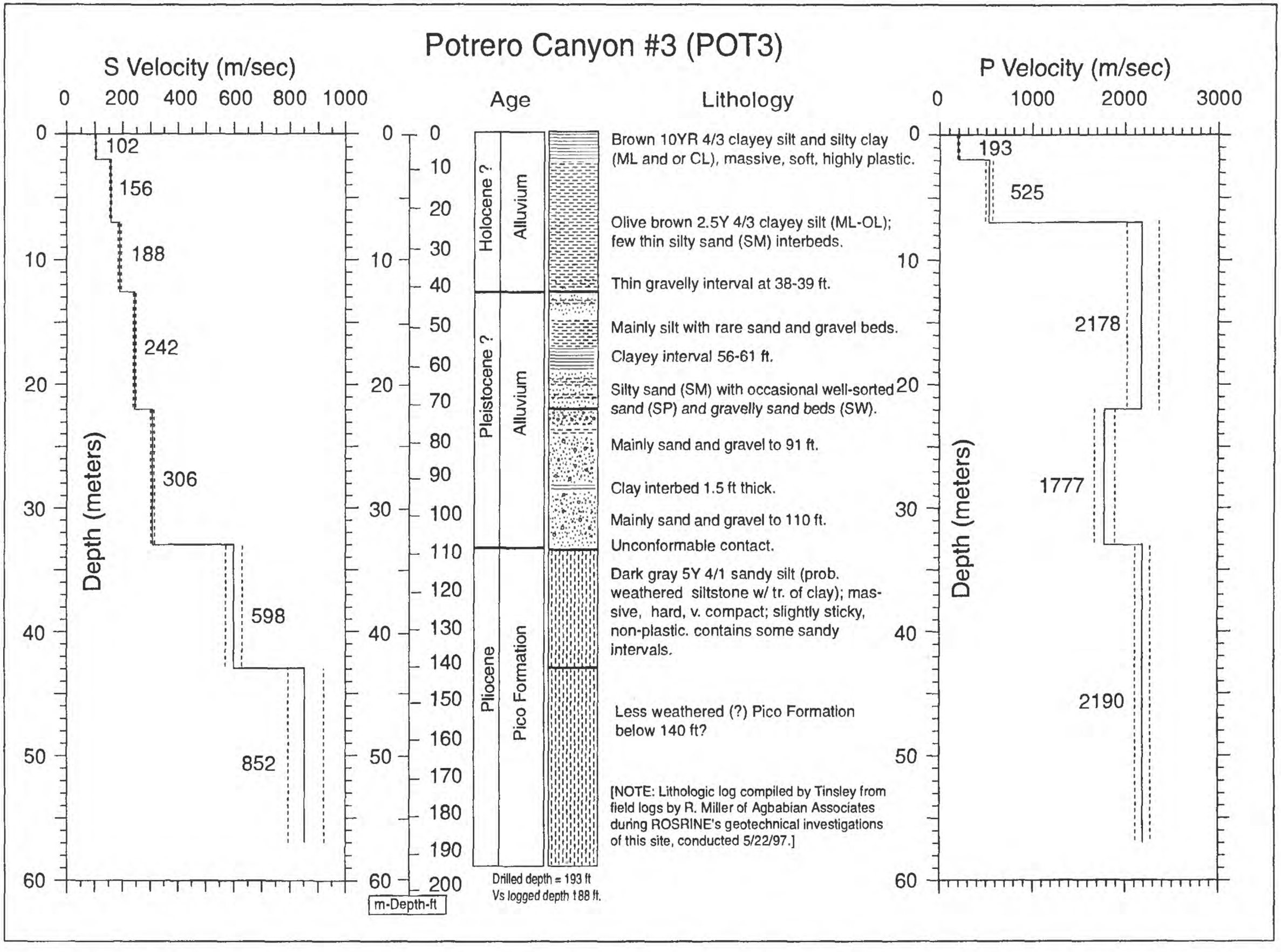

Figure A-30. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-11. S-wave arrival times and velocity summaries.

Location: Potrero Canyon (Valley Center) Coordinates: 34.39522 -118.66317 Hole_Code: 280
hoffset = 4.00 travel-time file: D:\POT\POTS.TT
nlayers = 7

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0444	0.0196	102	1	0.0003	2.0	2.0	102	100	103	6.6	6.6	333	327	339
4.5	14.8	0.0453	0.0356	126	1	-0.0017	7.0	5.0	156	153	159	23.0	16.4	513	503	523
7.0	23.0	0.0602	0.0517	136	1	0.0010	12.6	5.6	188	184	194	41.3	18.4	618	602	635
9.5	31.2	0.0705	0.0650	146	1	0.0003	22.0	9.4	242	237	248	72.2	30.8	795	779	812
12.0	39.4	0.0819	0.0783	153	1	-0.0004	33.0	11.0	306	300	313	108.3	36.1	1005	984	1027
14.5	47.6	0.0927	0.0893	162	1	0.0003	43.0	10.0	598	571	629	141.1	32.8	1963	1872	2063
17.0	55.8	0.1019	0.0996	171	1	-0.0002	57.0	14.0	852	793	920	187.0	45.9	2794	2600	3020
19.5	64.0	0.1122	0.1100	177	1	0.0002										
22.0	72.2	0.1224	0.1203	183	1	0.0004										
24.5	80.4	0.1297	0.1285	191	1	-0.0002										
27.0	88.6	0.1374	0.1366	198	1	-0.0005										
29.5	96.8	0.1453	0.1448	204	1	-0.0005										
32.0	105.0	0.1545	0.1530	209	1	0.0006										
34.5	113.2	0.1594	0.1587	217	1	-0.0001										
37.0	121.4	0.1630	0.1629	227	1	-0.0005										
39.5	129.6	0.1688	0.1671	236	1	0.0011										
42.0	137.8	0.1722	0.1713	245	1	0.0005										
44.5	146.0	0.1740	0.1747	255	1	-0.0011										
47.0	154.2	0.1784	0.1777	265	2	0.0004										
49.5	162.4	0.1812	0.1806	274	1	0.0004										
52.0	170.6	0.1831	0.1835	283	1	-0.0006										
54.5	178.8	0.1870	0.1865	292	3	0.0004										
57.0	187.0	0.1920	0.1894	301	3	0.0024										

Explanation:

d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

TABLE A-12. P-wave arrival times and velocity summaries.

Location: Potrero Canyon (Valley Center) Coordinates: 34.39522 -118.66317 Hole_Code: 280
hoffset = 4.00 travel-time file: D:\POT\POTP.TT
nlayers = 5

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0228	0.0104	193	3	-0.0004	2.0	2.0	193	182	205	6.6	6.6	633	598	673
4.5	14.8	0.0226	0.0151	298	3	0.0038	7.0	5.0	525	490	567	23.0	16.4	1723	1606	1859
7.0	23.0	0.0222	0.0199	352	2	-0.0001	22.0	15.0	2178	2022	2359	72.2	49.2	7145	6633	7741
9.5	31.2	0.0222	0.0210	452	1	0.0004	33.0	11.0	1777	1674	1894	108.3	36.1	5830	5491	6214
12.0	39.4	0.0224	0.0222	541	1	-0.0003	57.0	24.0	2190	2111	2275	187.0	78.7	7185	6926	7464
14.5	47.6	0.0228	0.0233	622	1	-0.0009										
17.0	55.8	0.0248	0.0245	695	1	0.0000										
19.5	64.0	0.0260	0.0256	761	1	0.0001										
22.0	72.2	0.0274	0.0268	822	1	0.0004										
24.5	80.4	0.0282	0.0282	869	1	-0.0002										
27.0	88.6	0.0300	0.0296	913	1	0.0002										
29.5	96.8	0.0310	0.0310	952	1	-0.0001										
32.0	105.0	0.0330	0.0324	988	1	0.0005										
34.5	113.2	0.0336	0.0336	1025	1	-0.0002										
37.0	121.4	0.0350	0.0348	1064	1	0.0001										
39.5	129.6	0.0358	0.0359	1099	1	-0.0002										
42.0	137.8	0.0372	0.0371	1133	1	0.0000										
44.5	146.0	0.0380	0.0382	1164	1	-0.0003										
47.0	154.2	0.0398	0.0394	1194	1	0.0004										
49.5	162.4	0.0404	0.0405	1222	1	-0.0002										
52.0	170.6	0.0414	0.0416	1249	1	-0.0003										
54.5	178.8	0.0428	0.0428	1274	1	-0.0001										
57.0	187.0	0.0444	0.0439	1298	1	0.0004										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

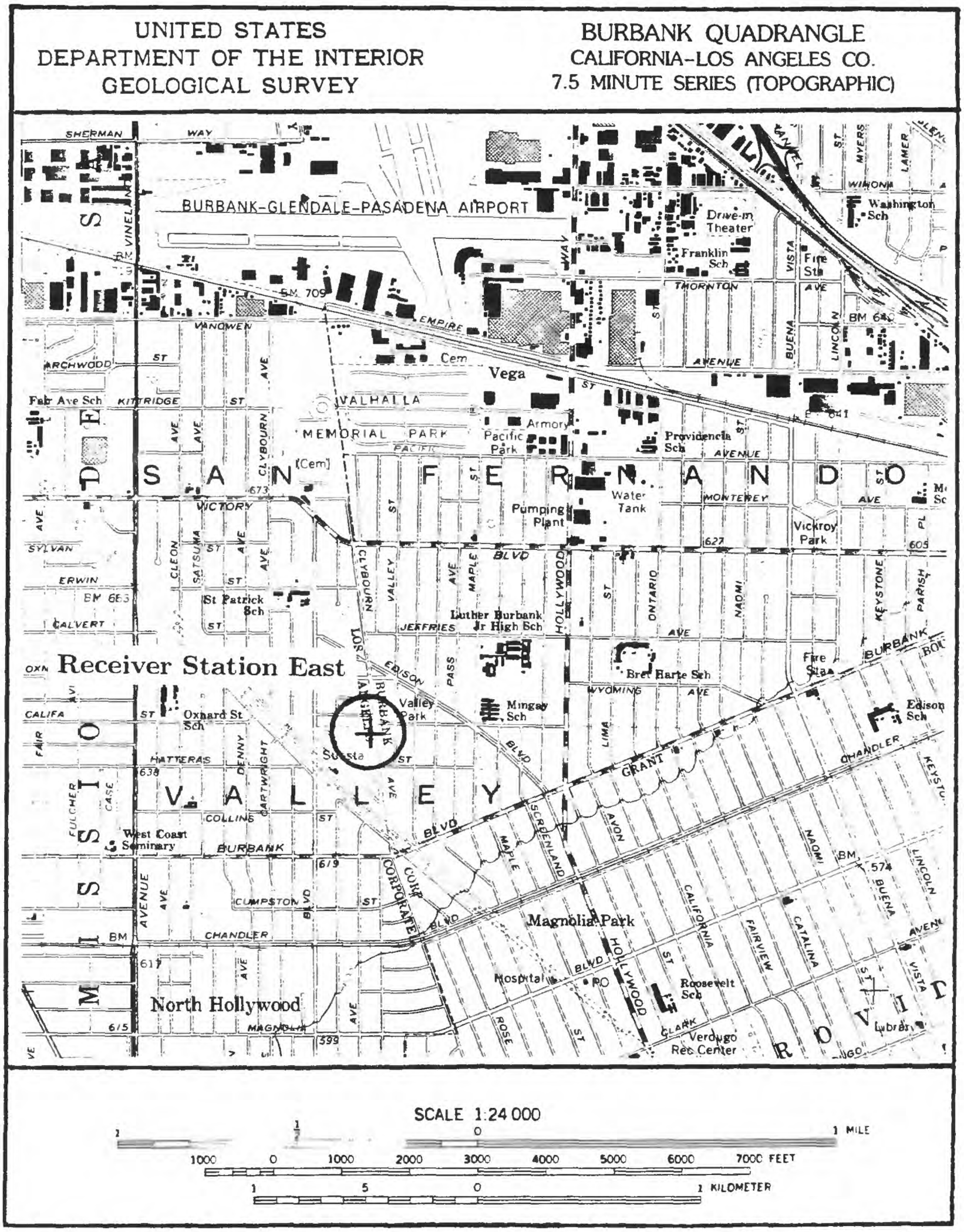

Figure A-31. Site location map for the borehole Receiver Station East. The borehole is located approximately 140 meters from the strong-motion accelerograph.

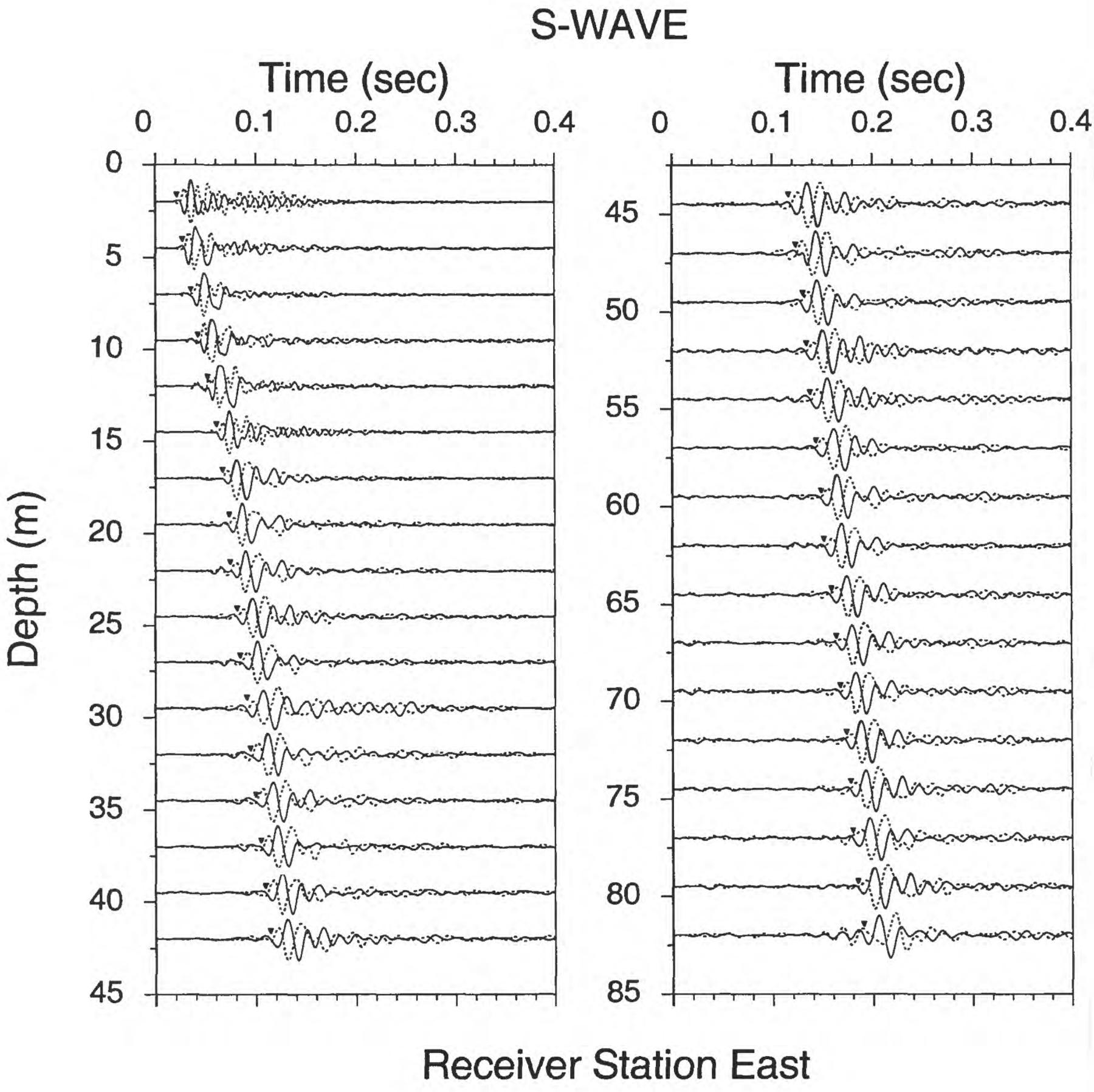

Figure A-32. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

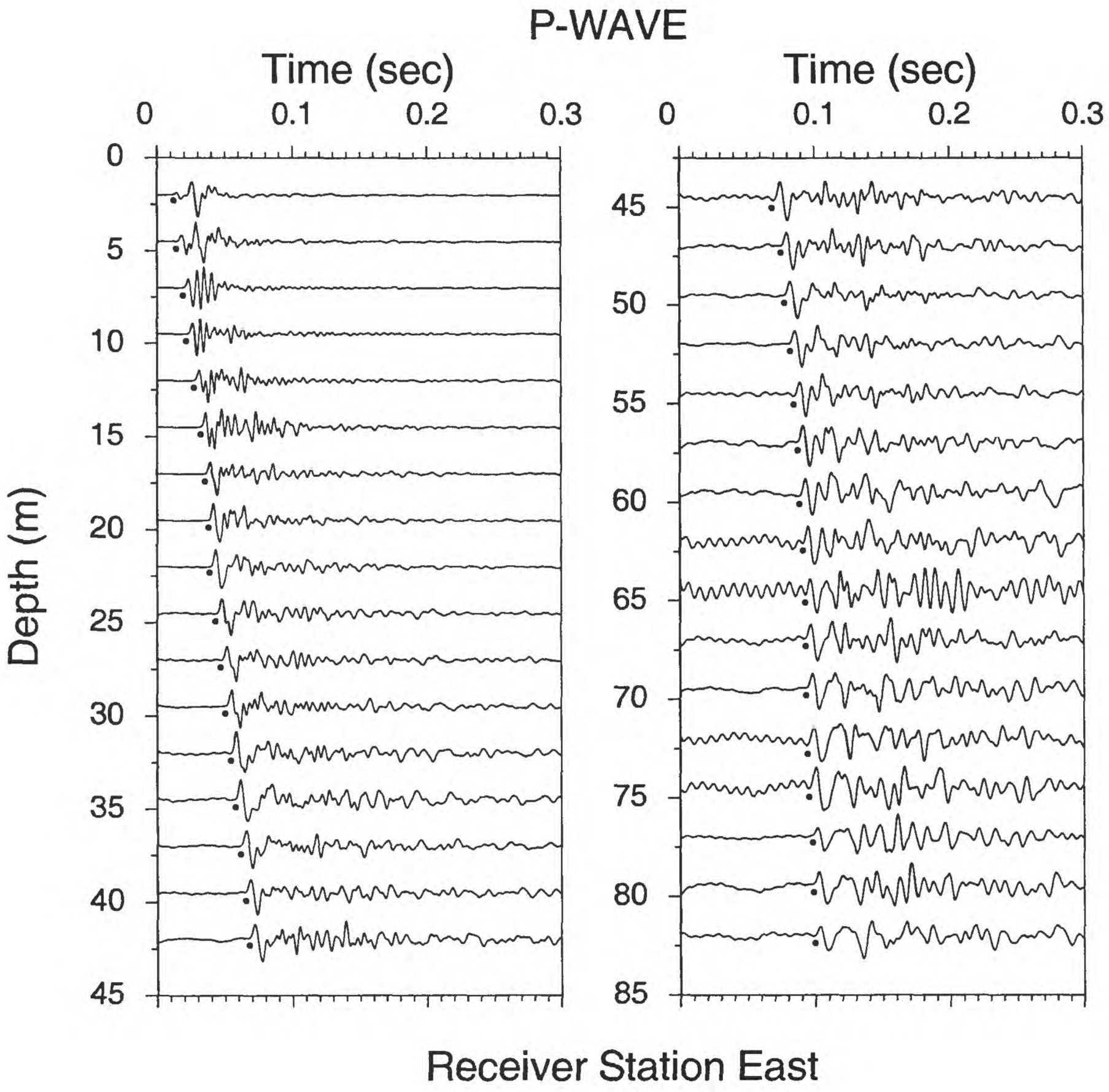

Figure A-33. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

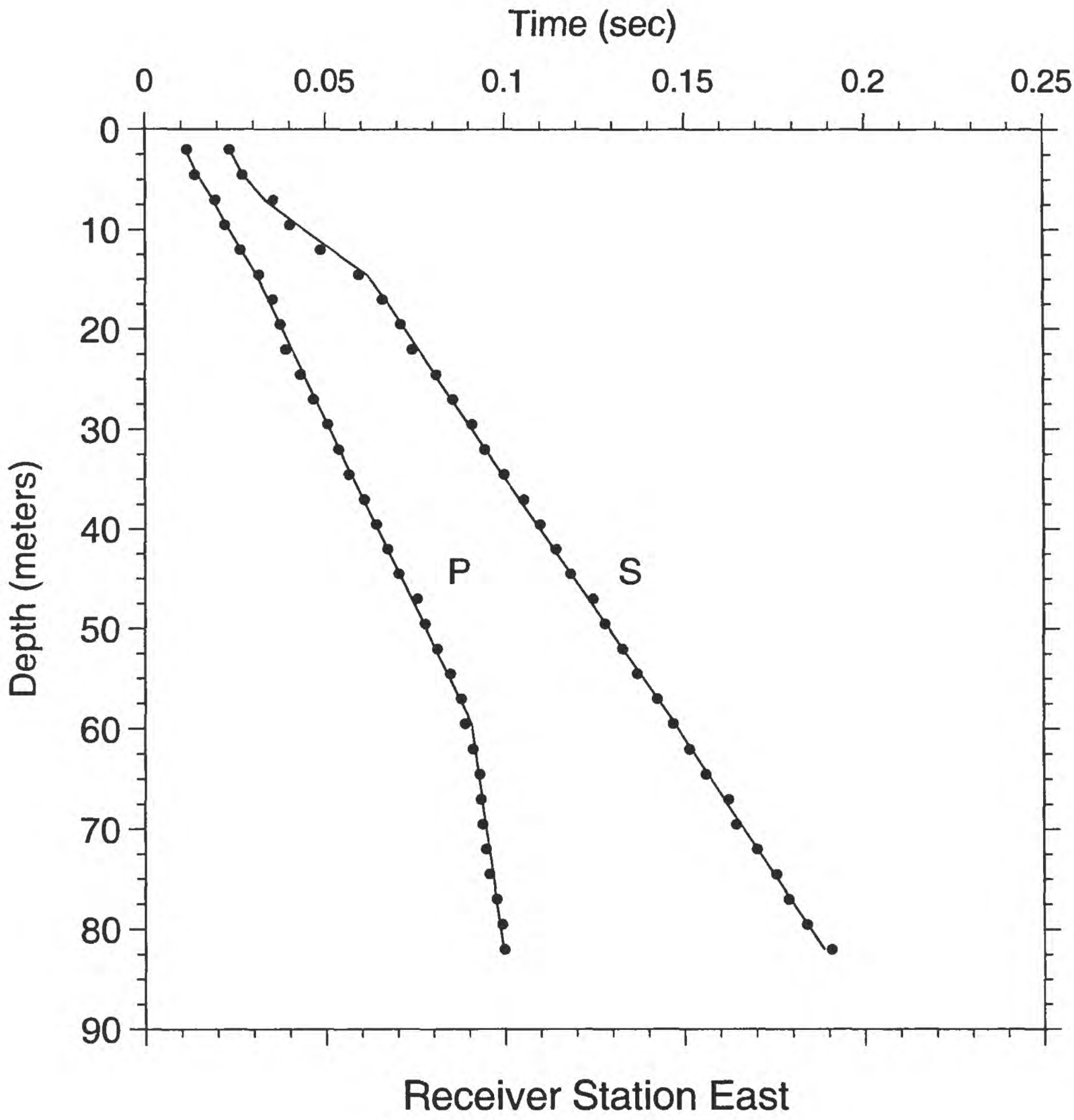

Figure A-34. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

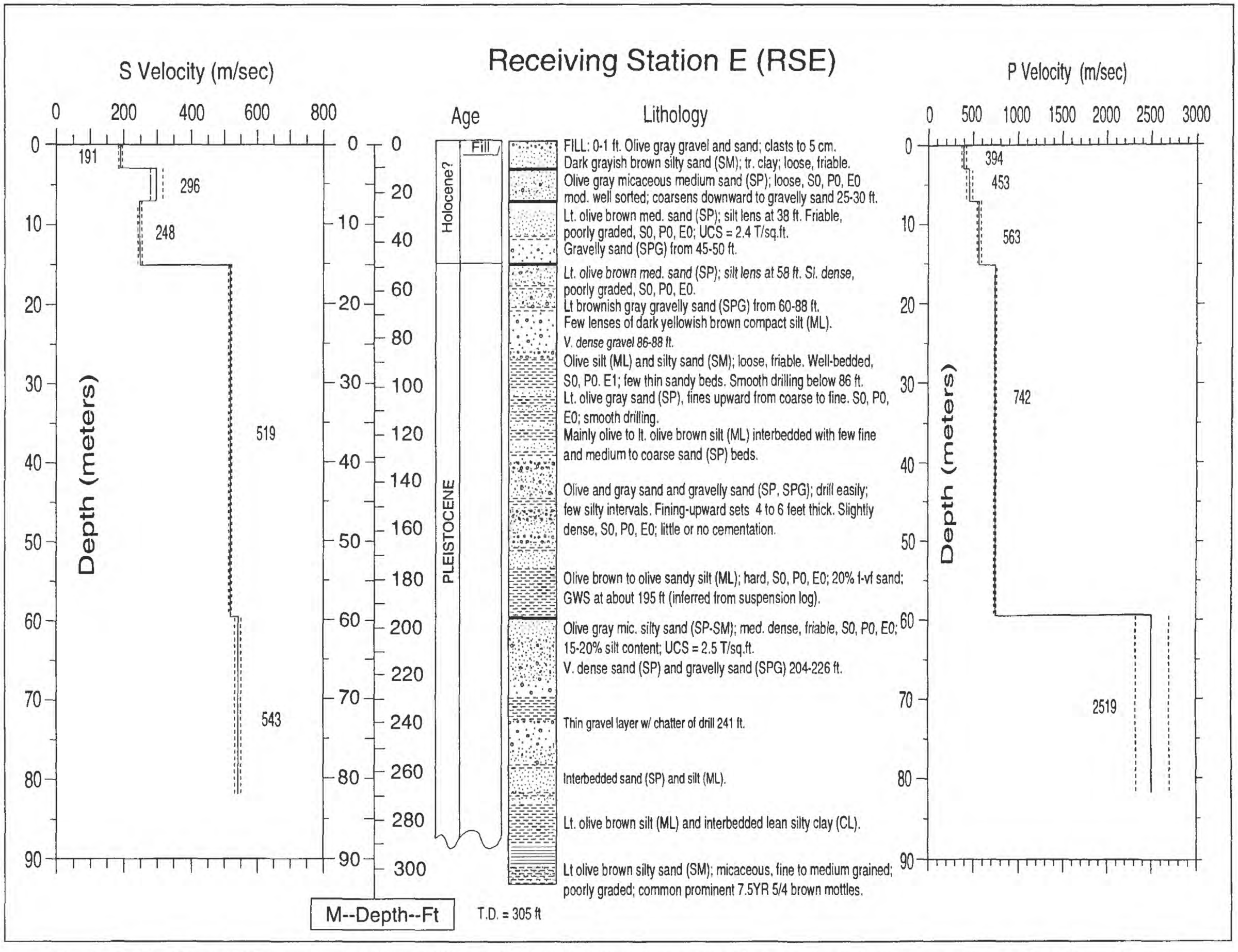

Figure A-35. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-13. S-wave arrival times and velocity summaries.

Location: Receiver Station East: S Coordinates: 34.17723 -118.35790 Hole_Code: 286
hoffset = 4.00 travel-time file: D:\RSE\RSES.TT
nlayers = 5

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0235	0.0105	191	1	0.0000	2.9	2.9	191	185	196	9.5	9.5	625	608	643
4.5	14.8	0.0270	0.0206	219	1	-0.0001	7.0	4.1	296	278	315	23.0	13.5	970	913	1035
7.0	23.0	0.0355	0.0290	241	2	0.0022	15.0	8.0	248	242	254	49.2	26.2	813	794	834
9.5	31.2	0.0402	0.0391	243	2	-0.0021	59.5	44.5	519	516	523	195.2	146.0	1703	1692	1714
12.0	39.4	0.0487	0.0492	244	3	-0.0031	82.0	22.5	543	534	551	269.0	73.8	1780	1753	1809
14.5	47.6	0.0593	0.0593	245	2	-0.0023										
17.0	55.8	0.0660	0.0651	261	1	-0.0008										
19.5	64.0	0.0710	0.0700	279	2	-0.0003										
22.0	72.2	0.0742	0.0748	294	2	-0.0017										
24.5	80.4	0.0810	0.0796	308	1	0.0004										
27.0	88.6	0.0857	0.0844	320	2	0.0005										
29.5	96.8	0.0910	0.0892	331	1	0.0010										
32.0	105.0	0.0945	0.0940	340	2	-0.0002										
34.5	113.2	0.1000	0.0989	349	1	0.0005										
37.0	121.4	0.1055	0.1037	357	2	0.0012										
39.5	129.6	0.1100	0.1085	364	1	0.0010										
42.0	137.8	0.1145	0.1133	371	1	0.0007										
44.5	146.0	0.1185	0.1181	377	1	-0.0001										
47.0	154.2	0.1248	0.1229	382	2	0.0014										
49.5	162.4	0.1280	0.1278	387	2	-0.0002										
52.0	170.6	0.1330	0.1326	392	1	0.0000										
54.5	178.8	0.1370	0.1374	397	1	-0.0008										
57.0	187.0	0.1425	0.1422	401	1	-0.0001										
59.5	195.2	0.1470	0.1470	405	1	-0.0004										
62.0	203.4	0.1515	0.1516	409	1	-0.0005										
64.5	211.6	0.1560	0.1562	413	1	-0.0006										
67.0	219.8	0.1622	0.1608	417	2	0.0011										
69.5	228.0	0.1645	0.1655	420	2	-0.0012										
72.0	236.2	0.1702	0.1701	423	1	-0.0001										
74.5	244.4	0.1755	0.1747	427	1	0.0006										
77.0	252.6	0.1790	0.1793	430	2	-0.0005										
79.5	260.8	0.1840	0.1839	432	1	-0.0001										
82.0	269.0	0.1908	0.1885	435	4	0.0020										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-14. P-wave arrival times and velocity summaries.

Location: Receiver Station East: P Coordinates: 34.17723 -118.35790 Hole_Code: 286
hoffset = 4.00 travel-time file: D:\RSE\RSEP.TT
nlayers = 5

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0117	0.0051	394	1	0.0004	2.9	2.9	394	372	420	9.5	9.5	1294	1220	1378
4.5	14.8	0.0138	0.0109	413	1	-0.0007	7.0	4.1	453	420	492	23.0	13.5	1487	1378	1614
7.0	23.0	0.0195	0.0164	427	1	0.0006	15.0	8.0	563	540	589	49.2	26.2	1848	1770	1933
9.5	31.2	0.0222	0.0209	456	1	-0.0004	59.5	44.5	742	735	748	195.2	146.0	2433	2412	2455
12.0	39.4	0.0264	0.0253	474	1	-0.0002	82.0	22.5	2519	2343	2724	269.0	73.8	8265	7687	8936
14.5	47.6	0.0315	0.0297	488	1	0.0007										
17.0	55.8	0.0354	0.0333	510	1	0.0012										
19.5	64.0	0.0375	0.0367	532	1	0.0001										
22.0	72.2	0.0390	0.0401	549	1	-0.0017										
24.5	80.4	0.0432	0.0434	564	1	-0.0008										
27.0	88.6	0.0468	0.0468	577	1	-0.0005										
29.5	96.8	0.0507	0.0502	588	1	0.0001										
32.0	105.0	0.0537	0.0535	598	1	-0.0002										
34.5	113.2	0.0567	0.0569	606	1	-0.0006										
37.0	121.4	0.0609	0.0603	614	1	0.0003										
39.5	129.6	0.0642	0.0636	621	1	0.0003										
42.0	137.8	0.0675	0.0670	627	1	0.0002										
44.5	146.0	0.0705	0.0704	632	1	-0.0002										
47.0	154.2	0.0756	0.0737	637	1	0.0016										
49.5	162.4	0.0777	0.0771	642	1	0.0003										
52.0	170.6	0.0813	0.0805	646	1	0.0006										
54.5	178.8	0.0849	0.0839	650	1	0.0008										
57.0	187.0	0.0879	0.0872	653	1	0.0005										
59.5	195.2	0.0891	0.0906	657	1	-0.0017										
62.0	203.4	0.0912	0.0916	677	2	-0.0006										
64.5	211.6	0.0930	0.0926	697	3	0.0003										
67.0	219.8	0.0933	0.0936	716	1	-0.0004										
69.5	228.0	0.0939	0.0946	735	1	-0.0008										
72.0	236.2	0.0948	0.0956	753	2	-0.0009										
74.5	244.4	0.0957	0.0965	772	2	-0.0010										
77.0	252.6	0.0978	0.0975	789	1	0.0002										
79.5	260.8	0.0993	0.0985	807	1	0.0007										
82.0	269.0	0.0999	0.0995	824	2	0.0003										

Explanation:

- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

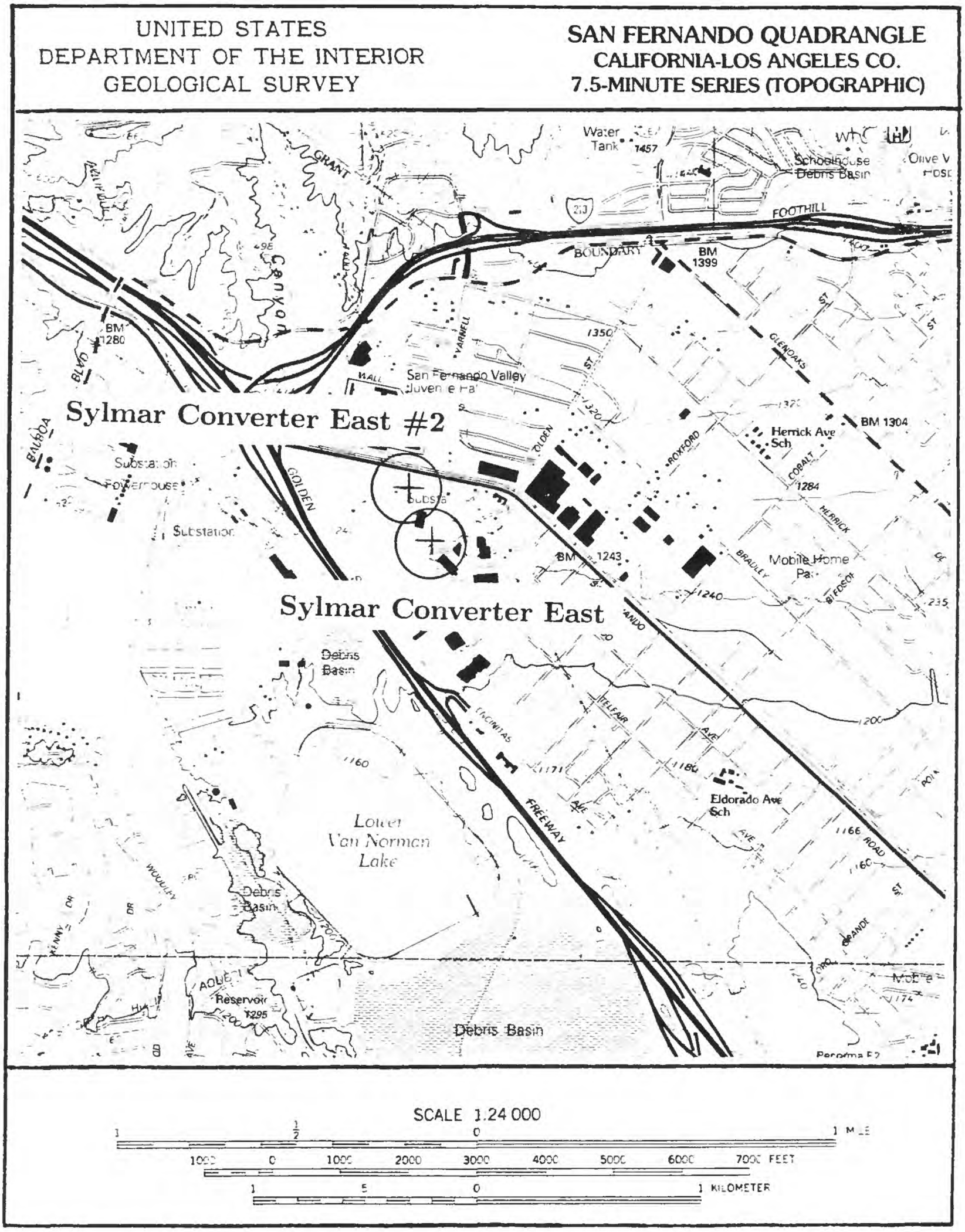

Figure A-36. Site location map for the borehole Sylmar Converter East. The borehole is located approximately 5 meters from the strong-motion accelerograph.

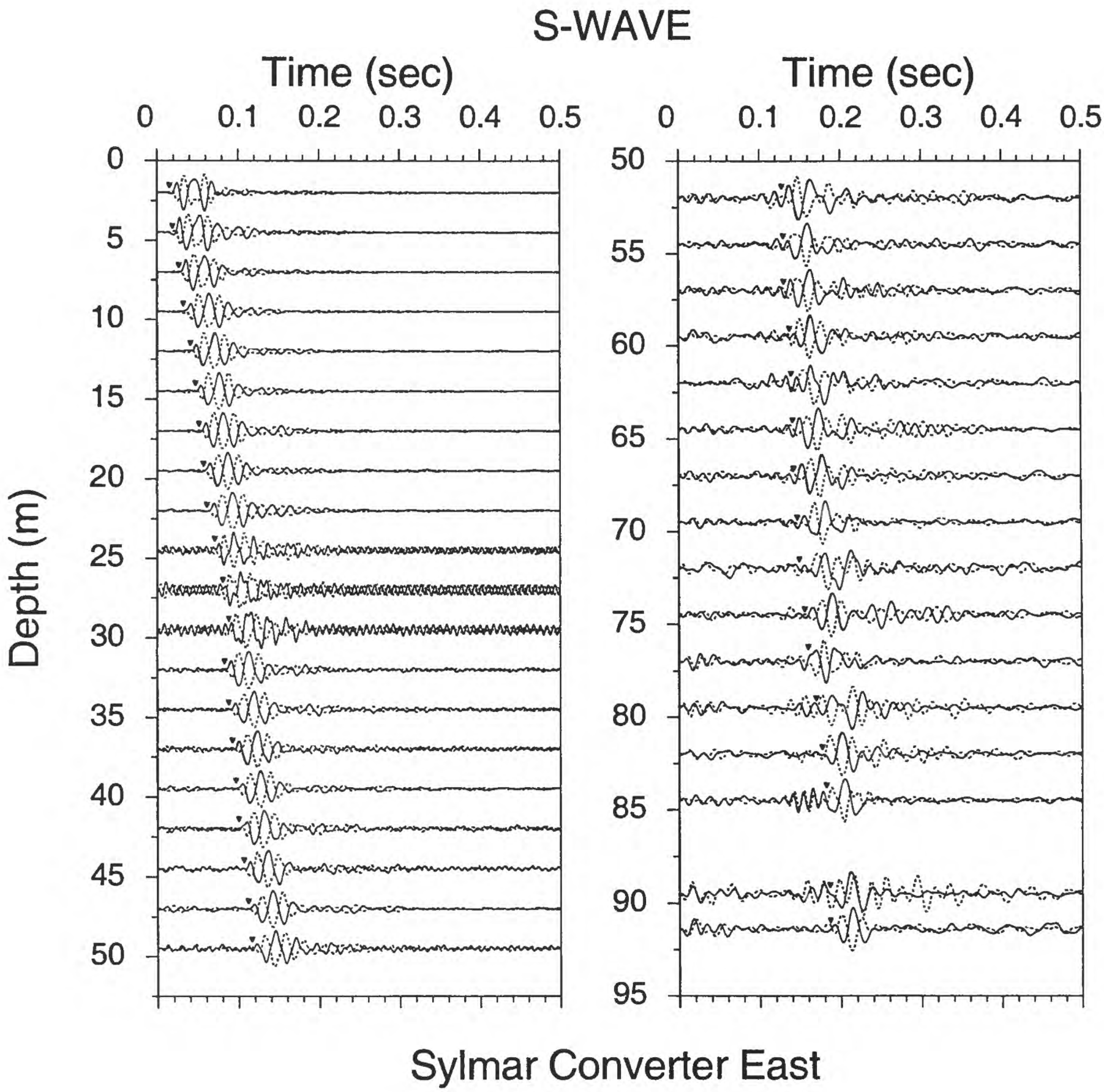

Figure A-37. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

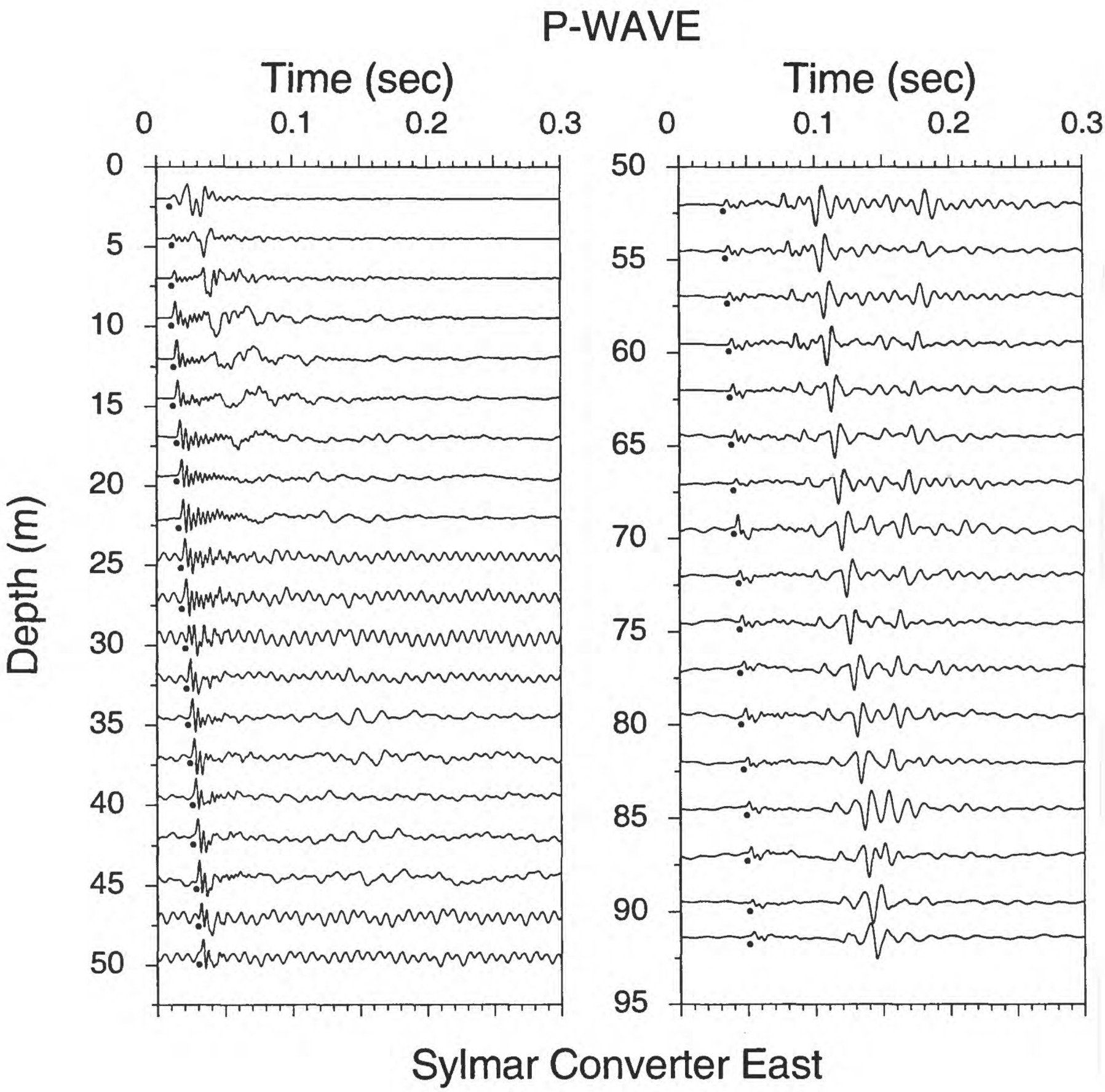

Figure A-38. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

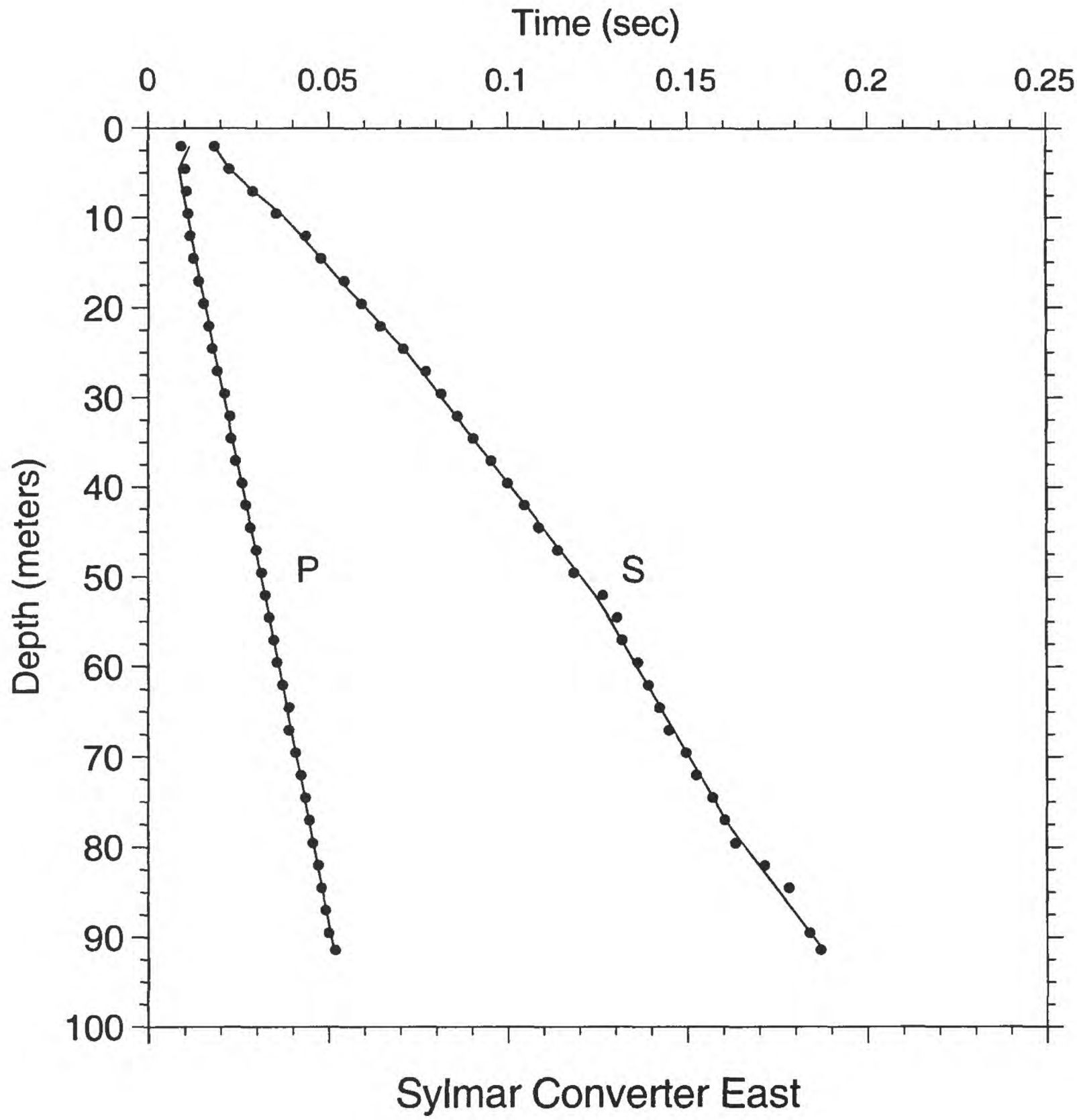

Figure A-39. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

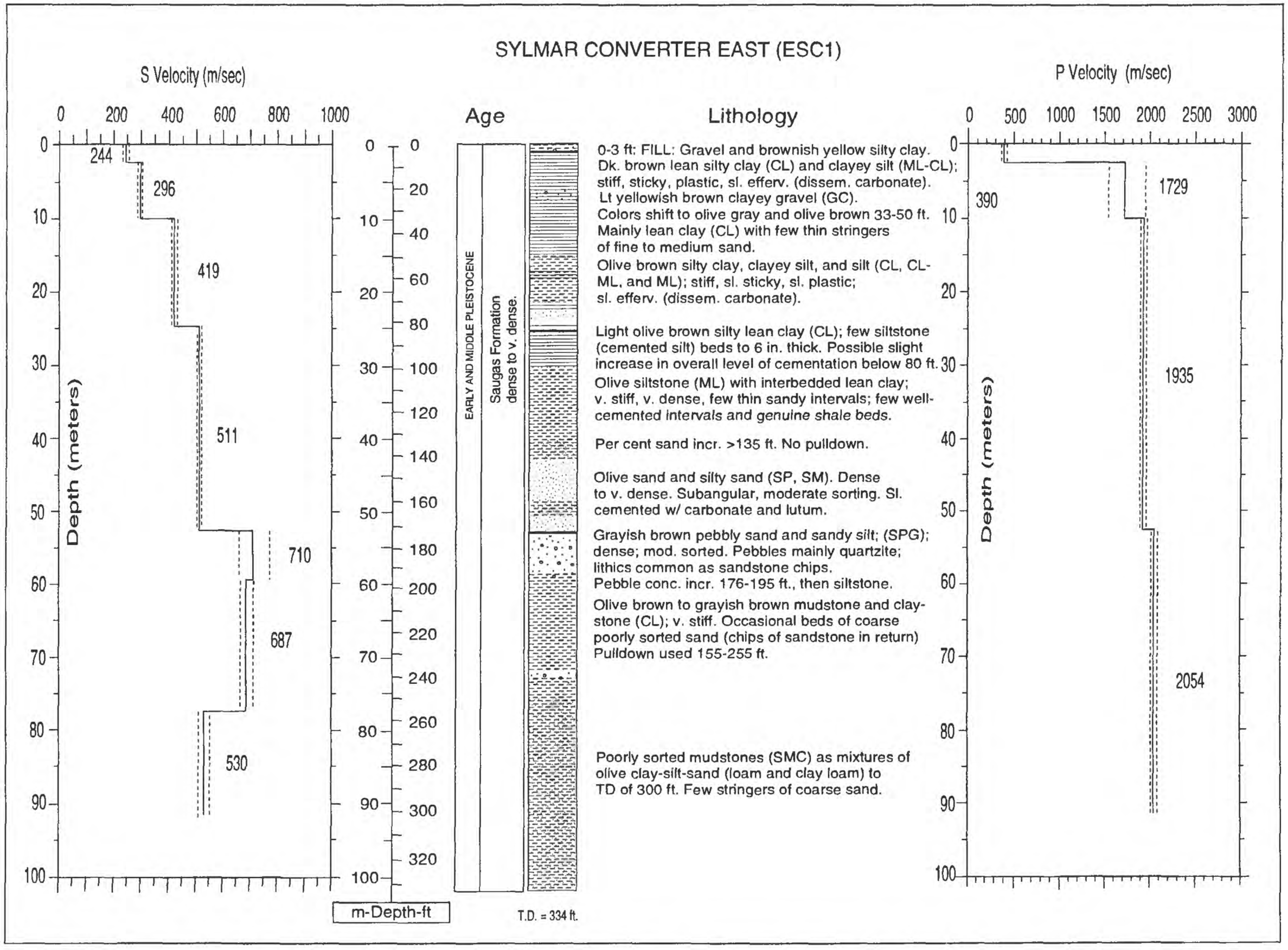

Figure A-40. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-15. S-wave arrival times and velocity summaries.

Location: Sylmar Converter East: S Coordinates: 34.31077 -118.47986 Hole_Code: 282
hoffset = 4.00 travel-time file: D:\ESC\ESCS.TT
nlayers = 7

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0185	0.0082	244	1	0.0001	2.4	2.4	244	234	254	7.9	7.9	799	767	833
4.5	14.8	0.0225	0.0169	266	1	-0.0001	10.0	7.6	296	288	304	32.8	24.9	970	945	996
7.0	23.0	0.0290	0.0254	276	1	-0.0002	24.7	14.7	419	409	428	81.0	48.2	1373	1343	1405
9.5	31.2	0.0355	0.0338	281	1	-0.0012	52.7	28.0	511	504	519	172.9	91.9	1677	1652	1702
12.0	39.4	0.0437	0.0403	298	1	0.0013	59.4	6.7	710	658	771	194.9	22.0	2330	2159	2530
14.5	47.6	0.0480	0.0463	314	1	0.0000	77.4	18.0	687	664	711	253.9	59.1	2253	2177	2334
17.0	55.8	0.0545	0.0522	326	1	0.0009	91.4	14.0	530	511	551	299.9	45.9	1740	1676	1809
19.5	64.0	0.0593	0.0582	335	1	-0.0002										
22.0	72.2	0.0645	0.0642	343	1	-0.0007										
24.5	80.4	0.0710	0.0701	349	2	-0.0001										
27.0	88.6	0.0772	0.0751	360	3	0.0013										
29.5	96.8	0.0815	0.0800	369	2	0.0007										
32.0	105.0	0.0860	0.0849	377	1	0.0004										
34.5	113.2	0.0905	0.0898	384	1	0.0001										
37.0	121.4	0.0955	0.0947	391	1	0.0002										
39.5	129.6	0.1000	0.0996	397	1	-0.0001										
42.0	137.8	0.1047	0.1045	402	1	-0.0002										
44.5	146.0	0.1088	0.1093	407	1	-0.0011										
47.0	154.2	0.1140	0.1142	411	1	-0.0007										
49.5	162.4	0.1185	0.1191	416	1	-0.0011										
52.0	170.6	0.1265	0.1240	419	1	0.0021										
54.5	178.8	0.1305	0.1279	426	3	0.0022										
57.0	187.0	0.1320	0.1314	434	2	0.0002										
59.5	195.2	0.1363	0.1350	441	1	0.0009										
62.0	203.4	0.1392	0.1386	447	2	0.0003										
64.5	211.6	0.1423	0.1423	453	1	-0.0003										
67.0	219.8	0.1450	0.1459	459	1	-0.0012										
69.5	228.0	0.1497	0.1495	465	1	-0.0001										
72.0	236.2	0.1525	0.1532	470	2	-0.0010										
74.5	244.4	0.1570	0.1568	475	1	-0.0001										
77.0	252.6	0.1605	0.1604	480	1	-0.0002										
79.5	260.8	0.1635	0.1650	482	4	-0.0018										
82.0	269.0	0.1715	0.1697	483	1	0.0015										
84.5	277.2	0.1782	0.1744	484	3	0.0036										
89.5	293.6	0.1840	0.1839	487	5	-0.0001										
91.4	299.9	0.1870	0.1874	488	1	-0.0007										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-16. P-wave arrival times and velocity summaries.

Location: Sylmar Converter East: P Coordinates: 34.31077 -118.47986 Hole_Code: 282
hoffset = 4.00 travel-time file: D:\ESC\ESCP.TT
nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0092	0.0051	390	2	-0.0023	2.4	2.4	390	363	422	7.9	7.9	1281	1192	1384
4.5	14.8	0.0102	0.0074	611	1	0.0016	10.0	7.6	1729	1548	1956	32.8	24.9	5671	5080	6418
7.0	23.0	0.0106	0.0088	794	1	0.0010	52.7	42.7	1935	1910	1961	172.9	140.1	6350	6266	6435
9.5	31.2	0.0110	0.0103	926	1	0.0002	91.4	38.7	2054	2020	2089	299.9	127.0	6738	6626	6853
12.0	39.4	0.0116	0.0116	1036	1	-0.0004										
14.5	47.6	0.0126	0.0129	1126	1	-0.0006										
17.0	55.8	0.0140	0.0142	1200	1	-0.0004										
19.5	64.0	0.0154	0.0155	1261	1	-0.0003										
22.0	72.2	0.0168	0.0168	1313	1	-0.0002										
24.5	80.4	0.0178	0.0180	1358	2	-0.0004										
27.0	88.6	0.0192	0.0193	1396	2	-0.0003										
29.5	96.8	0.0212	0.0206	1430	2	0.0004										
32.0	105.0	0.0226	0.0219	1460	1	0.0005										
34.5	113.2	0.0230	0.0232	1486	1	-0.0003										
37.0	121.4	0.0242	0.0245	1510	1	-0.0004										
39.5	129.6	0.0260	0.0258	1531	2	0.0001										
42.0	137.8	0.0270	0.0271	1551	1	-0.0002										
44.5	146.0	0.0284	0.0284	1568	1	-0.0001										
47.0	154.2	0.0300	0.0297	1584	1	0.0002										
49.5	162.4	0.0314	0.0310	1599	1	0.0004										
52.0	170.6	0.0324	0.0323	1612	1	0.0001										
54.5	178.8	0.0336	0.0335	1627	1	0.0000										
57.0	187.0	0.0348	0.0347	1642	1	0.0000										
59.5	195.2	0.0357	0.0359	1656	1	-0.0003										
62.0	203.4	0.0372	0.0371	1669	1	0.0000										
64.5	211.6	0.0390	0.0384	1681	1	0.0006										
67.0	219.8	0.0390	0.0396	1693	1	-0.0006										
69.5	228.0	0.0408	0.0408	1704	1	0.0000										
72.0	236.2	0.0423	0.0420	1714	1	0.0002										
74.5	244.4	0.0435	0.0432	1723	1	0.0002										
77.0	252.6	0.0447	0.0444	1732	1	0.0002										
79.5	260.8	0.0456	0.0457	1741	1	-0.0001										
82.0	269.0	0.0471	0.0469	1749	1	0.0002										
84.5	277.2	0.0480	0.0481	1757	1	-0.0001										
87.0	285.4	0.0492	0.0493	1764	1	-0.0002										
89.5	293.6	0.0501	0.0505	1771	1	-0.0005										
91.4	299.9	0.0519	0.0515	1776	1	0.0004										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

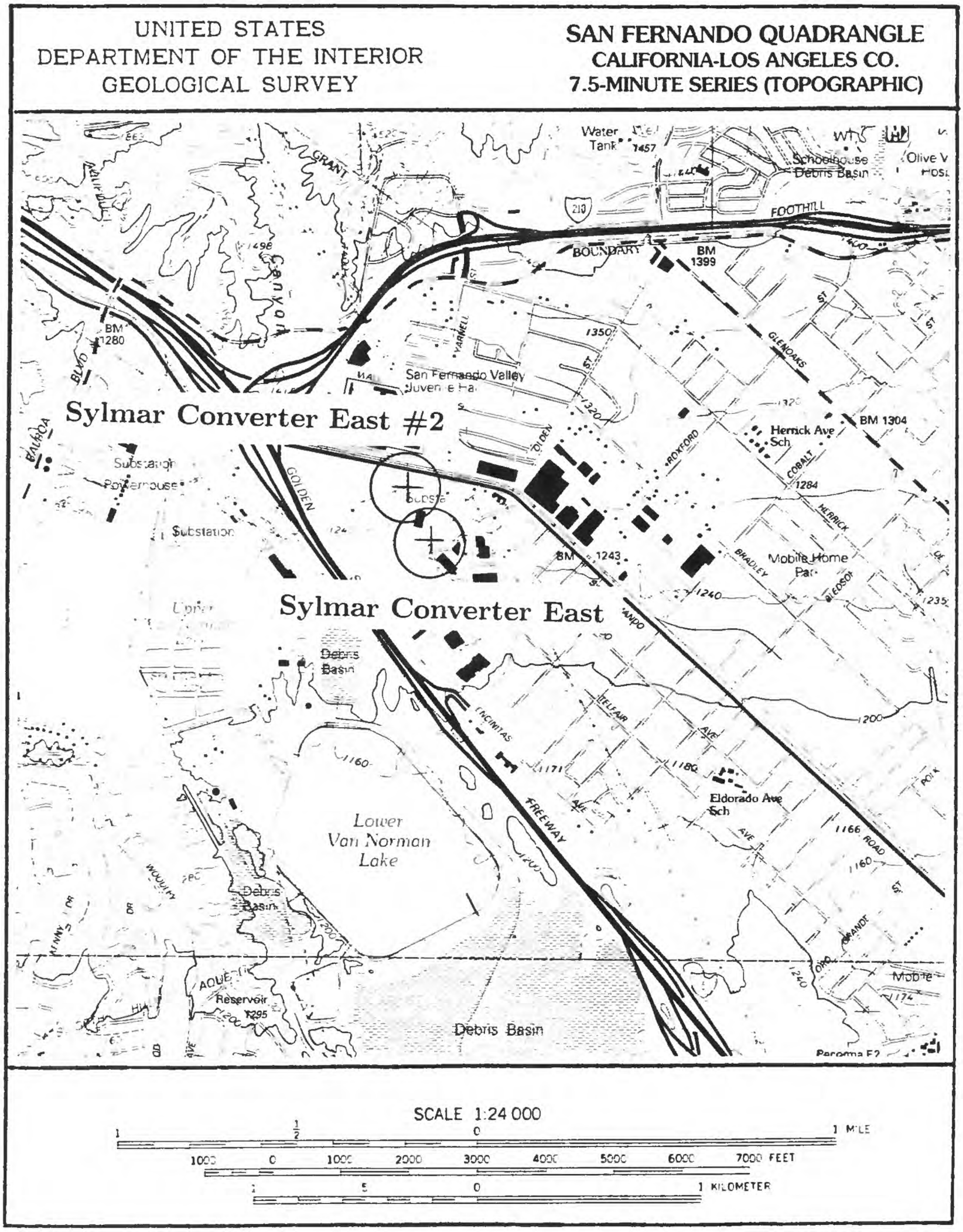

Figure A-41. Site location map for the borehole Sylmar Converter East #2. This site was drilled for geologic information.

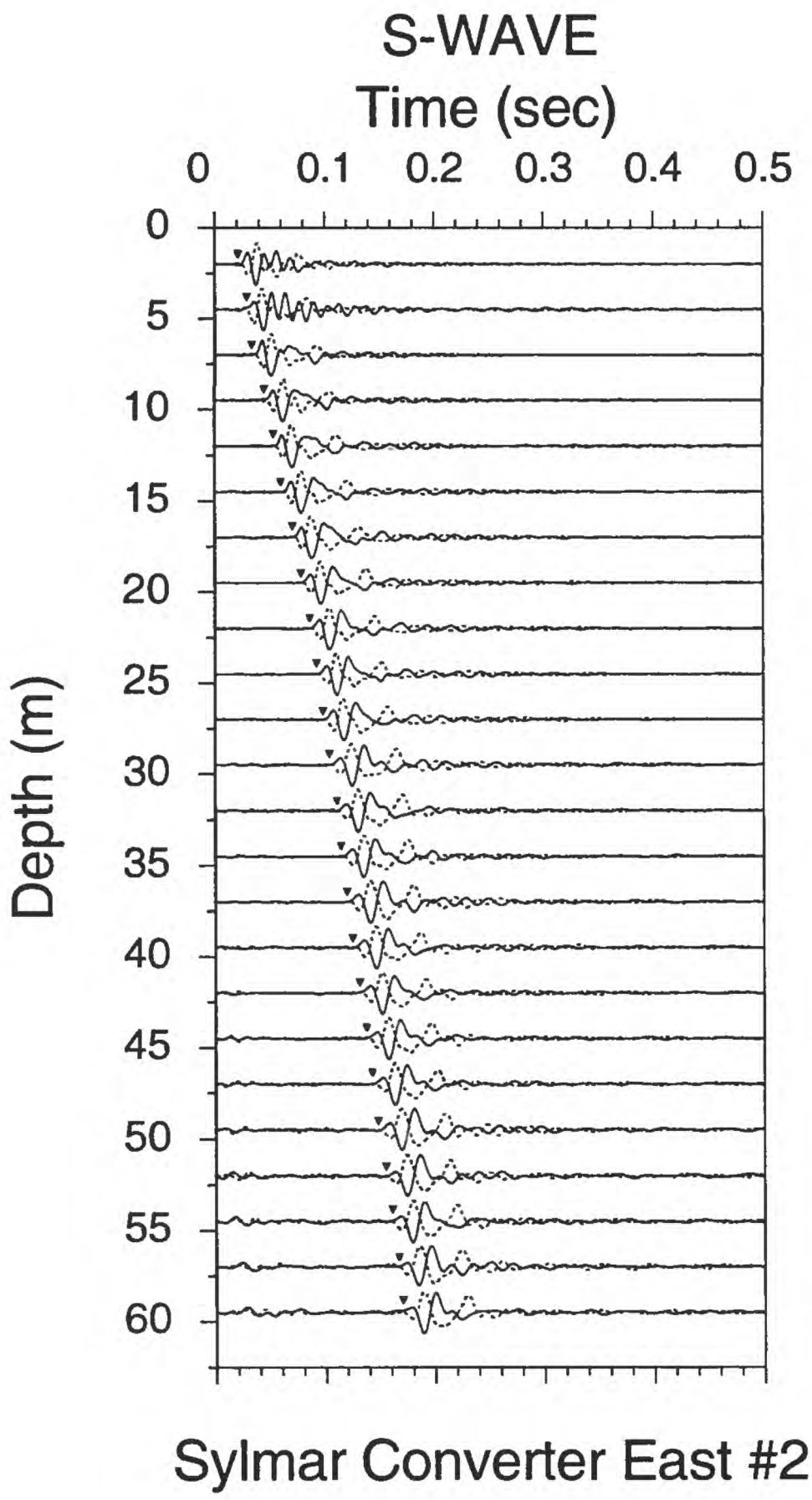

Figure A-42. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

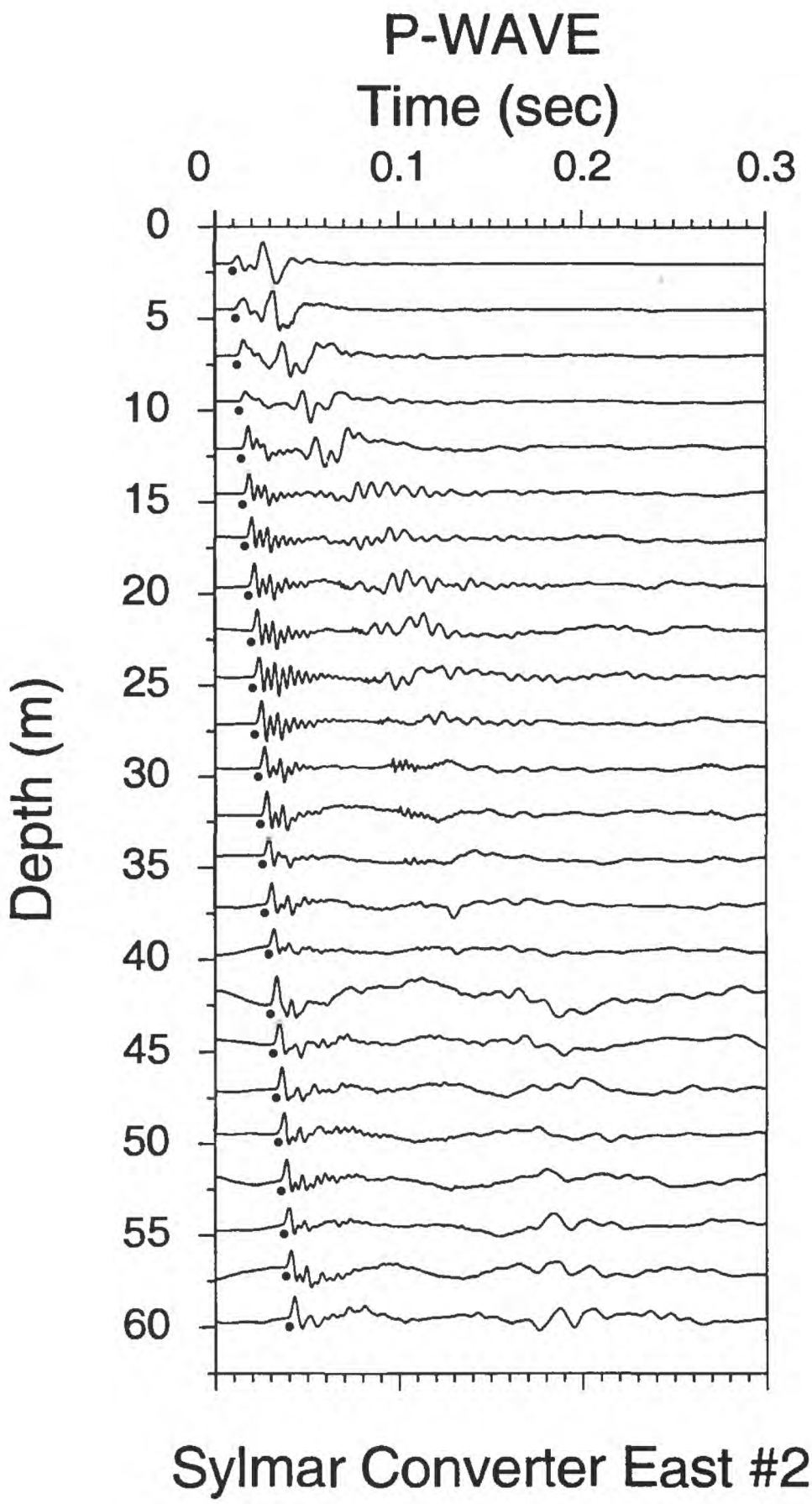

Figure A-43. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

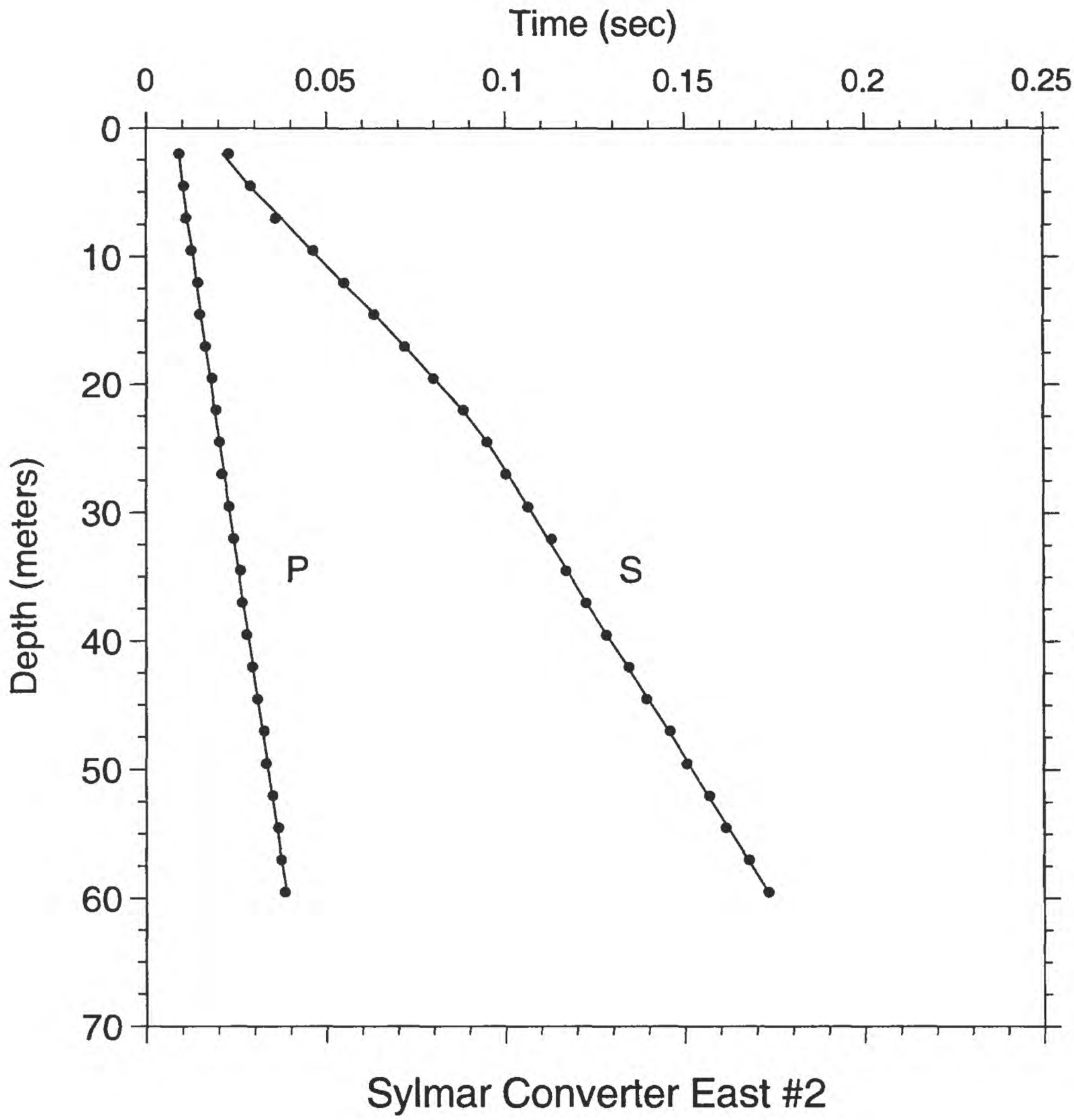

Figure A-44. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

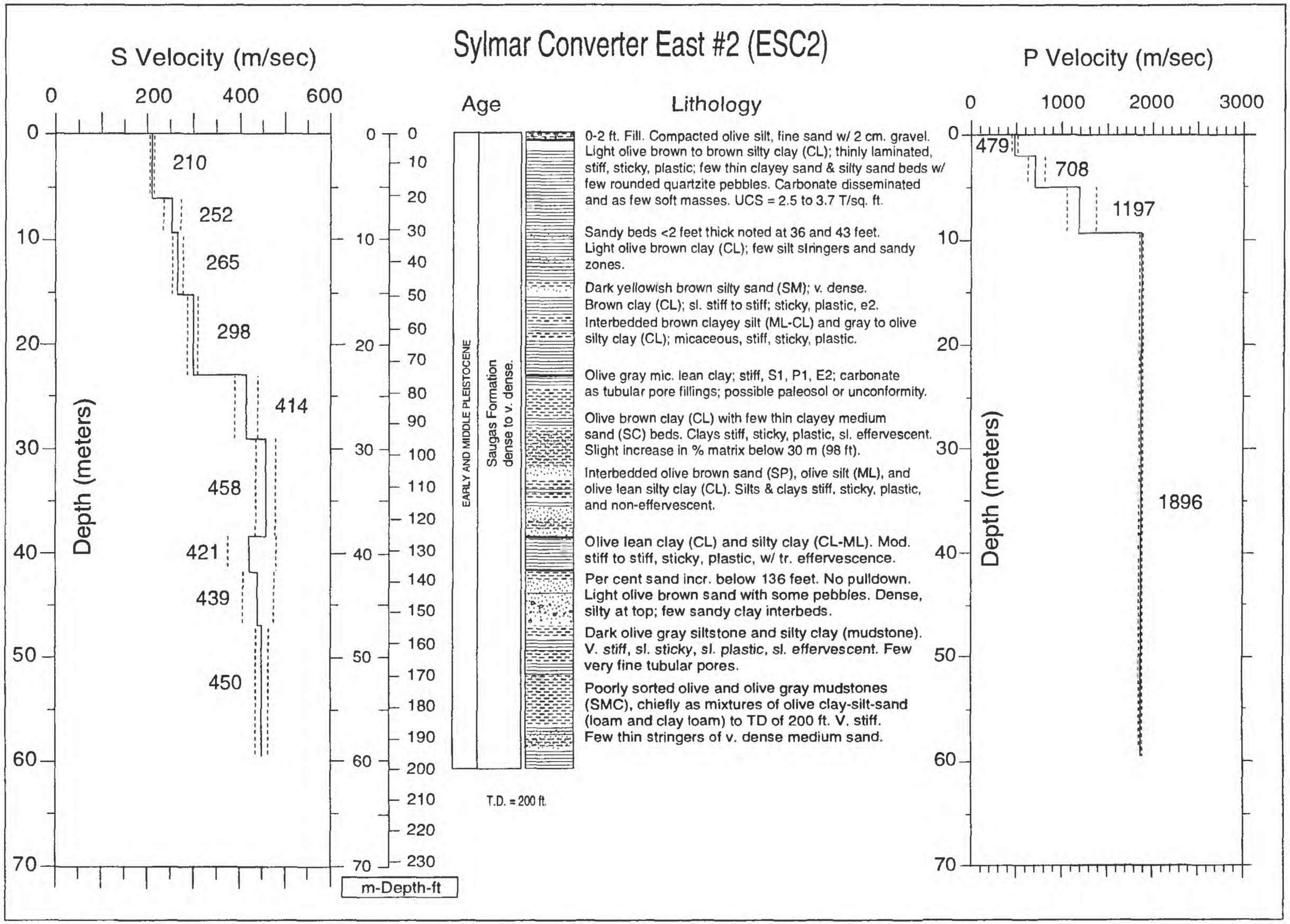

Figure A-45. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-17. S-wave arrival times and velocity summaries.

Location: Sylmar Converter East #2: S Coordinates: 34.31288 -118.48089 Hole_Code: 289
hoffset = 4.00 travel-time file: D:\ESC2\ESC2S.TT
nlayers = 9

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0230	0.0095	210	1	0.0017	6.1	6.1	210	205	214	20.0	20.0	688	673	703
4.5	14.8	0.0290	0.0214	210	2	0.0003	9.4	3.3	252	235	272	30.8	10.8	828	773	892
7.0	23.0	0.0360	0.0326	215	1	-0.0016	15.2	5.8	265	254	277	49.9	19.0	870	834	909
9.5	31.2	0.0465	0.0425	223	1	0.0004	22.9	7.7	298	287	309	75.1	25.3	977	942	1014
12.0	39.4	0.0550	0.0520	231	1	0.0003	29.0	6.1	414	390	441	95.1	20.0	1358	1280	1446
14.5	47.6	0.0635	0.0614	236	1	-0.0002	38.4	9.4	458	437	481	126.0	30.8	1502	1434	1578
17.0	55.8	0.0720	0.0701	243	1	0.0000	41.8	3.4	421	375	480	137.1	11.2	1381	1229	1576
19.5	64.0	0.0800	0.0785	249	1	-0.0001	47.0	5.2	439	407	476	154.2	17.1	1441	1337	1562
22.0	72.2	0.0885	0.0868	253	1	0.0002	59.5	12.5	450	437	465	195.2	41.0	1477	1433	1524
24.5	80.4	0.0950	0.0937	261	1	0.0000										
27.0	88.6	0.1002	0.0998	271	1	-0.0006										
29.5	96.8	0.1065	0.1057	279	1	-0.0001										
32.0	105.0	0.1130	0.1112	288	1	0.0010										
34.5	113.2	0.1170	0.1166	296	1	-0.0004										
37.0	121.4	0.1227	0.1221	303	1	0.0000										
39.5	129.6	0.1283	0.1277	309	1	-0.0001										
42.0	137.8	0.1345	0.1337	314	1	0.0002										
44.5	146.0	0.1395	0.1394	319	1	-0.0004										
47.0	154.2	0.1460	0.1450	324	1	0.0004										
49.5	162.4	0.1507	0.1506	329	1	-0.0003										
52.0	170.6	0.1570	0.1562	333	1	0.0004										
54.5	178.8	0.1615	0.1617	337	1	-0.0006										
57.0	187.0	0.1680	0.1673	341	1	0.0003										
59.5	195.2	0.1733	0.1728	344	1	0.0000										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-18. P-wave arrival times and velocity summaries.

Location: Sylmar Converter East #2: P Coordinates: 34.31288 -118.48089 Hole_Code: 289
hoffset = 4.00 travel-time file: D:\ESC2\ESC2P.TT
nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0093	0.0042	479	2	0.0000	2.0	2.0	479	445	519	6.6	6.6	1573	1460	1704
4.5	14.8	0.0105	0.0077	584	2	0.0003	5.0	3.0	708	627	812	16.4	9.8	2323	2058	2664
7.0	23.0	0.0111	0.0101	694	1	-0.0003	9.4	4.4	1197	1058	1379	30.8	14.4	3929	3471	4526
9.5	31.2	0.0126	0.0121	782	1	-0.0004	59.5	50.1	1876	1858	1893	195.2	164.4	6154	6097	6211
12.0	39.4	0.0144	0.0135	891	1	0.0004										
14.5	47.6	0.0150	0.0148	979	1	-0.0002										
17.0	55.8	0.0165	0.0161	1053	1	0.0000										
19.5	64.0	0.0183	0.0175	1116	1	0.0005										
22.0	72.2	0.0195	0.0188	1170	1	0.0005										
24.5	80.4	0.0204	0.0201	1217	1	0.0000										
27.0	88.6	0.0210	0.0215	1258	1	-0.0007										
29.5	96.8	0.0231	0.0228	1294	1	0.0001										
32.0	105.0	0.0243	0.0241	1326	1	0.0000										
34.5	113.2	0.0261	0.0255	1355	1	0.0005										
37.0	121.4	0.0267	0.0268	1381	1	-0.0002										
39.5	129.6	0.0279	0.0281	1404	1	-0.0004										
42.0	137.8	0.0294	0.0295	1425	1	-0.0002										
44.5	146.0	0.0309	0.0308	1445	1	0.0000										
47.0	154.2	0.0327	0.0321	1463	1	0.0005										
49.5	162.4	0.0333	0.0335	1479	1	-0.0003										
52.0	170.6	0.0351	0.0348	1494	1	0.0002										
54.5	178.8	0.0366	0.0361	1508	1	0.0004										
57.0	187.0	0.0375	0.0375	1522	1	0.0000										
59.5	195.2	0.0384	0.0388	1534	1	-0.0005										

Explanation:
d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

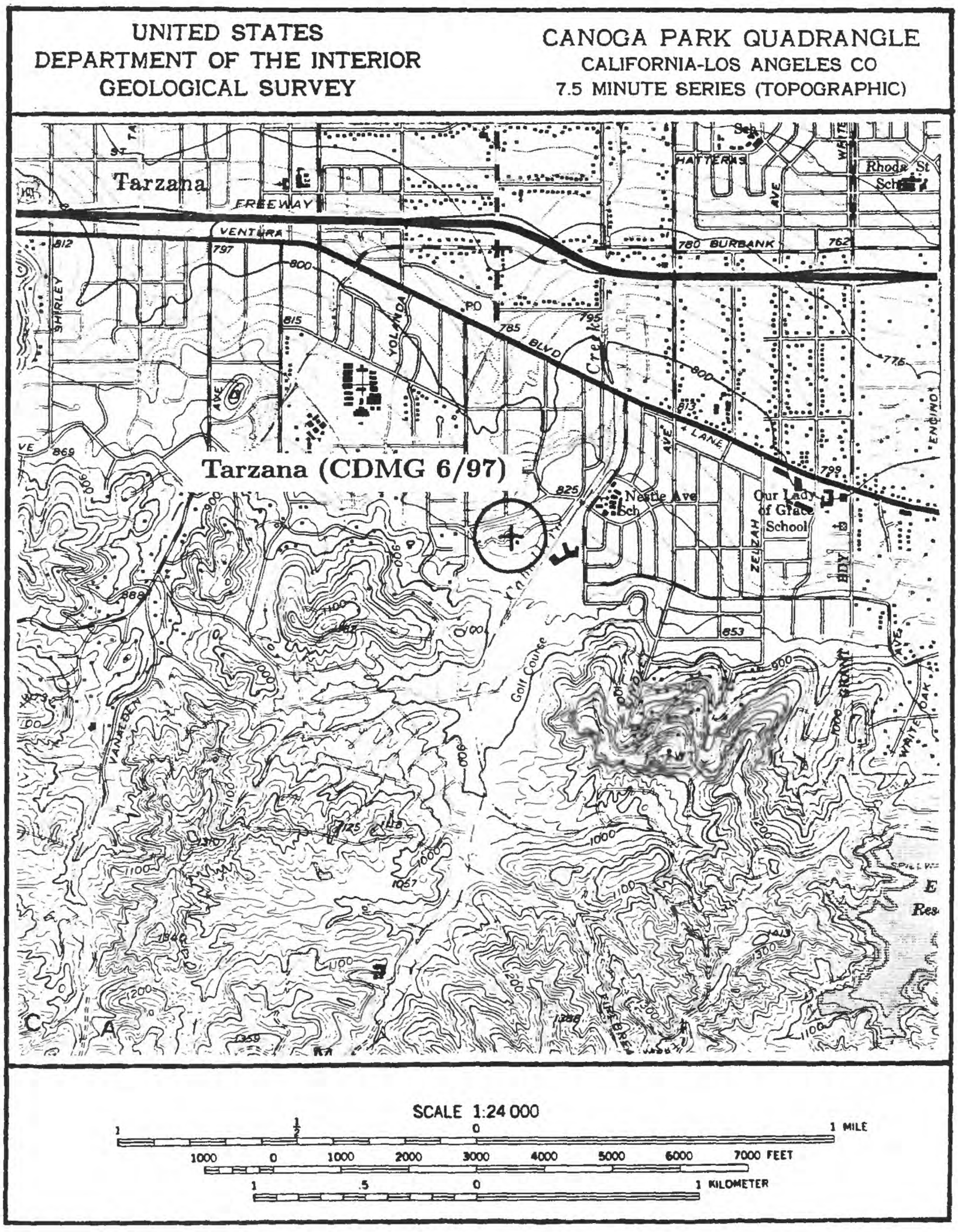

Figure A-46. Site location map for the borehole at Tarzana (top of hill near residence). A borehole seismic array is being installed at this location by California Division of Mines and Geology.

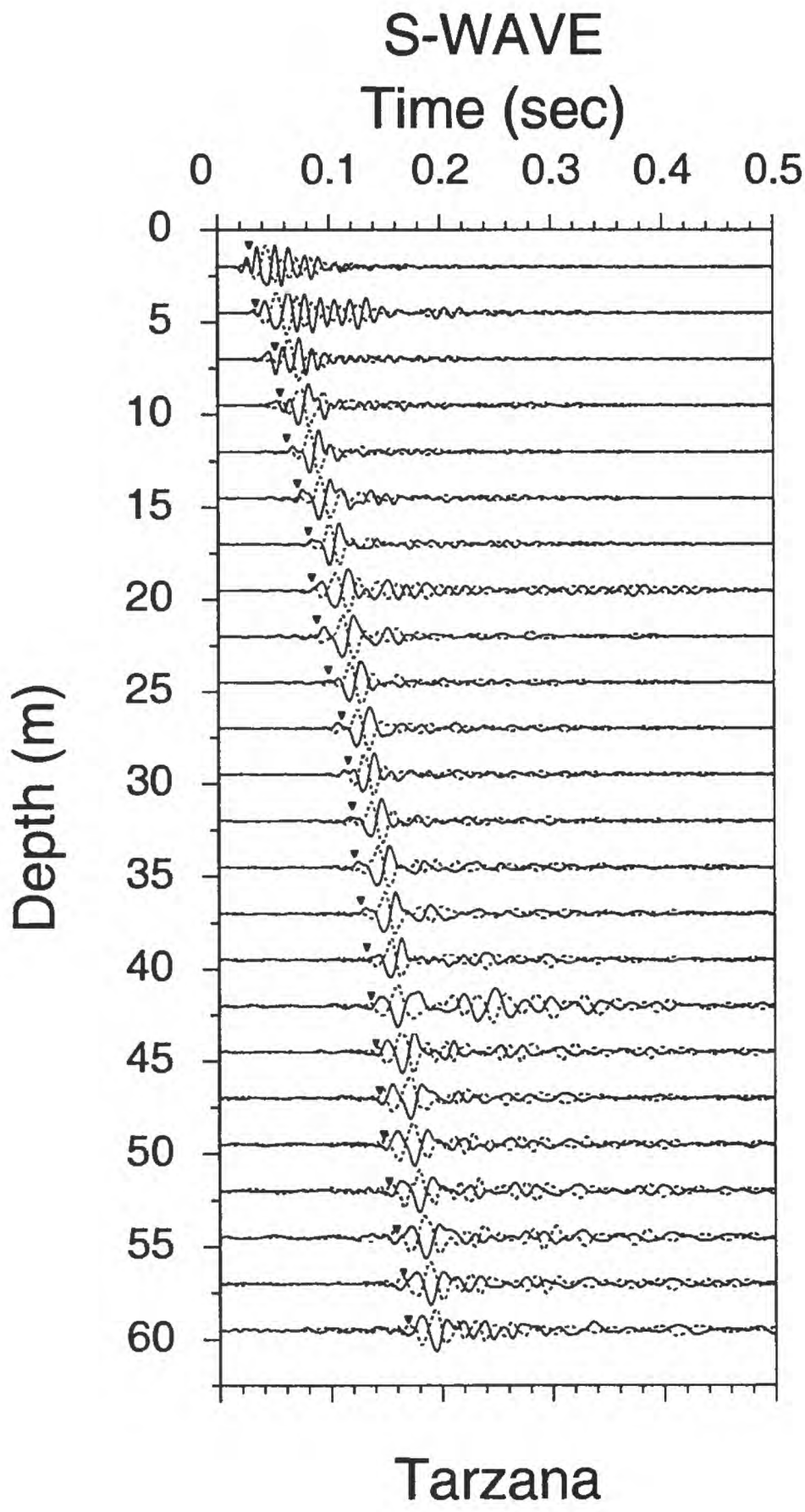

Figure A-47. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

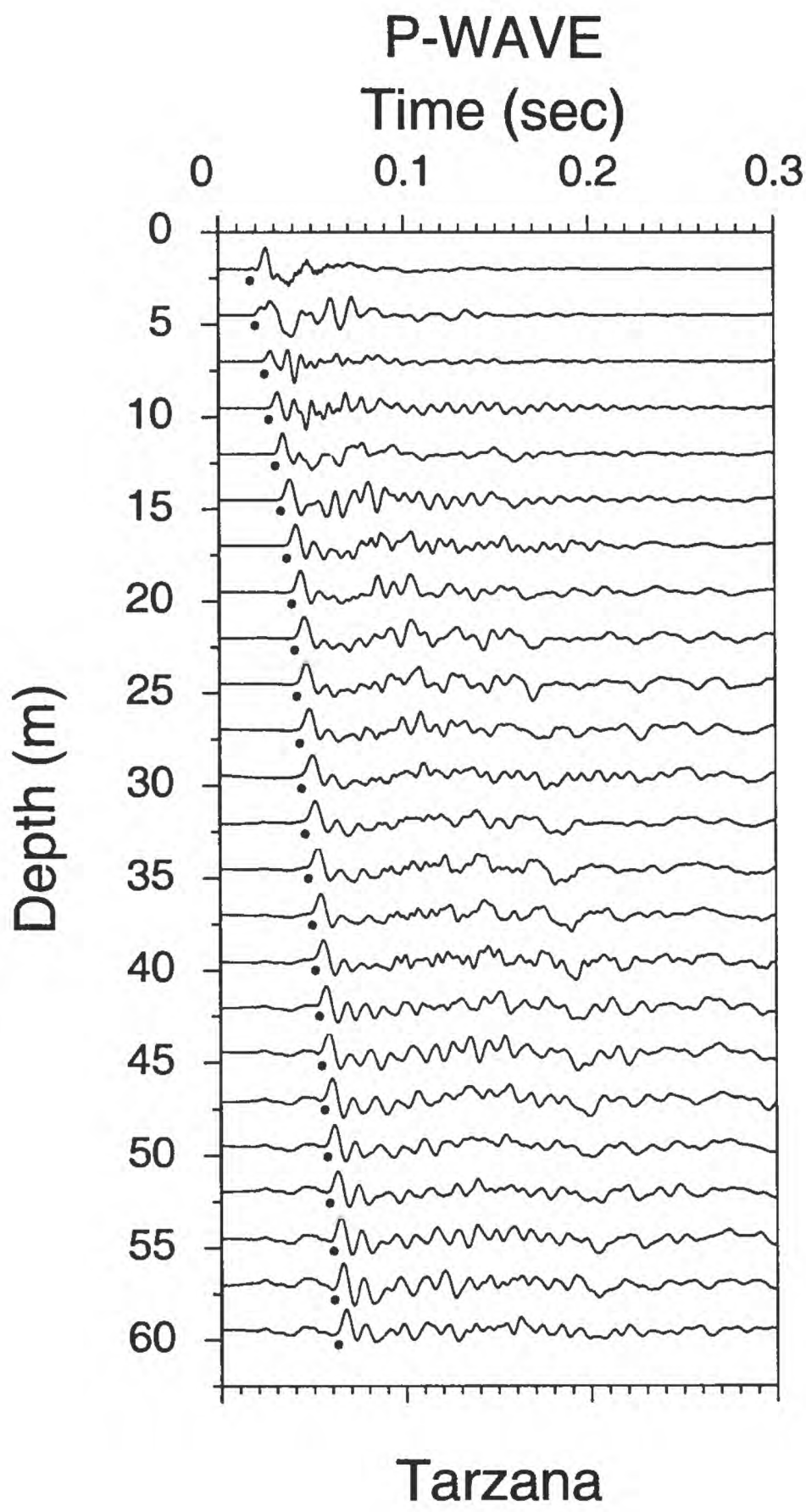

Figure A-48. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

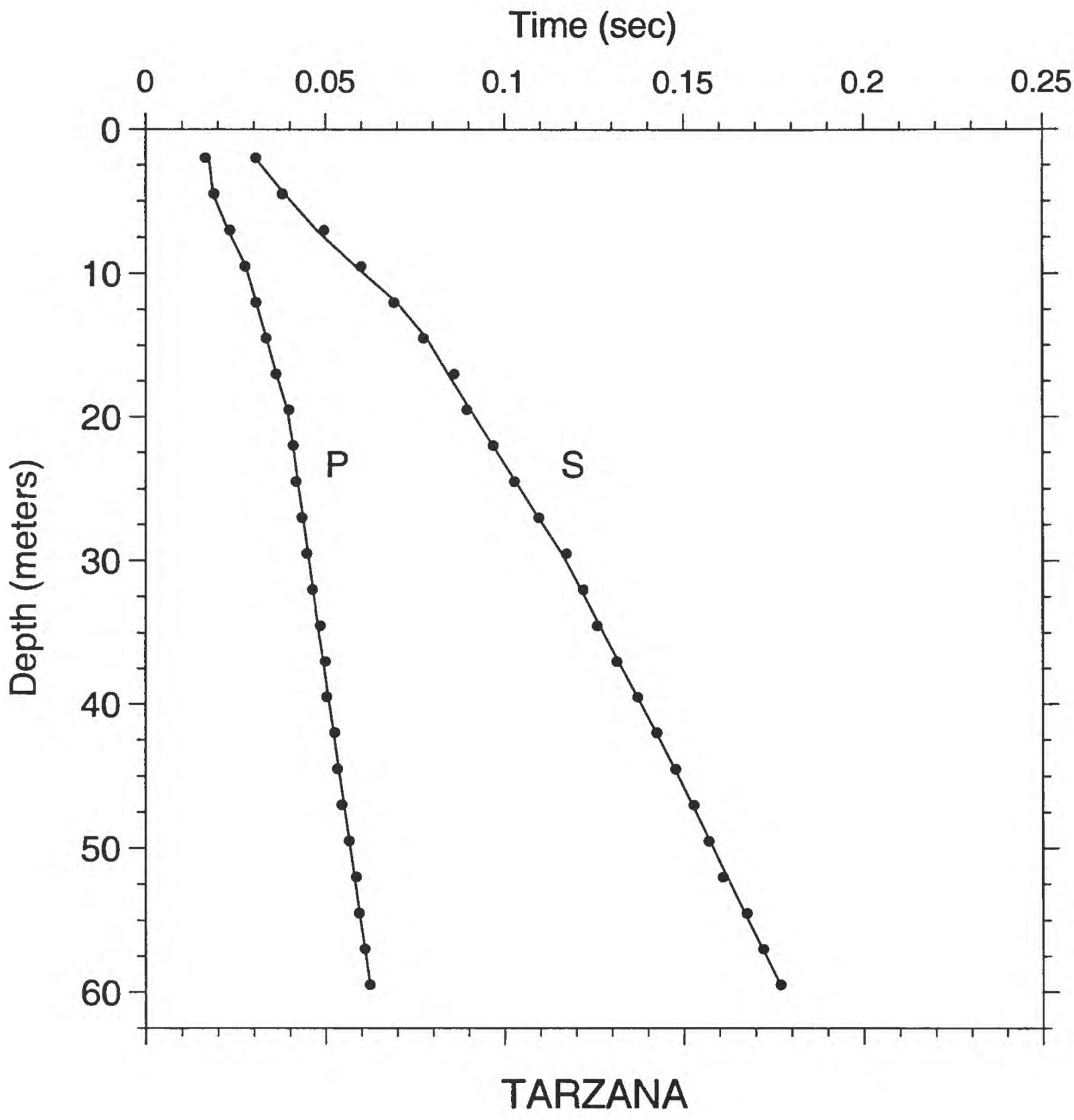

Figure A-49. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

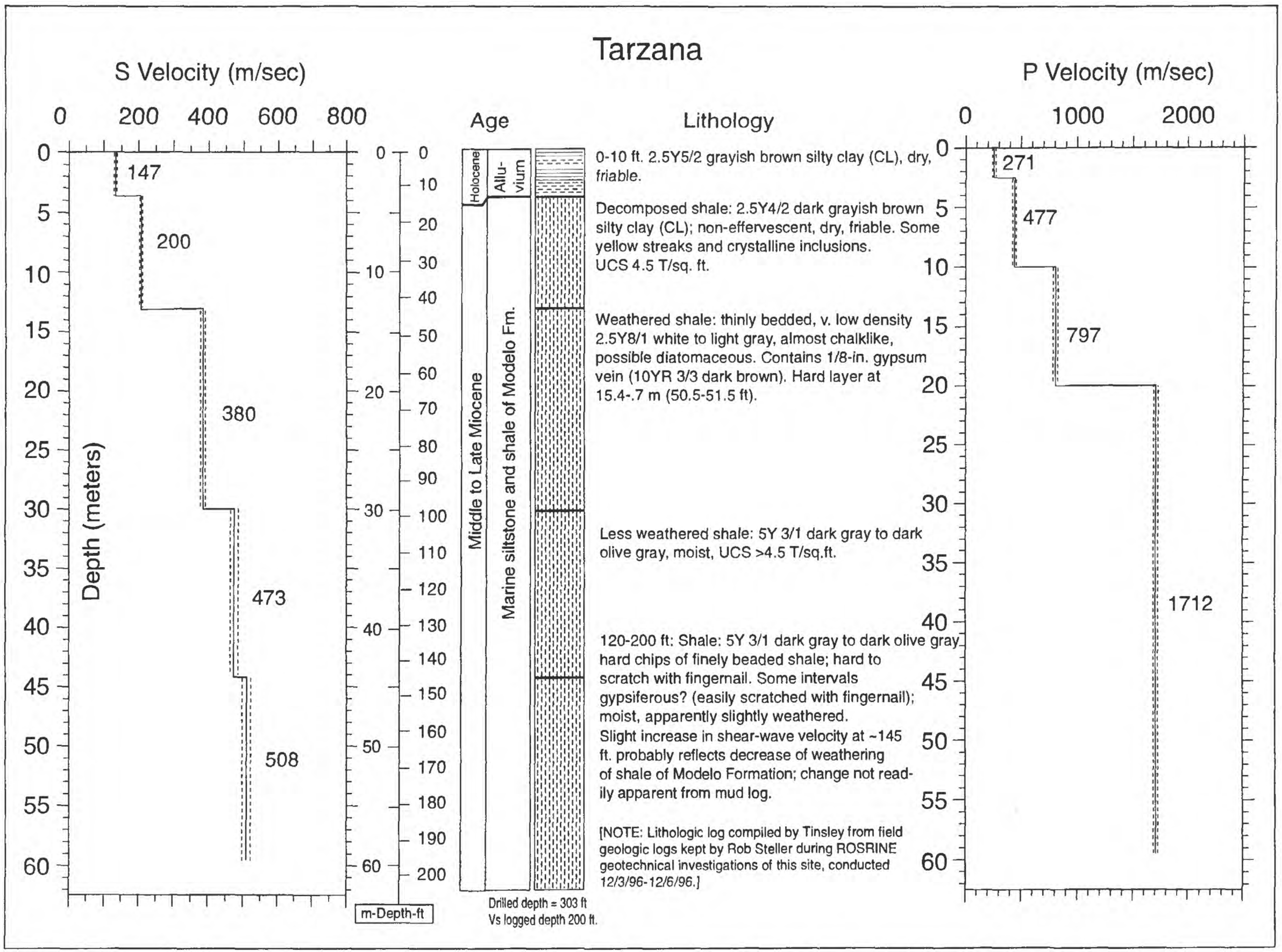

Figure A-50. S- and P-wave velocity profiles with dashed line representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-19. S-wave arrival times and velocity summaries.

Location: TARZANA: S Coordinates: 34.16048 -118.53440 Hole_Code: 281
hoffset = 4.00 travel-time file: D:\TAR\TARS.TT
nlayers = 5

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0306	0.0136	147	3	0.0002	3.6	3.6	147	143	151	11.8	11.8	483	470	496
4.5	14.8	0.0380	0.0290	155	1	-0.0006	13.1	9.5	200	196	204	43.0	31.2	656	644	668
7.0	23.0	0.0496	0.0415	169	4	0.0021	30.0	16.9	380	374	386	98.4	55.4	1246	1226	1268
9.5	31.2	0.0600	0.0540	176	1	0.0015	44.2	14.2	473	462	485	145.0	46.6	1553	1515	1593
12.0	39.4	0.0692	0.0665	180	1	-0.0009	59.5	15.3	508	495	522	195.2	50.2	1667	1625	1712
14.5	47.6	0.0774	0.0757	192	1	-0.0009										
17.0	55.8	0.0860	0.0823	207	1	0.0017										
19.5	64.0	0.0896	0.0888	220	1	-0.0009										
22.0	72.2	0.0969	0.0954	231	2	0.0001										
24.5	80.4	0.1029	0.1020	240	1	-0.0003										
27.0	88.6	0.1097	0.1086	249	1	0.0000										
29.5	96.8	0.1173	0.1151	256	2	0.0012										
32.0	105.0	0.1221	0.1207	265	1	0.0006										
34.5	113.2	0.1260	0.1260	274	1	-0.0007										
37.0	121.4	0.1315	0.1313	282	1	-0.0004										
39.5	129.6	0.1373	0.1365	289	1	0.0001										
42.0	137.8	0.1426	0.1418	296	1	0.0003										
44.5	146.0	0.1478	0.1471	303	1	0.0002										
47.0	154.2	0.1529	0.1520	309	1	0.0004										
49.5	162.4	0.1570	0.1569	315	3	-0.0003										
52.0	170.6	0.1610	0.1618	321	1	-0.0013										
54.5	178.8	0.1677	0.1668	327	1	0.0006										
57.0	187.0	0.1722	0.1717	332	1	0.0002										
59.5	195.2	0.1770	0.1766	337	1	0.0001										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-20. P-wave arrival times and velocity summaries.

Location: TARZANA: P Coordinates: 34.16048 -118.53440 Hole_Code: 281
hoffset = 4.00 travel-time file: D:\TAR\TARP.TT
nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0166	0.0074	271	3	0.0001	3.6	3.6	271	259	283	11.8	11.8	889	851	929
4.5	14.8	0.0190	0.0152	297	3	-0.0008	10.0	6.4	477	454	502	32.8	21.0	1564	1488	1648
7.0	23.0	0.0234	0.0204	343	1	0.0002	20.0	10.0	797	778	817	65.6	32.8	2616	2554	2681
9.5	31.2	0.0276	0.0257	370	1	-0.0001	59.5	39.5	1712	1692	1732	195.2	129.6	5617	5552	5683
12.0	39.4	0.0306	0.0292	411	1	0.0000										
14.5	47.6	0.0334	0.0323	448	1	0.0000										
17.0	55.8	0.0362	0.0355	479	1	-0.0001										
19.5	64.0	0.0398	0.0386	505	1	0.0005										
22.0	72.2	0.0410	0.0404	544	1	0.0001										
24.5	80.4	0.0418	0.0419	585	1	-0.0005										
27.0	88.6	0.0434	0.0433	623	1	-0.0003										
29.5	96.8	0.0448	0.0448	659	1	-0.0003										
32.0	105.0	0.0464	0.0463	692	1	-0.0001										
34.5	113.2	0.0486	0.0477	723	1	0.0007										
37.0	121.4	0.0500	0.0492	752	1	0.0006										
39.5	129.6	0.0504	0.0506	780	1	-0.0004										
42.0	137.8	0.0526	0.0521	806	1	0.0003										
44.5	146.0	0.0534	0.0536	831	1	-0.0003										
47.0	154.2	0.0546	0.0550	854	1	-0.0006										
49.5	162.4	0.0566	0.0565	876	1	0.0000										
52.0	170.6	0.0586	0.0579	897	1	0.0005										
54.5	178.8	0.0594	0.0594	918	1	-0.0001										
57.0	187.0	0.0610	0.0609	937	1	0.0000										
59.5	195.2	0.0624	0.0623	955	1	0.0000										

Explanation:
d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

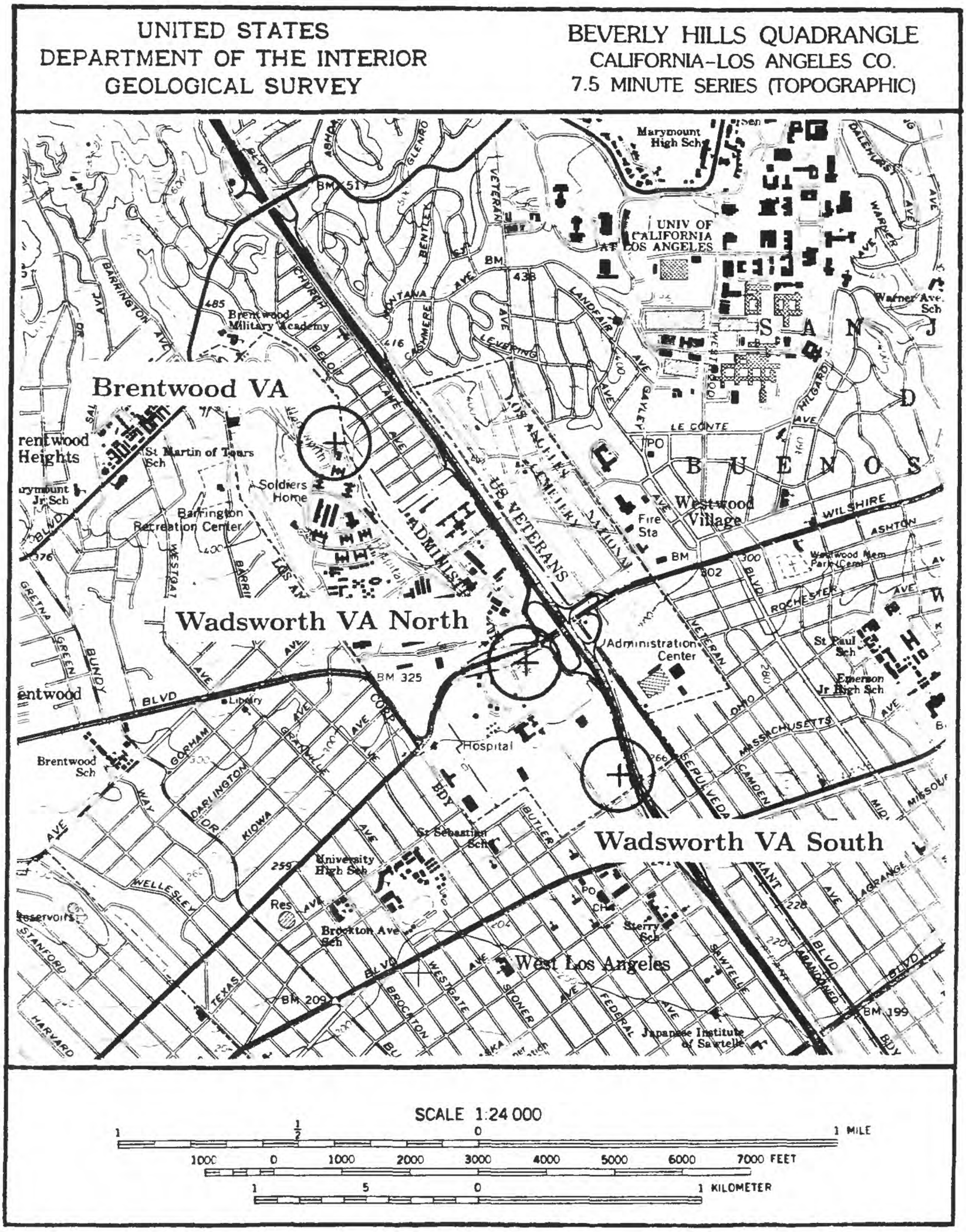

Figure A-51. Site location map for the borehole at Wadsworth VA North. The borehole location is about 5 meters from the strong-motion instrument.

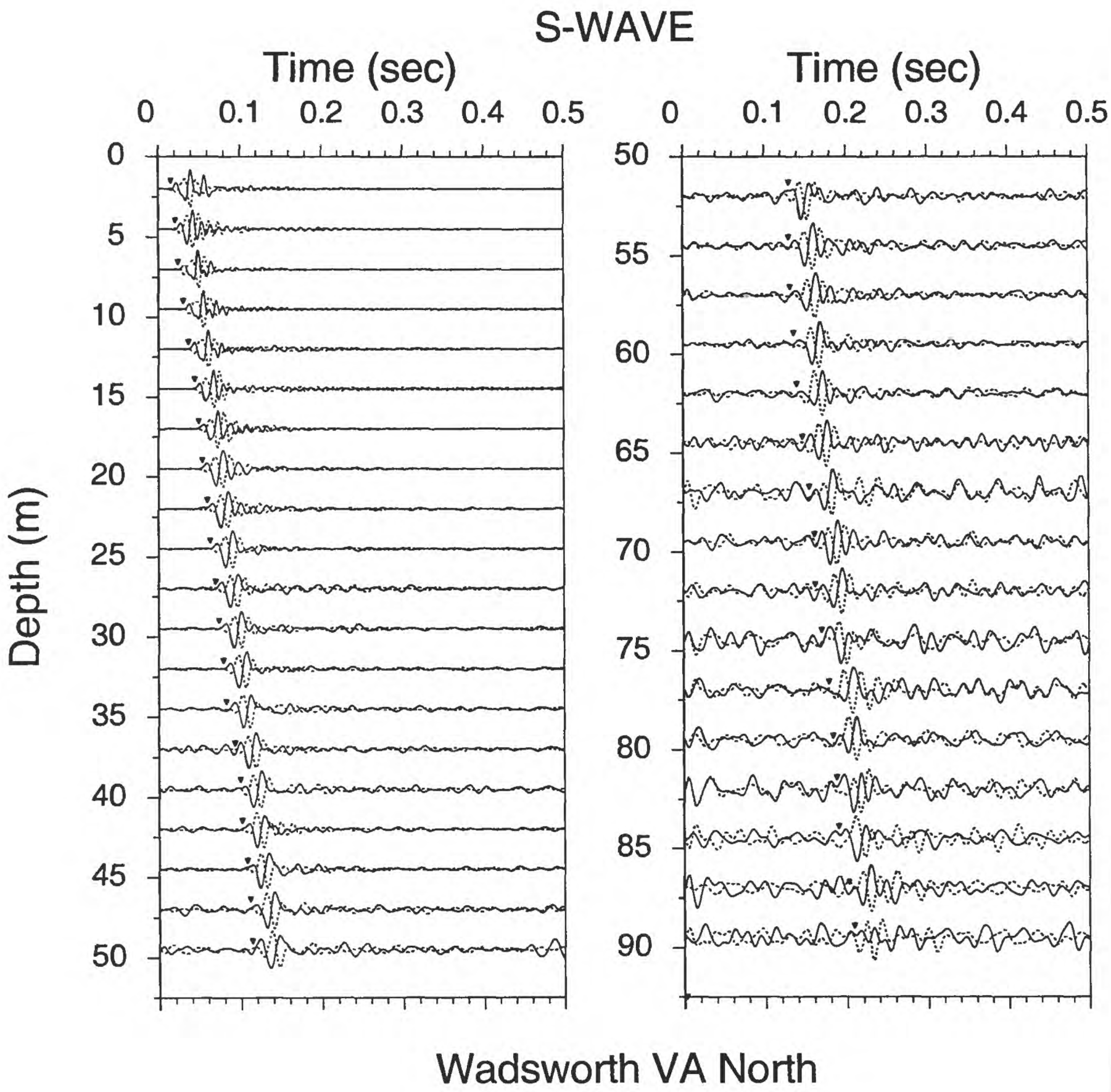

Figure A-52. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

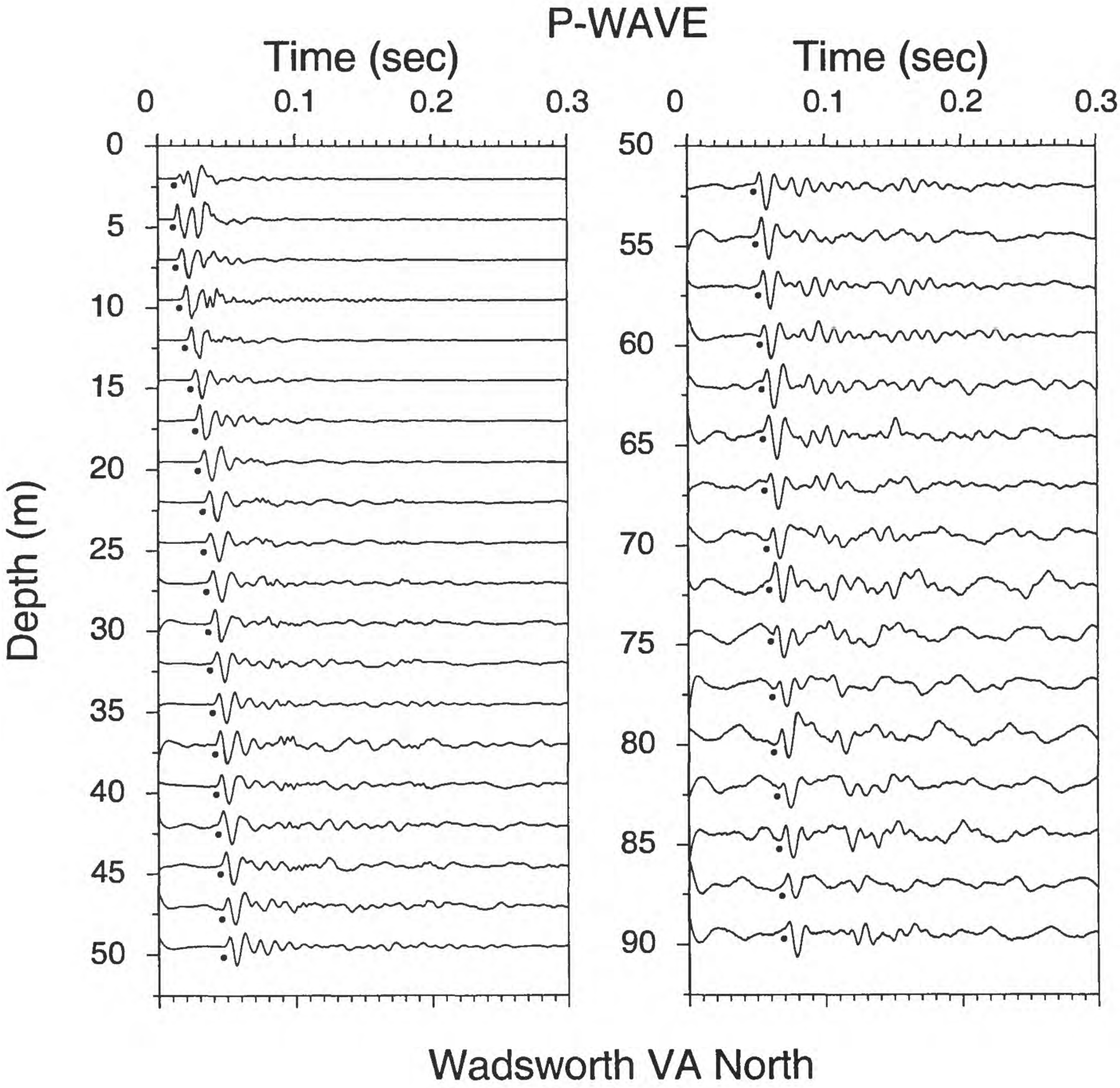

Figure A-53. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

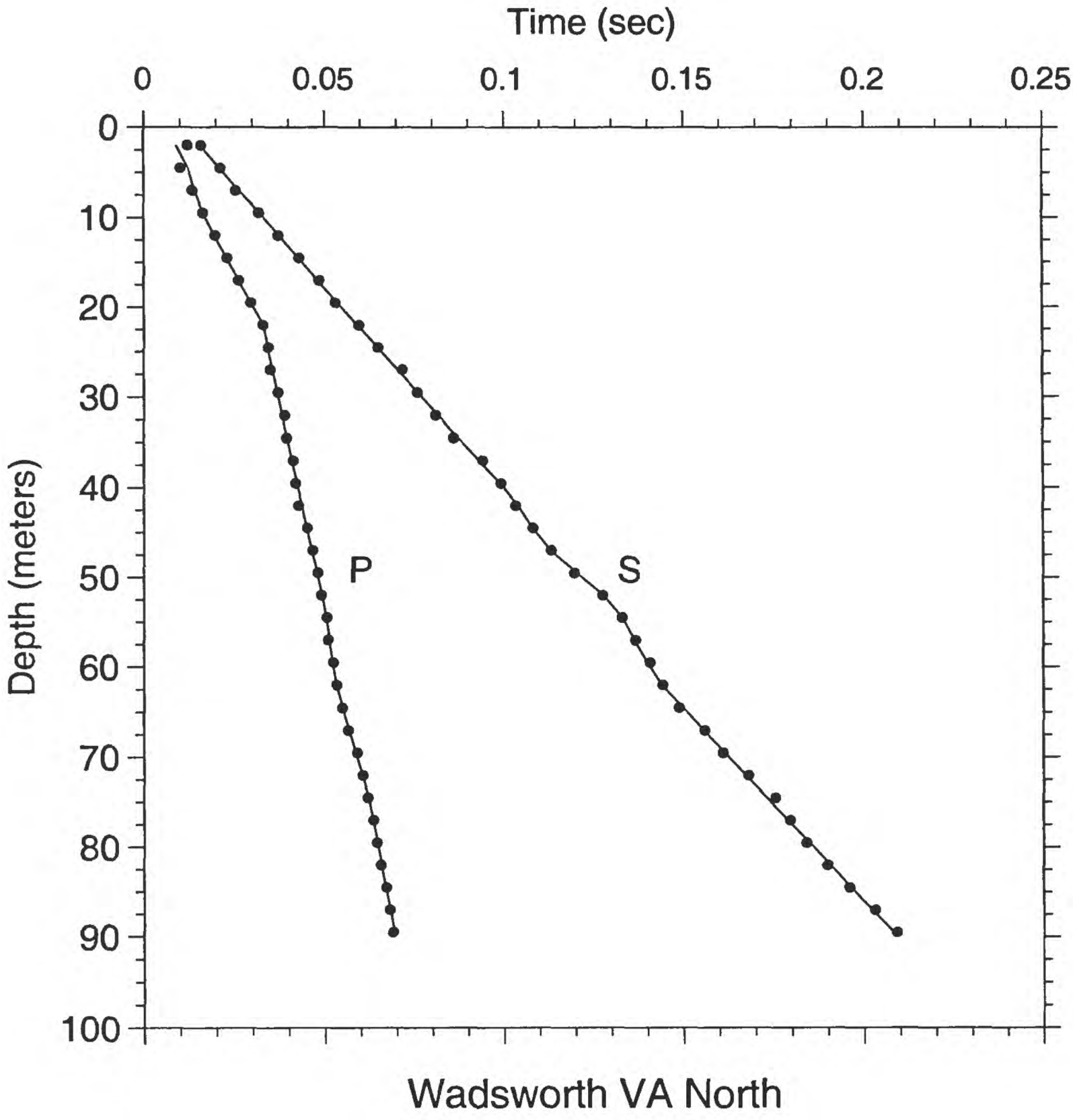

Figure A-54. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

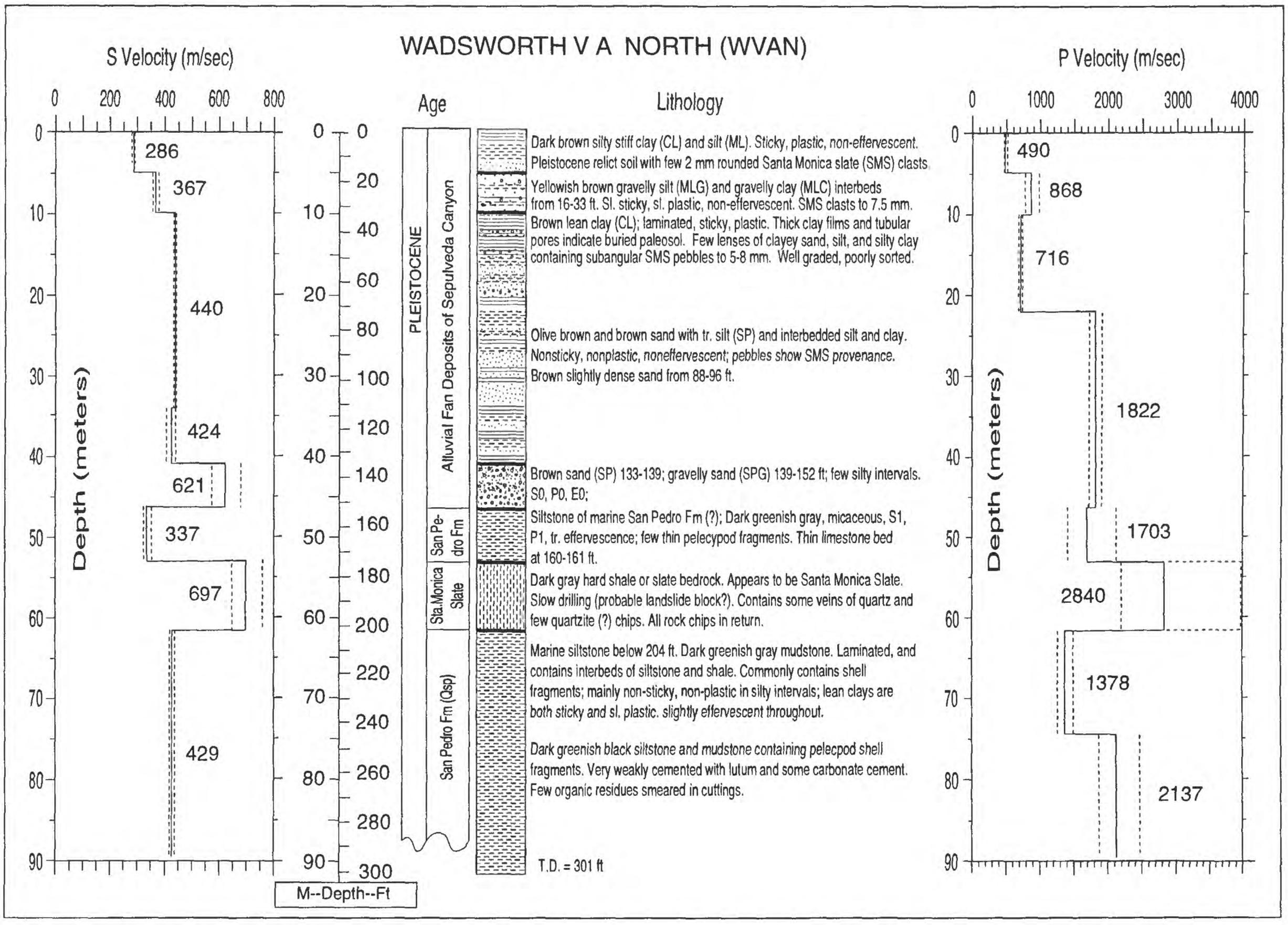

Figure A-55. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-21. S-wave arrival times and velocity summaries.

Location: Wadsworth VA North: S Coordinates: 34.05440 -118.45320 Hole_Code: 287
hoffset = 4.00 travel-time file: D:\WVAN\WVANS.TT
nlayers = 8

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0160	0.0070	286	1	0.0003	4.9	4.9	286	280	291	16.1	16.1	937	919	955
4.5	14.8	0.0213	0.0157	286	1	0.0002	10.0	5.1	367	355	379	32.8	16.7	1203	1165	1244
7.0	23.0	0.0255	0.0229	306	1	-0.0008	34.1	24.1	440	436	444	111.9	79.1	1443	1430	1455
9.5	31.2	0.0320	0.0297	320	1	-0.0002	40.9	6.8	424	409	440	134.2	22.3	1391	1342	1444
12.0	39.4	0.0373	0.0356	337	1	-0.0002	46.3	5.4	621	572	680	151.9	17.7	2037	1876	2230
14.5	47.6	0.0430	0.0413	351	1	0.0002	53.0	6.7	337	324	352	173.9	22.0	1106	1061	1154
17.0	55.8	0.0487	0.0469	362	1	0.0005	61.6	8.6	697	646	758	202.1	28.2	2288	2120	2486
19.5	64.0	0.0532	0.0526	371	1	-0.0005	89.5	27.9	429	420	438	293.6	91.5	1407	1378	1438
22.0	72.2	0.0597	0.0583	377	1	0.0005										
24.5	80.4	0.0650	0.0640	383	1	0.0001										
27.0	88.6	0.0718	0.0697	388	1	0.0013										
29.5	96.8	0.0760	0.0753	392	1	-0.0001										
32.0	105.0	0.0810	0.0810	395	1	-0.0007										
34.5	113.2	0.0862	0.0867	398	1	-0.0011										
37.0	121.4	0.0943	0.0926	399	1	0.0010										
39.5	129.6	0.0993	0.0985	401	1	0.0001										
42.0	137.8	0.1035	0.1036	405	1	-0.0006										
44.5	146.0	0.1082	0.1076	413	1	0.0001										
47.0	154.2	0.1133	0.1126	417	1	0.0002										
49.5	162.4	0.1198	0.1200	412	2	-0.0007										
52.0	170.6	0.1277	0.1274	408	3	-0.0001										
54.5	178.8	0.1330	0.1326	411	1	0.0000										
57.0	187.0	0.1367	0.1362	419	2	0.0002										
59.5	195.2	0.1408	0.1397	426	2	0.0006										
62.0	203.4	0.1443	0.1437	431	2	0.0002										
64.5	211.6	0.1488	0.1495	431	2	-0.0011										
67.0	219.8	0.1560	0.1553	431	3	0.0003										
69.5	228.0	0.1610	0.1612	431	2	-0.0005										
72.0	236.2	0.1680	0.1670	431	4	0.0007										
74.5	244.4	0.1755	0.1728	431	3	0.0024										
77.0	252.6	0.1795	0.1787	431	4	0.0006										
79.5	260.8	0.1840	0.1845	431	2	-0.0008										
82.0	269.0	0.1898	0.1903	431	4	-0.0008										
84.5	277.2	0.1960	0.1961	431	4	-0.0004										
87.0	285.4	0.2030	0.2020	431	4	0.0008										
89.5	293.6	0.2090	0.2078	431	5	0.0009										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-22. S-wave arrival times and velocity summaries.

Location: Wadsworth VA North: P Coordinates: 34.05440 -118.45320 Hole_Code: 287
hoffset = 4.00 travel-time file: D:\WVAN\WVANP.TT
nlayers = 8

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0123	0.0041	490	1	0.0032	4.9	4.9	490	467	516	16.1	16.1	1609	1533	1692
4.5	14.8	0.0102	0.0092	490	1	-0.0021	10.0	5.1	868	774	989	32.8	16.7	2848	2538	3243
7.0	23.0	0.0135	0.0124	564	1	-0.0006	22.0	12.0	716	688	747	72.2	39.4	2350	2256	2452
9.5	31.2	0.0165	0.0153	621	1	0.0000	46.3	24.3	1822	1734	1920	151.9	79.7	5979	5690	6299
12.0	39.4	0.0198	0.0187	643	1	0.0002	53.0	6.7	1703	1420	2129	173.9	22.0	5589	4658	6985
14.5	47.6	0.0231	0.0222	654	1	0.0002	61.6	8.6	2840	2209	3976	202.1	28.2	9317	7246	13043
17.0	55.8	0.0264	0.0257	663	1	0.0001	74.4	12.8	1378	1270	1507	244.1	42.0	4521	4165	4943
19.5	64.0	0.0297	0.0291	669	1	0.0000	89.5	15.1	2137	1880	2475	293.6	49.5	7011	6169	8119
22.0	72.2	0.0330	0.0326	674	1	-0.0001										
24.5	80.4	0.0345	0.0340	720	1	0.0001										
27.0	88.6	0.0351	0.0354	763	1	-0.0006										
29.5	96.8	0.0372	0.0368	803	1	0.0002										
32.0	105.0	0.0390	0.0381	839	1	0.0007										
34.5	113.2	0.0396	0.0395	874	1	-0.0001										
37.0	121.4	0.0414	0.0409	905	1	0.0004										
39.5	129.6	0.0420	0.0422	935	1	-0.0004										
42.0	137.8	0.0429	0.0436	963	1	-0.0009										
44.5	146.0	0.0453	0.0450	989	1	0.0002										
47.0	154.2	0.0468	0.0464	1013	1	0.0003										
49.5	162.4	0.0483	0.0479	1034	1	0.0003										
52.0	170.6	0.0492	0.0493	1054	1	-0.0002										
54.5	178.8	0.0507	0.0504	1081	1	0.0002										
57.0	187.0	0.0510	0.0513	1111	1	-0.0004										
59.5	195.2	0.0525	0.0522	1140	1	0.0002										
62.0	203.4	0.0534	0.0532	1165	1	0.0001										
64.5	211.6	0.0549	0.0550	1172	1	-0.0002										
67.0	219.8	0.0567	0.0569	1178	1	-0.0002										
69.5	228.0	0.0591	0.0587	1185	1	0.0004										
72.0	236.2	0.0606	0.0605	1190	1	0.0001										
74.5	244.4	0.0621	0.0623	1196	1	-0.0002										
77.0	252.6	0.0636	0.0634	1214	1	0.0001										
79.5	260.8	0.0645	0.0646	1230	3	-0.0002										
82.0	269.0	0.0657	0.0658	1247	1	-0.0001										
84.5	277.2	0.0672	0.0669	1262	1	0.0002										
87.0	285.4	0.0681	0.0681	1277	1	-0.0001										
89.5	293.6	0.0690	0.0693	1292	3	-0.0003										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

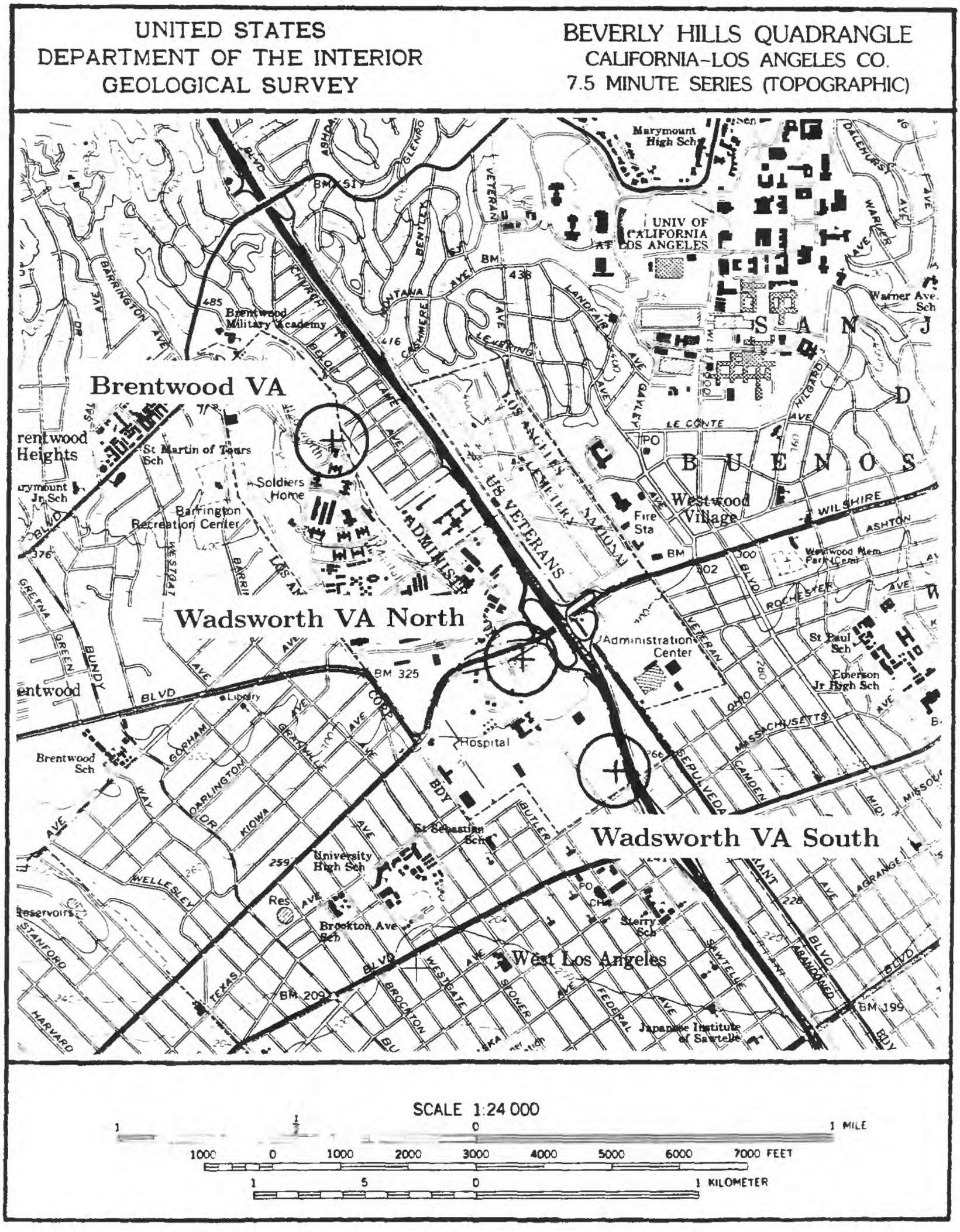

Figure A-56. Site location map for the borehole at Wadsworth VA South. The borehole location is about 12 meters from the strong-motion instrument.

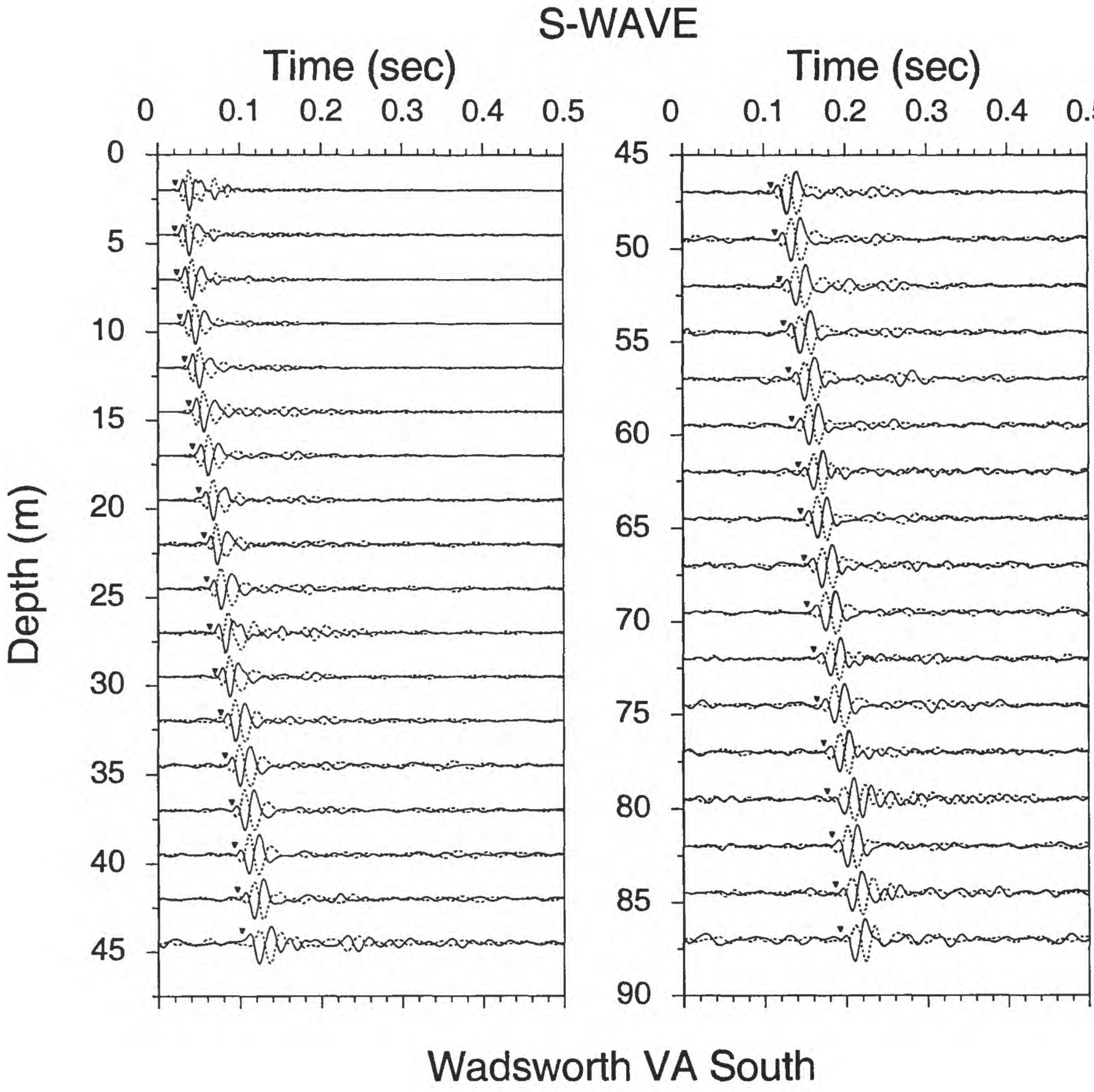

Figure A-57. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles.

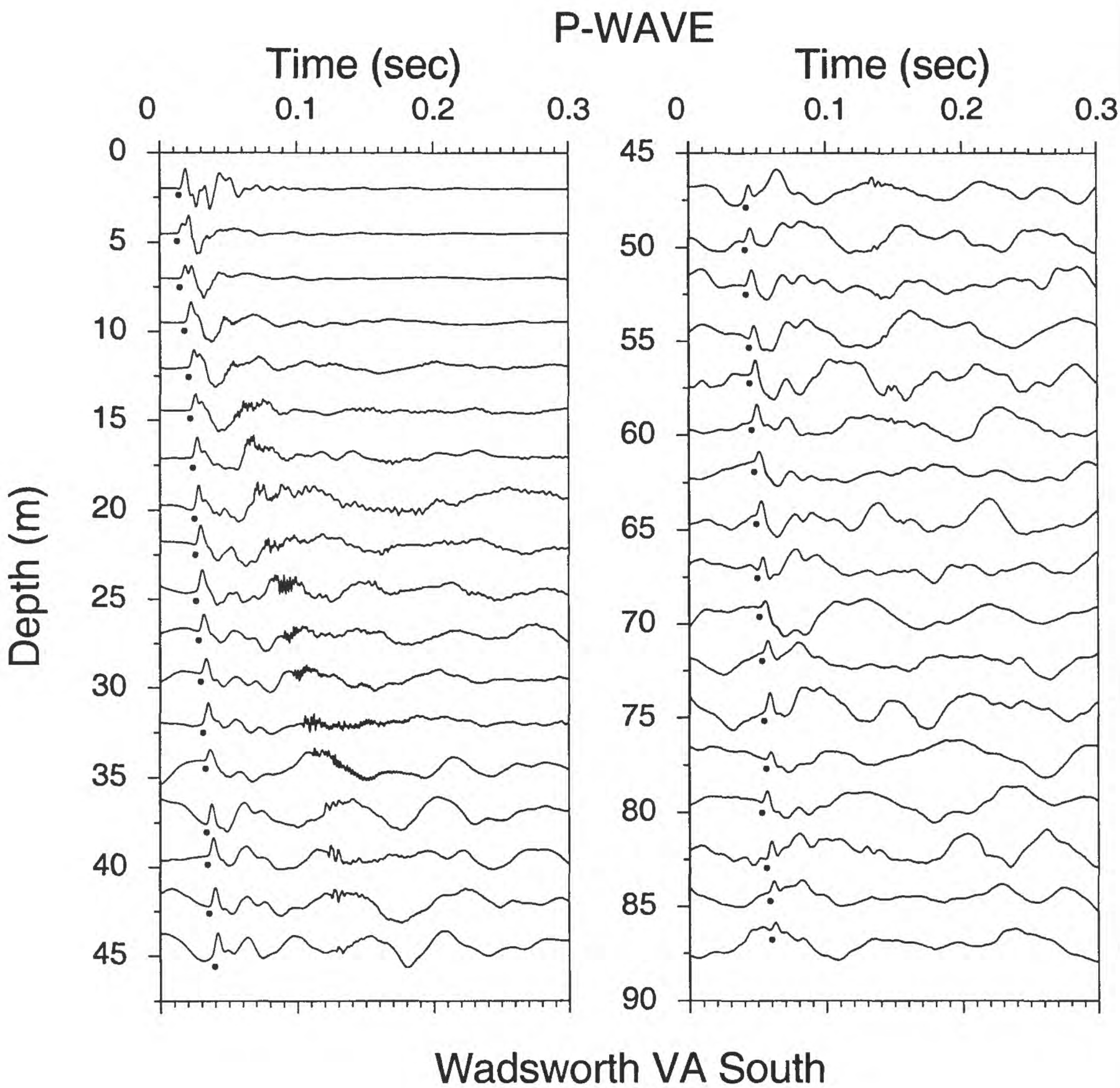

Figure A-58. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles.

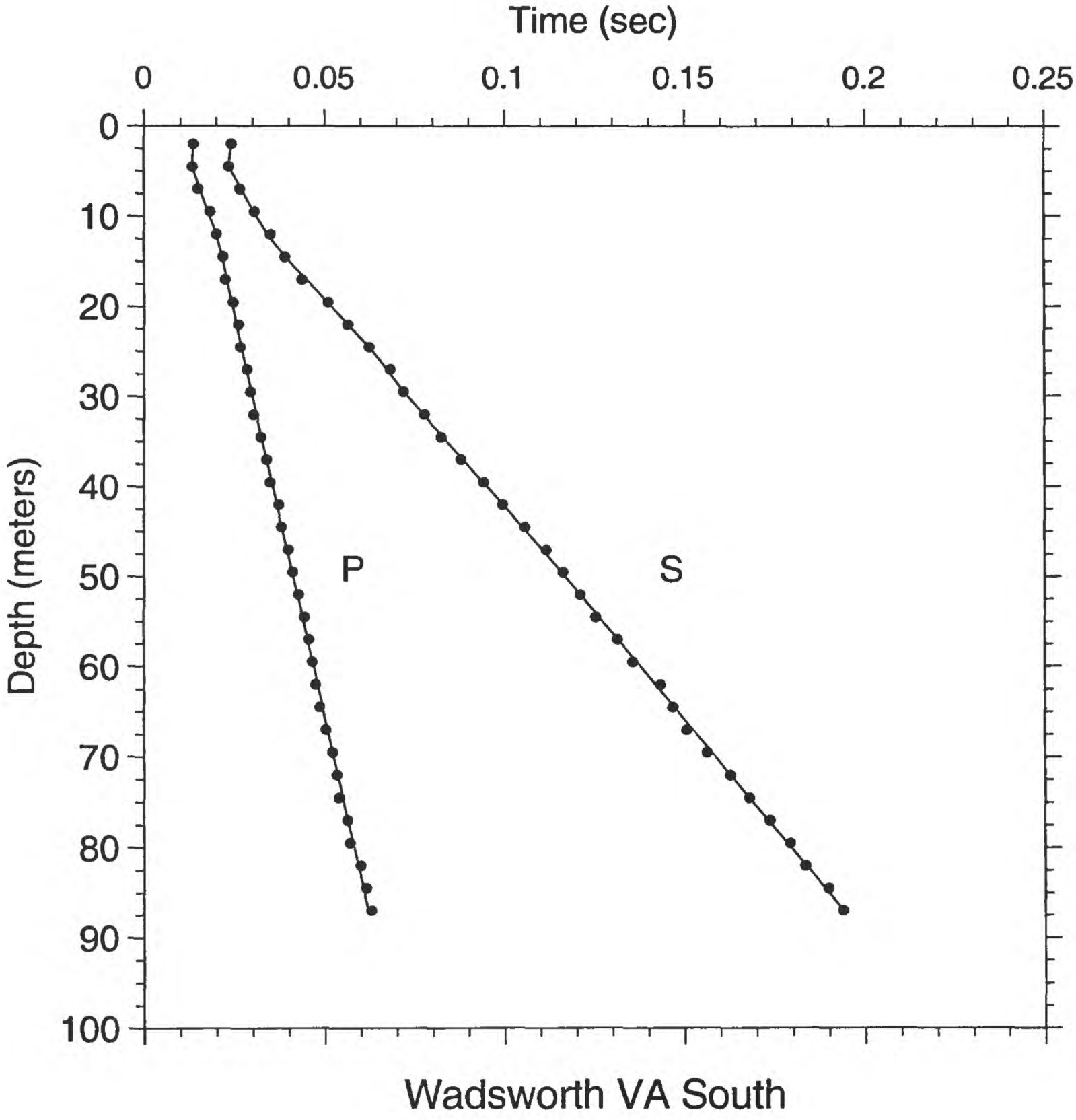

Figure A-59. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

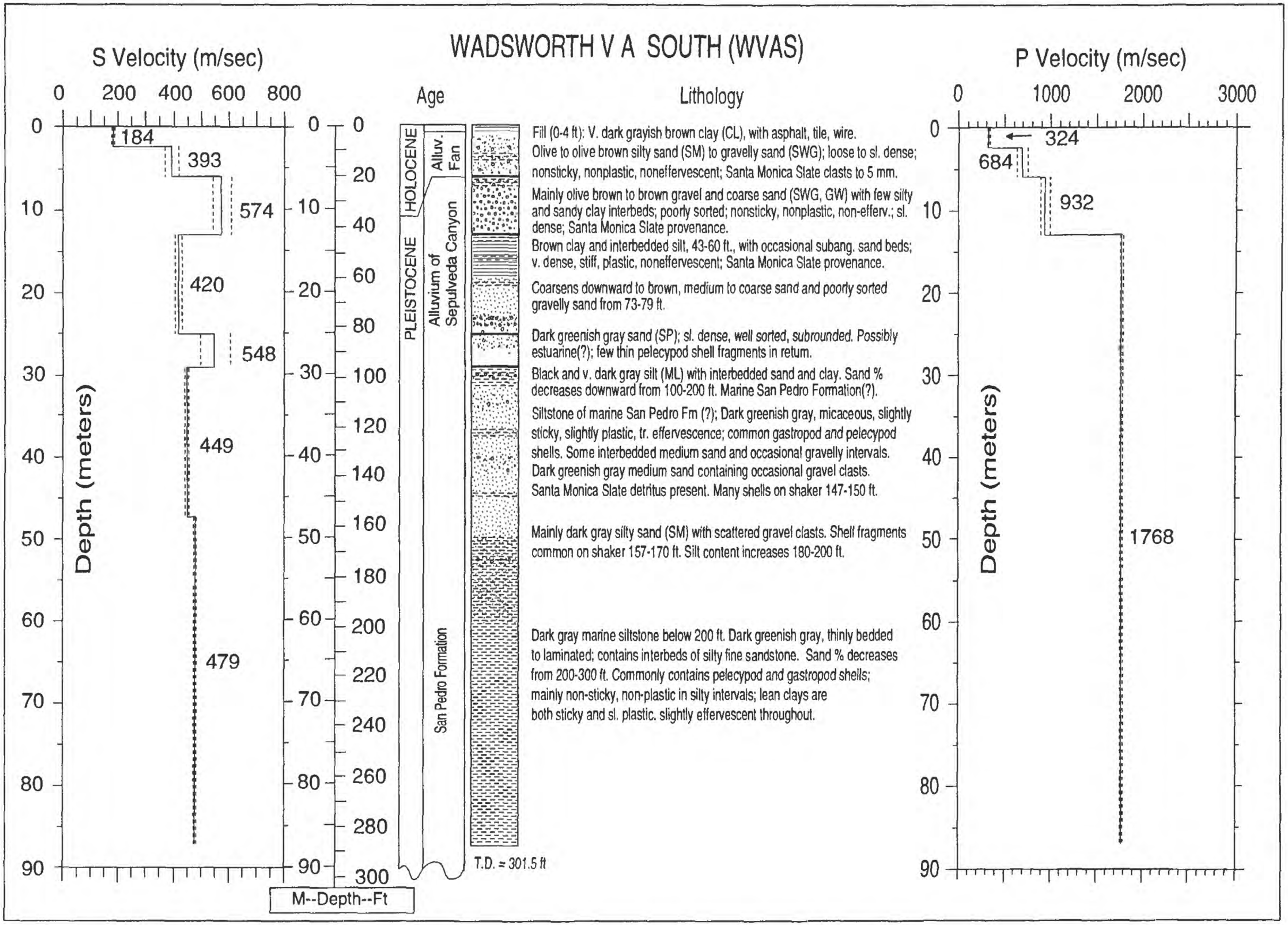

Figure A-60. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-23. S-wave arrival times and velocity summaries.

Location: Wadsworth VA South: S Coordinates: 34.04968 -118.44850 Hole_Code: 288
hoffset = 4.00 travel-time file: D:\WVAS\WVASS.TT
nlayers = 7

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0243	0.0109	184	1	0.0000	2.4	2.4	184	179	189	7.9	7.9	605	589	622
4.5	14.8	0.0235	0.0184	245	1	0.0001	6.0	3.6	393	370	420	19.7	11.8	1291	1214	1378
7.0	23.0	0.0265	0.0239	292	1	-0.0004	13.0	7.0	574	543	610	42.7	23.0	1885	1782	2000
9.5	31.2	0.0305	0.0283	336	1	0.0003	25.0	12.0	420	409	431	82.0	39.4	1377	1341	1414
12.0	39.4	0.0350	0.0327	367	1	0.0009	29.0	4.0	548	499	606	95.1	13.1	1796	1638	1989
14.5	47.6	0.0390	0.0380	382	1	-0.0001	47.3	18.3	449	443	456	155.2	60.0	1475	1453	1497
17.0	55.8	0.0437	0.0439	387	1	-0.0012	87.0	39.7	479	475	482	285.4	130.2	1570	1559	1582
19.5	64.0	0.0510	0.0499	391	2	0.0002										
22.0	72.2	0.0565	0.0558	394	1	-0.0001										
24.5	80.4	0.0625	0.0618	397	1	0.0000										
27.0	88.6	0.0683	0.0666	405	1	0.0010										
29.5	96.8	0.0720	0.0714	413	1	0.0000										
32.0	105.0	0.0777	0.0770	416	2	0.0003										
34.5	113.2	0.0825	0.0825	418	1	-0.0005										
37.0	121.4	0.0880	0.0881	420	1	-0.0005										
39.5	129.6	0.0943	0.0937	422	1	0.0002										
42.0	137.8	0.0995	0.0992	423	1	-0.0001										
44.5	146.0	0.1058	0.1048	425	2	0.0006										
47.0	154.2	0.1117	0.1104	426	1	0.0011										
49.5	162.4	0.1163	0.1156	428	1	0.0003										
52.0	170.6	0.1210	0.1208	430	2	-0.0001										
54.5	178.8	0.1255	0.1261	432	1	-0.0008										
57.0	187.0	0.1315	0.1313	434	1	-0.0001										
59.5	195.2	0.1357	0.1365	436	2	-0.0010										
62.0	203.4	0.1433	0.1417	437	1	0.0013										
64.5	211.6	0.1468	0.1469	439	1	-0.0004										
67.0	219.8	0.1507	0.1522	440	1	-0.0016										
69.5	228.0	0.1563	0.1574	442	2	-0.0014										
72.0	236.2	0.1628	0.1626	443	1	-0.0001										
74.5	244.4	0.1680	0.1678	444	1	0.0000										
77.0	252.6	0.1737	0.1730	445	1	0.0005										
79.5	260.8	0.1793	0.1783	446	1	0.0008										
82.0	269.0	0.1835	0.1835	447	1	-0.0002										
84.5	277.2	0.1898	0.1887	448	2	0.0008										
87.0	285.4	0.1940	0.1939	449	3	-0.0001										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-24. P-wave arrival times and velocity summaries.

Location: Wadsworth VA South: P Coordinates: 34.04968 -118.44855 Hole_Code: 288
hoffset = 4.00 travel-time file: D:\WVAS\WVASP.TT
nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0138	0.0062	324	1	0.0000	2.4	2.4	324	312	336	7.9	7.9	1062	1023	1104
4.5	14.8	0.0135	0.0105	429	1	0.0001	6.0	3.6	684	631	747	19.7	11.8	2244	2069	2451
7.0	23.0	0.0150	0.0137	509	1	-0.0005	13.0	7.0	932	883	987	42.7	23.0	3057	2897	3237
9.5	31.2	0.0183	0.0164	578	1	0.0007	87.0	74.0	1768	1755	1782	285.4	242.8	5802	5759	5845
12.0	39.4	0.0201	0.0191	628	1	0.0001										
14.5	47.6	0.0219	0.0210	690	1	0.0002										
17.0	55.8	0.0225	0.0224	757	1	-0.0004										
19.5	64.0	0.0246	0.0239	817	1	0.0004										
22.0	72.2	0.0261	0.0253	871	1	0.0005										
24.5	80.4	0.0267	0.0267	918	1	-0.0003										
27.0	88.6	0.0285	0.0281	961	1	0.0002										
29.5	96.8	0.0294	0.0295	1000	1	-0.0003										
32.0	105.0	0.0303	0.0309	1035	1	-0.0008										
34.5	113.2	0.0324	0.0323	1067	1	-0.0001										
37.0	121.4	0.0339	0.0338	1096	1	0.0000										
39.5	129.6	0.0348	0.0352	1123	1	-0.0005										
42.0	137.8	0.0372	0.0366	1148	1	0.0005										
44.5	146.0	0.0381	0.0380	1171	1	0.0000										
47.0	154.2	0.0399	0.0394	1193	1	0.0004										
49.5	162.4	0.0411	0.0408	1212	1	0.0002										
52.0	170.6	0.0426	0.0422	1231	1	0.0003										
54.5	178.8	0.0444	0.0437	1248	1	0.0006										
57.0	187.0	0.0456	0.0451	1265	1	0.0004										
59.5	195.2	0.0465	0.0465	1280	1	-0.0001										
62.0	203.4	0.0474	0.0479	1294	1	-0.0006										
64.5	211.6	0.0486	0.0493	1308	1	-0.0008										
67.0	219.8	0.0504	0.0507	1321	1	-0.0004										
69.5	228.0	0.0522	0.0521	1333	1	0.0000										
72.0	236.2	0.0534	0.0536	1344	1	-0.0002										
74.5	244.4	0.0540	0.0550	1355	1	-0.0010										
77.0	252.6	0.0564	0.0564	1366	1	0.0000										
79.5	260.8	0.0570	0.0578	1376	1	-0.0009										
82.0	269.0	0.0600	0.0592	1385	1	0.0007										
84.5	277.2	0.0615	0.0606	1394	1	0.0008										
87.0	285.4	0.0630	0.0620	1402	1	0.0009										

Explanation:

d(m) = depth in meters
d(ft) = depth in feet
tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
tvrt(s) = vertical travel time computed from the model
vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
sig = sigma, standard deviation normalized to the standard deviation of best picks
rsdl(sec)= residual (observed - fitted travel time), in secs
dtb(m) = depth to bottom of layer in meters
thk(m) = thickness of layer in meters
v(m/s) = velocity of layer in meters per second
vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
vu(m/s) = upper limit of velocity in meters per second
dtb(ft) = depth to bottom of layer in feet
thk(ft) = thickness of layer in feet
v(ft/s) = velocity of layer in feet per second
vl(ft/s) = lower limit of velocity in feet per second
vu(ft/s) = upper limit of velocity in feet per second

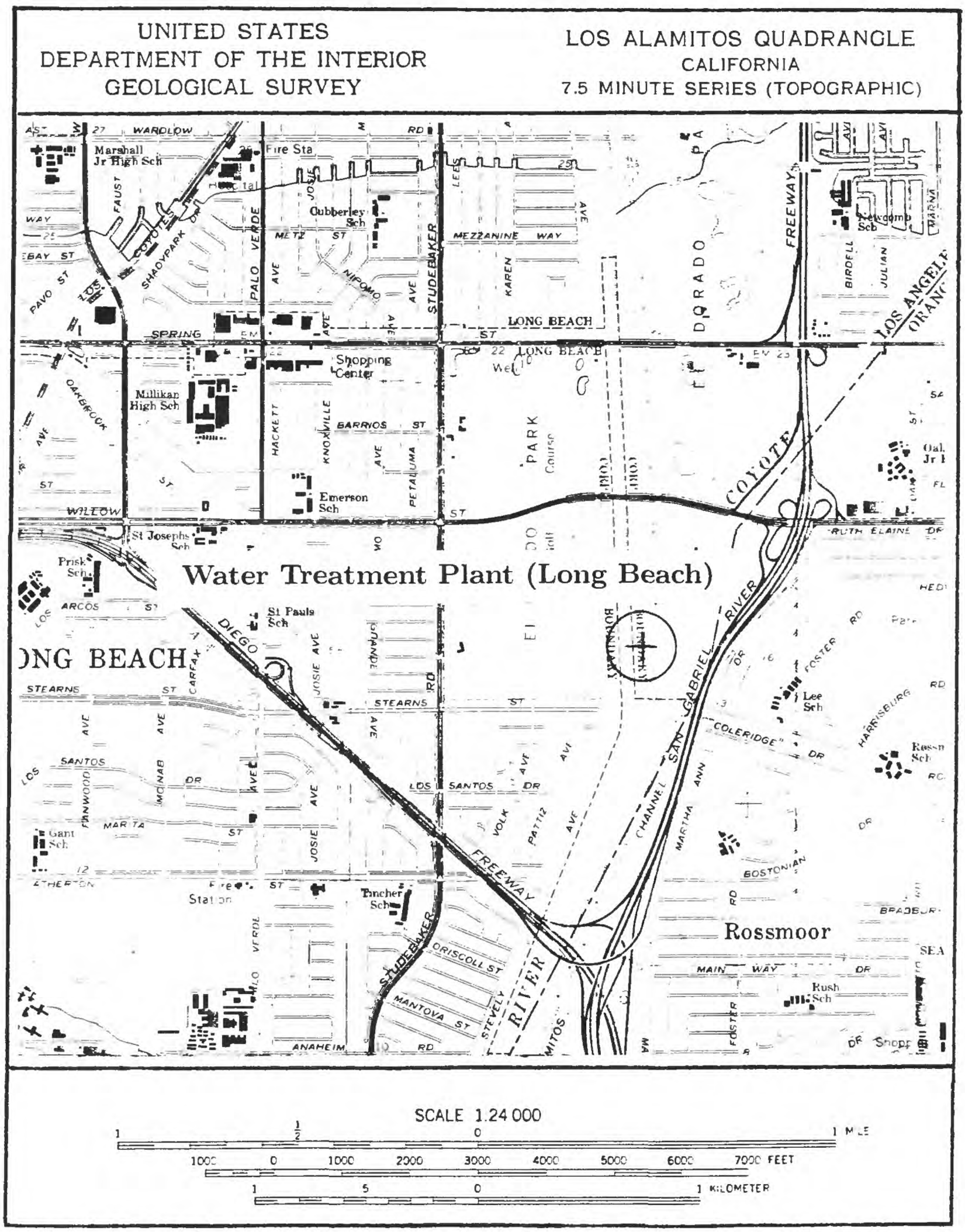

Figure A-61. Site location map for the borehole Long Beach Water Treatment Plant.

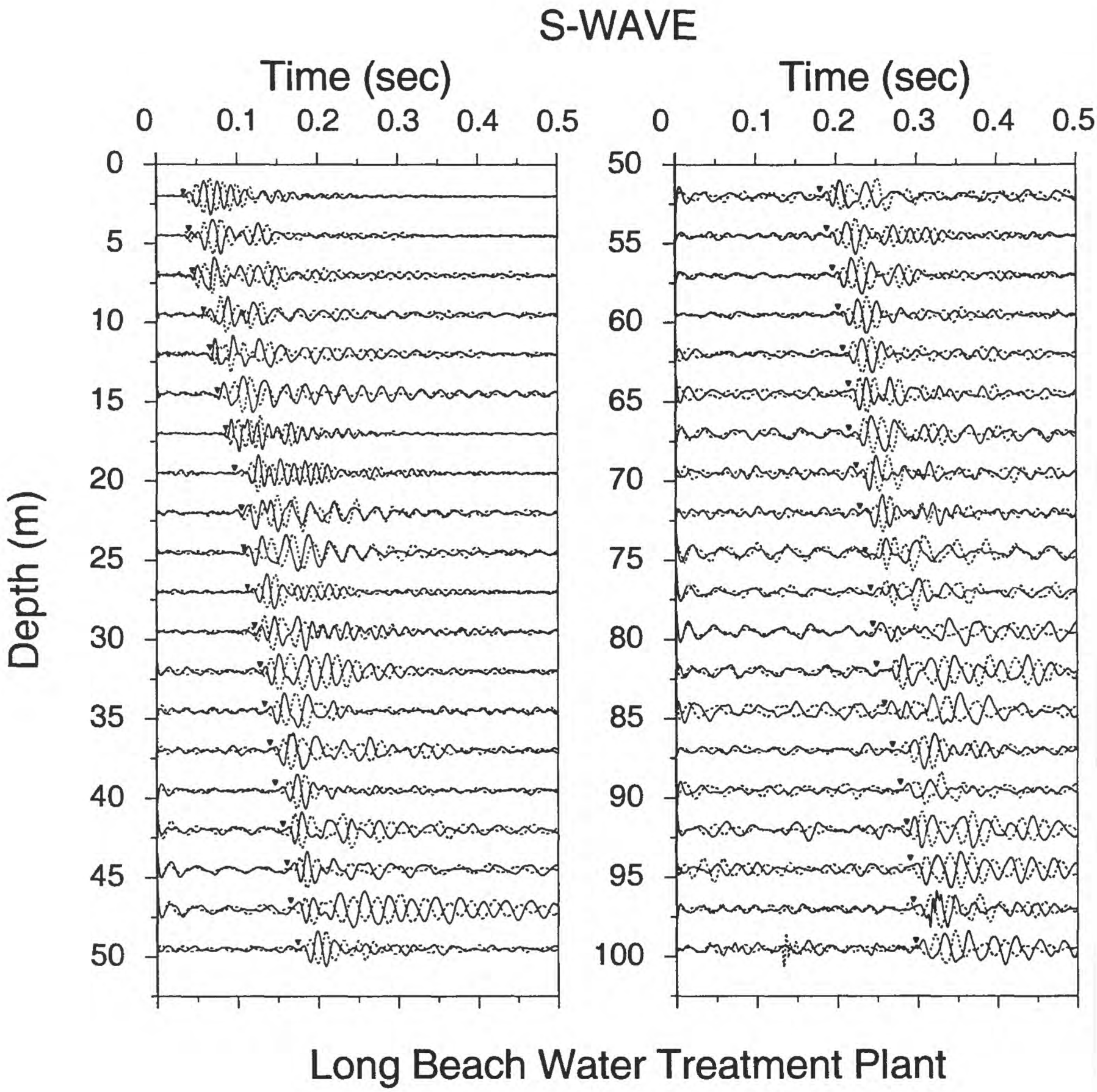

Figure A-62. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the inverted triangles. The seismic noise level at this site is extreemly high due in part to operation of the treatment plant,(mostly pumps), overhead powerlines, and nearby freeway traffic. Although data were taken to 230 meters depth the noise obliterated the signal at approximately 100 meters making the deeper data uninterpretable.

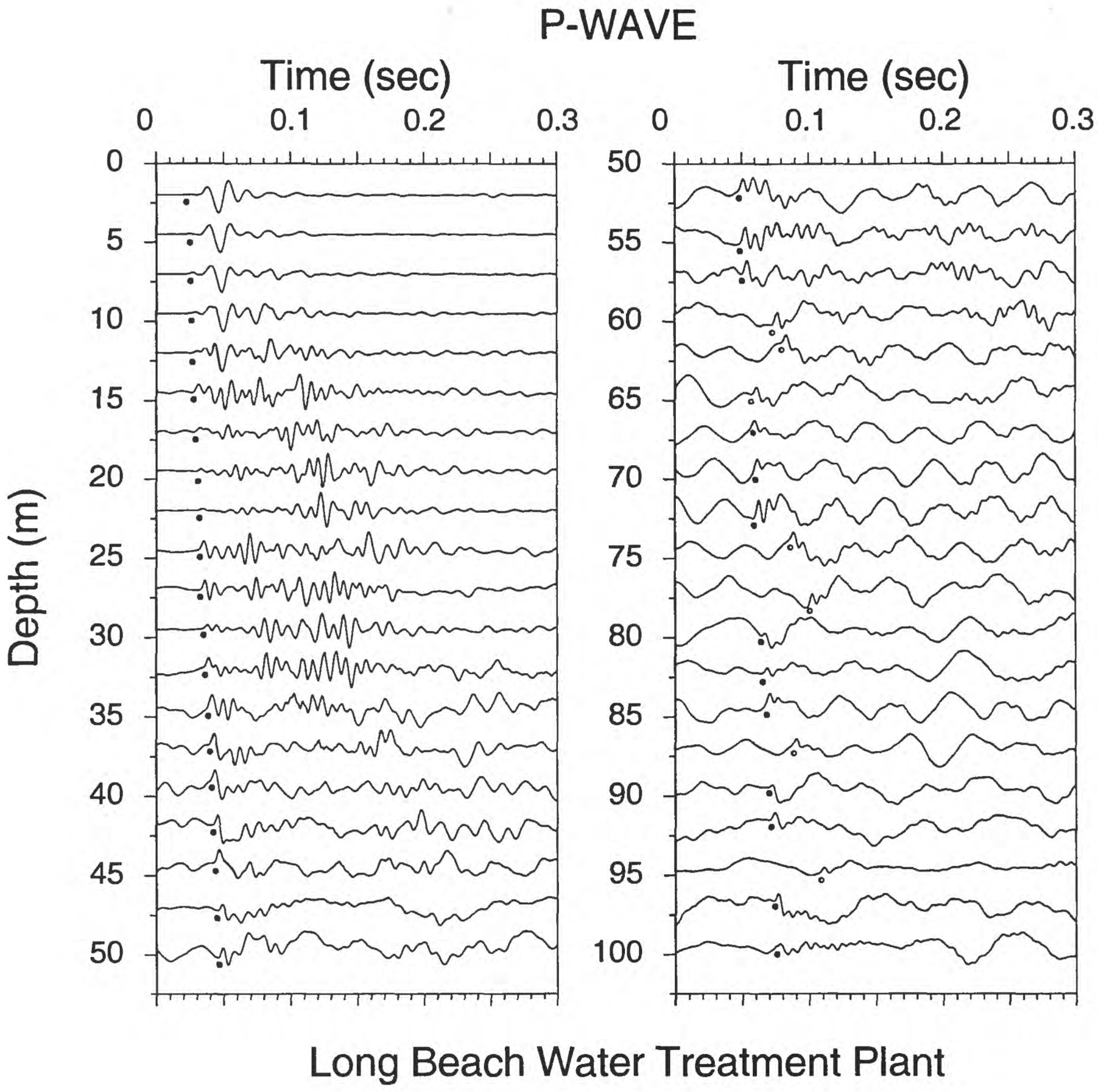

Figure A-63. Vertical component record section. Approximate P-wave arrivals are indicated by the solid circles. Early tiggering of the recorder occured at seven depths shown by the open-circles. A correction was applied to the early triggered arrivals by measuring the difference in time between the reference traces.

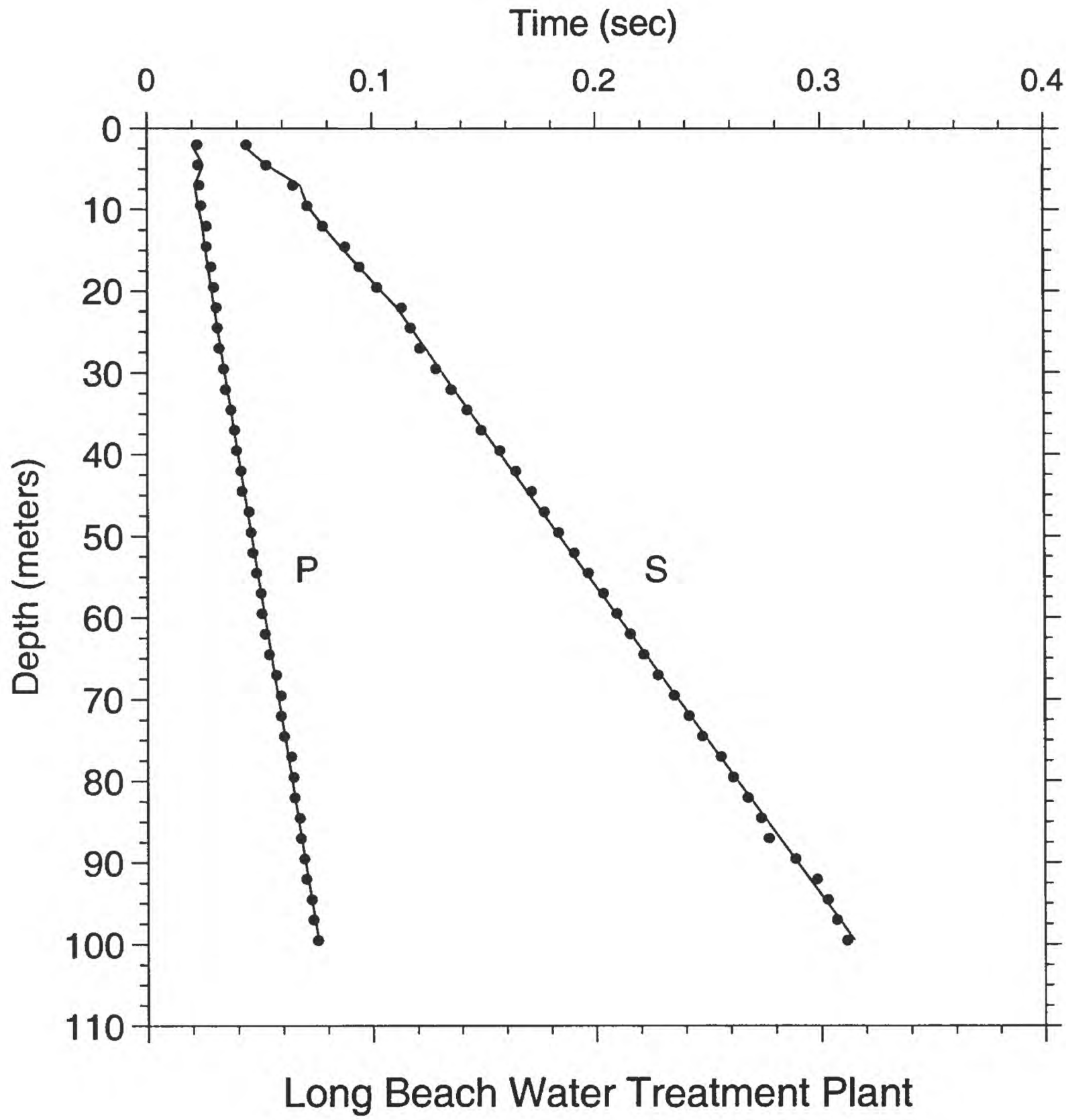

Figure A-64. Time-depth graph of P-wave and S-wave picks. Line segments show the hinged-least-squares fit to the data points.

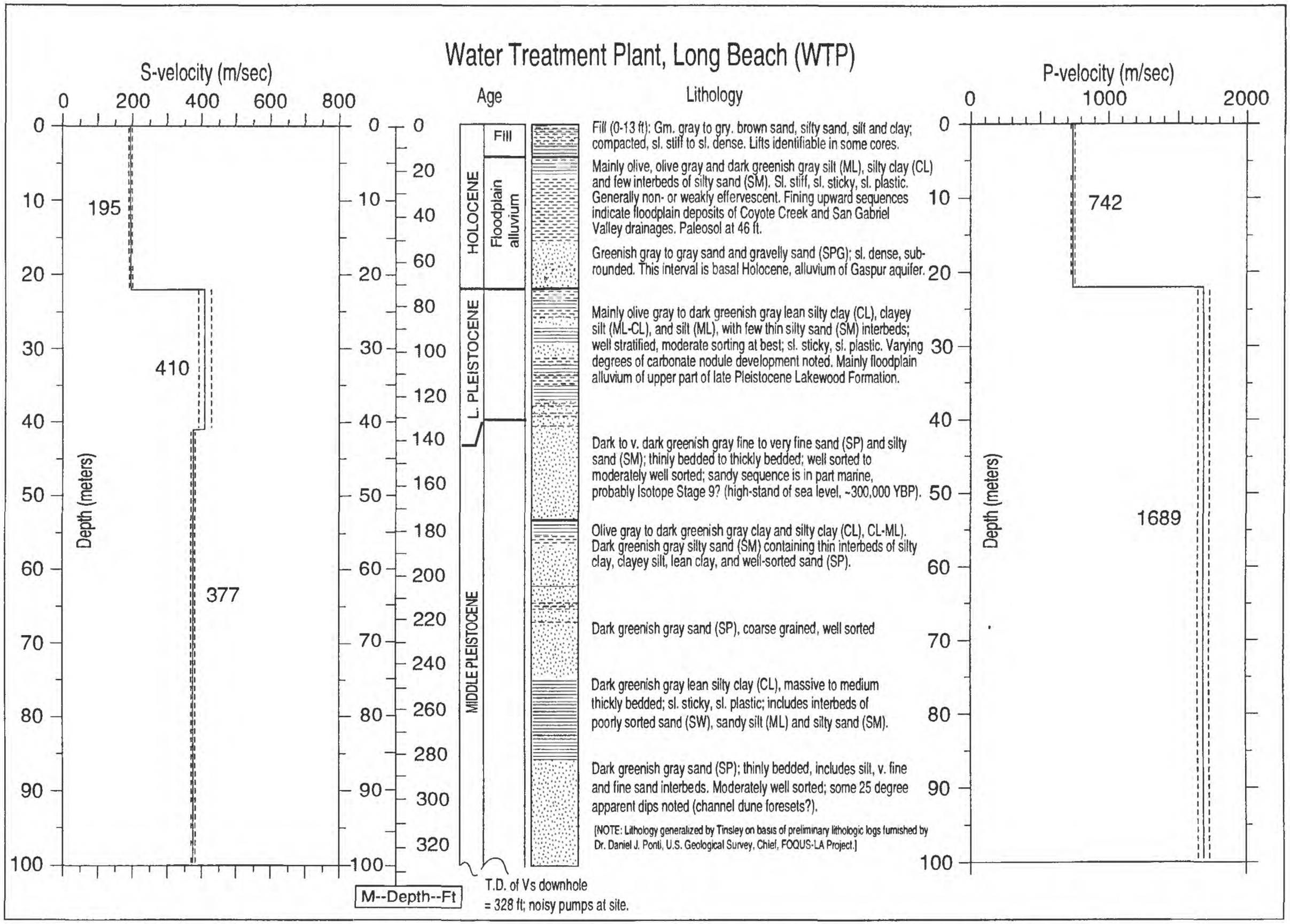

Figure A-65. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

TABLE A-25. S-wave arrival times and velocity summaries.

Location: Long Beach Water Treatment Pla Coordinates: 33.79800 -118.08840 Hole_Code: 295
hoffset = 5.00 travel-time file: E:\WTPLANT\WTPS.TT
nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0443	0.0103	195	3	0.0166	22.0	22.0	195	192	198	72.2	72.2	640	631	649
4.5	14.8	0.0530	0.0231	195	3	0.0185	41.0	19.0	410	392	429	134.5	62.3	1344	1288	1406
7.0	23.0	0.0650	0.0359	195	5	0.0209	99.5	58.5	377	372	382	326.4	191.9	1236	1220	1253
9.5	31.2	0.0712	0.0487	195	3	0.0162										
12.0	39.4	0.0782	0.0615	195	3	0.0116										
14.5	47.6	0.0880	0.0744	195	2	0.0094										
17.0	55.8	0.0945	0.0872	195	1	0.0036										
19.5	64.0	0.1023	0.1000	195	3	-0.0010										
22.0	72.2	0.1155	0.1128	195	1	-0.0002										
24.5	80.4	0.1173	0.1189	206	3	-0.0040										
27.0	88.6	0.1215	0.1250	216	1	-0.0055										
29.5	96.8	0.1287	0.1311	225	2	-0.0040										
32.0	105.0	0.1357	0.1372	233	1	-0.0029										
34.5	113.2	0.1427	0.1433	241	1	-0.0019										
37.0	121.4	0.1490	0.1494	248	1	-0.0016										
39.5	129.6	0.1573	0.1555	254	1	0.0006										
42.0	137.8	0.1645	0.1618	260	1	0.0017										
44.5	146.0	0.1715	0.1684	264	1	0.0021										
47.0	154.2	0.1772	0.1751	268	2	0.0013										
49.5	162.4	0.1835	0.1817	272	1	0.0009										
52.0	170.6	0.1905	0.1883	276	2	0.0014										
54.5	178.8	0.1968	0.1950	280	1	0.0010										
57.0	187.0	0.2035	0.2016	283	1	0.0012										
59.5	195.2	0.2095	0.2082	286	1	0.0006										
62.0	203.4	0.2155	0.2149	289	1	0.0000										
64.5	211.6	0.2215	0.2215	291	1	-0.0006										
67.0	219.8	0.2278	0.2281	294	2	-0.0010										
69.5	228.0	0.2350	0.2348	296	2	-0.0004										
72.0	236.2	0.2415	0.2414	298	1	-0.0005										
74.5	244.4	0.2475	0.2480	300	4	-0.0011										
77.0	252.6	0.2558	0.2547	302	4	0.0005										
79.5	260.8	0.2612	0.2613	304	4	-0.0006										
82.0	269.0	0.2677	0.2679	306	1	-0.0007										
84.5	277.2	0.2735	0.2745	308	4	-0.0016										
87.0	285.4	0.2770	0.2812	309	1	-0.0047										
89.5	293.6	0.2887	0.2878	311	3	0.0005										
92.0	301.8	0.2982	0.2944	312	1	0.0033										
94.5	310.0	0.3030	0.3011	314	1	0.0015										
97.0	318.2	0.3070	0.3077	315	3	-0.0012										
99.5	326.4	0.3117	0.3143	317	3	-0.0030										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s) = average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec) = residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

TABLE A-26. S-wave arrival times and velocity summaries.

Location: Long Beach Water Treatment Pla Coordinates: 34.79800 -118.08840 Hole_Code: 295
hoffset = 5.00 travel-time file: E:\WTPLANT\VERT\WTPP.TT
nlayers = 2

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)	dtb(m)	thk(m)	v(m/s)	vl(m/s)	vu(m/s)	dtb(ft)	thk(ft)	v(ft/s)	vl(ft/s)	vu(ft/s)
2.0	6.6	0.0224	0.0027	742	3	0.0151	22.0	22.0	742	727	758	72.2	72.2	2434	2384	2486
4.5	14.8	0.0228	0.0061	742	3	0.0137	99.5	77.5	1689	1647	1733	326.4	254.3	5541	5403	5686
7.0	23.0	0.0232	0.0094	742	3	0.0116										
9.5	31.2	0.0240	0.0128	742	3	0.0095										
12.0	39.4	0.0264	0.0162	742	3	0.0089										
14.5	47.6	0.0264	0.0195	742	4	0.0057										
17.0	55.8	0.0284	0.0229	742	2	0.0045										
19.5	64.0	0.0296	0.0263	742	3	0.0025										
22.0	72.2	0.0308	0.0296	742	3	0.0004										
24.5	80.4	0.0312	0.0311	787	1	-0.0005										
27.0	88.6	0.0320	0.0326	828	1	-0.0011										
29.5	96.8	0.0340	0.0341	865	1	-0.0005										
32.0	105.0	0.0348	0.0356	900	1	-0.0011										
34.5	113.2	0.0372	0.0371	931	1	-0.0002										
37.0	121.4	0.0388	0.0385	960	1	0.0000										
39.5	129.6	0.0396	0.0400	987	1	-0.0007										
42.0	137.8	0.0416	0.0415	1012	1	-0.0001										
44.5	146.0	0.0420	0.0430	1036	1	-0.0012										
47.0	154.2	0.0452	0.0445	1057	1	0.0005										
49.5	162.4	0.0460	0.0459	1078	2	-0.0001										
52.0	170.6	0.0468	0.0474	1097	3	-0.0008										
54.5	178.8	0.0484	0.0489	1115	1	-0.0007										
57.0	187.0	0.0504	0.0504	1132	2	-0.0001										
59.5	195.2	0.0508	0.0519	1147	3	-0.0012										
62.0	203.4	0.0522	0.0533	1163	3	-0.0013										
64.5	211.6	0.0540	0.0548	1177	3	-0.0010										
67.0	219.8	0.0572	0.0563	1190	1	0.0008										
69.5	228.0	0.0592	0.0578	1203	1	0.0013										
72.0	236.2	0.0592	0.0593	1215	1	-0.0002										
74.5	244.4	0.0606	0.0607	1227	4	-0.0003										
77.0	252.6	0.0638	0.0622	1238	4	0.0015										
79.5	260.8	0.0648	0.0637	1248	1	0.0010										
82.0	269.0	0.0652	0.0652	1258	1	-0.0001										
84.5	277.2	0.0676	0.0667	1268	1	0.0008										
87.0	285.4	0.0680	0.0681	1277	3	-0.0002										
89.5	293.6	0.0696	0.0696	1286	3	-0.0001										
92.0	301.8	0.0704	0.0711	1294	1	-0.0008										
94.5	310.0	0.0728	0.0726	1302	4	0.0001										
97.0	318.2	0.0736	0.0741	1310	1	-0.0005										
99.5	326.4	0.0756	0.0755	1317	3	0.0000										

Explanation:
- d(m) = depth in meters
- d(ft) = depth in feet
- tsl(s) = observed arrival time in seconds (from source to receiver, along a slant path). For the arrival times used in the S-wave model, the times are the average of picks from traces obtained from hammer blows differing in direction by 180 degrees.
- tvrt(s) = vertical travel time computed from the model
- vavg(m/s)= average velocity from the surface to each depth, computed as avg_vel = d(m)/tvrt(s)
- sig = sigma, standard deviation normalized to the standard deviation of best picks
- rsdl(sec)= residual (observed - fitted travel time), in secs
- dtb(m) = depth to bottom of layer in meters
- thk(m) = thickness of layer in meters
- v(m/s) = velocity of layer in meters per second
- vl(m/s) = lower limit of velocity in meters per second (see text for explanation of velocity limits)
- vu(m/s) = upper limit of velocity in meters per second
- dtb(ft) = depth to bottom of layer in feet
- thk(ft) = thickness of layer in feet
- v(ft/s) = velocity of layer in feet per second
- vl(ft/s) = lower limit of velocity in feet per second
- vu(ft/s) = upper limit of velocity in feet per second

APPENDIX—B

Poisson's Ratios

Table B-1. Poisson's ratio calculated from P- and S-wave velocity models determined for the Brentwood VA site.

P wave - d2bot, pvel, for file: BVAP.VEL

2.00000	439.000
6.00000	744.000
30.8000	778.000
39.9000	1111.00
50.3000	1953.00
67.0000	1985.00
82.0000	1734.00
99.5000	1861.00

S wave - d2bot, svel, for file: BVAS.VEL

2.00000	219.000
6.00000	373.000
10.7000	424.000
15.2000	492.000
25.0000	541.000
30.8000	362.000
39.9000	667.000
50.3000	418.000
67.0000	784.000
82.0000	537.000
99.5000	310.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.000E+00	2.000E+00	2.000E+00	2.000E+00	4.390E+02	2.190E+02	0.33
6.000E+00	6.000E+00	6.000E+00	4.000E+00	7.440E+02	3.730E+02	0.33
3.080E+01	1.070E+01	1.070E+01	4.700E+00	7.780E+02	4.240E+02	0.29
3.080E+01	1.520E+01	1.520E+01	4.500E+00	7.780E+02	4.920E+02	0.17
3.080E+01	2.500E+01	2.500E+01	9.800E+00	7.780E+02	5.410E+02	0.03
3.080E+01	3.080E+01	3.080E+01	5.800E+00	7.780E+02	3.620E+02	0.36
3.990E+01	3.990E+01	3.990E+01	9.100E+00	1.111E+03	6.670E+02	0.22
5.030E+01	5.030E+01	5.030E+01	1.040E+01	1.953E+03	4.180E+02	0.48
6.700E+01	6.700E+01	6.700E+01	1.670E+01	1.985E+03	7.840E+02	0.41
8.200E+01	8.200E+01	8.200E+01	1.500E+01	1.734E+03	5.370E+02	0.45
9.950E+01	9.950E+01	9.950E+01	1.750E+01	1.861E+03	3.100E+02	0.49

Table B-2. Poisson's ratio calculated from P- and S-wave velocity models determined for the Colton Interchange East site.

P wave - d2bot, pvel, for file: COEP.VEL

2.00000	348.000
5.00000	587.000
10.3000	473.000
22.8000	1222.00
28.0000	1323.00
44.5000	1083.00

S wave - d2bot, svel, for file: COES.VEL

2.00000	135.000
5.00000	157.000
13.0000	254.000
25.5000	289.000
41.0000	432.000
54.0000	546.000
60.5000	407.000
74.0000	457.000
89.5000	501.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.000E+00	2.000E+00	2.000E+00	2.000E+00	3.480E+02	1.350E+02	0.41
5.000E+00	5.000E+00	5.000E+00	3.000E+00	5.870E+02	1.570E+02	0.46
1.030E+01	1.300E+01	1.030E+01	5.300E+00	4.730E+02	2.540E+02	0.30
2.280E+01	1.300E+01	1.300E+01	2.700E+00	1.222E+03	2.540E+02	0.48
2.280E+01	2.550E+01	2.280E+01	9.800E+00	1.222E+03	2.890E+02	0.47
2.800E+01	2.550E+01	2.550E+01	2.700E+00	1.323E+03	2.890E+02	0.47
2.800E+01	4.100E+01	2.800E+01	2.500E+00	1.323E+03	4.320E+02	0.44
4.450E+01	4.100E+01	4.100E+01	1.300E+01	1.083E+03	4.320E+02	0.41
4.450E+01	5.400E+01	4.450E+01	3.500E+00	1.083E+03	5.460E+02	0.33

Table B-3. Poisson's ratio calculated from P- and S-wave velocity models determined for the Colton Interchange West site.

P wave - d2bot, pvel, for file: COWP.VEL

3.00000	512.000
13.7000	427.000
89.5000	1944.00

S wave - d2bot, svel, for file: COWS.VEL

3.00000	220.000
4.60000	201.000
13.7000	184.000
29.0000	421.000
37.0000	587.000
48.8000	619.000
75.0000	595.000
81.0000	529.000
89.5000	648.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
3.000E+00	3.000E+00	3.000E+00	3.000E+00	5.120E+02	2.200E+02	0.39
1.370E+01	4.600E+00	4.600E+00	1.600E+00	4.270E+02	2.010E+02	0.36
1.370E+01	1.370E+01	1.370E+01	9.100E+00	4.270E+02	1.840E+02	0.39
8.950E+01	2.900E+01	2.900E+01	1.530E+01	1.944E+03	4.210E+02	0.48
8.950E+01	3.700E+01	3.700E+01	8.000E+00	1.944E+03	5.870E+02	0.45
8.950E+01	4.880E+01	4.880E+01	1.180E+01	1.944E+03	6.190E+02	0.44
8.950E+01	7.500E+01	7.500E+01	2.620E+01	1.944E+03	5.950E+02	0.45
8.950E+01	8.100E+01	8.100E+01	6.000E+00	1.944E+03	5.290E+02	0.46
8.950E+01	8.950E+01	8.950E+01	8.500E+00	1.944E+03	6.480E+02	0.44

Table B-4. Poisson's ratio calculated from P- and S-wave velocity models determined for the ETEC (RD7) site.

P wave - d2bot, pvel, for file: RD7P.VEL

12.0000	724.000
28.0000	2272.00
44.0000	2790.00
54.0000	2834.00
62.0000	4373.00
89.5000	2783.00

S wave - d2bot, svel, for file: RD7S.VEL

12.0000	430.000
28.0000	1268.00
54.0000	1403.00
62.0000	1600.00
89.5000	1441.00

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
1.200E+01	1.200E+01	1.200E+01	1.200E+01	7.240E+02	4.300E+02	0.23
2.800E+01	2.800E+01	2.800E+01	1.600E+01	2.272E+03	1.268E+03	0.27
4.400E+01	5.400E+01	4.400E+01	1.600E+01	2.790E+03	1.403E+03	0.33
5.400E+01	5.400E+01	5.400E+01	1.000E+01	2.834E+03	1.403E+03	0.34
6.200E+01	6.200E+01	6.200E+01	8.000E+00	4.373E+03	1.600E+03	0.42
8.950E+01	8.950E+01	8.950E+01	2.750E+01	2.783E+03	1.441E+03	0.32

Table B-5. Poisson's ratio calculated from P- and S-wave velocity models determined for the Obregon Park site.

P wave - d2bot, pvel, for file: OBGP.VEL

6.50000	450.000
14.0000	658.000
37.0000	1605.00
47.0000	2290.00
57.0000	981.000
67.0000	1868.00

S wave - d2bot, svel, for file: OBGS.VEL

6.50000	205.000
47.0000	434.000
67.0000	608.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
6.500E+00	6.500E+00	6.500E+00	6.500E+00	4.500E+02	2.050E+02	0.37
1.400E+01	4.700E+01	1.400E+01	7.500E+00	6.580E+02	4.340E+02	0.11
3.700E+01	4.700E+01	3.700E+01	2.300E+01	1.605E+03	4.340E+02	0.46
4.700E+01	4.700E+01	4.700E+01	1.000E+01	2.290E+03	4.340E+02	0.48
5.700E+01	6.700E+01	5.700E+01	1.000E+01	9.810E+02	6.080E+02	0.19
6.700E+01	6.700E+01	6.700E+01	1.000E+01	1.868E+03	6.080E+02	0.44

Table B-6. Poisson's ratio calculated from P- and S-wave velocity models determined for the Potrero Canyon #3 site.

P wave - d2bot, pvel, for file: POTP.VEL

2.00000	193.000
7.00000	525.000
22.0000	2178.00
33.0000	1777.00
57.0000	2190.00

S wave - d2bot, svel, for file: POTS.VEL

2.00000	102.000
7.00000	156.000
12.6000	188.000
22.0000	242.000
33.0000	306.000
43.0000	598.000
57.0000	852.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.000E+00	2.000E+00	2.000E+00	2.000E+00	1.930E+02	1.020E+02	0.31
7.000E+00	7.000E+00	7.000E+00	5.000E+00	5.250E+02	1.560E+02	0.45
2.200E+01	1.260E+01	1.260E+01	5.600E+00	2.178E+03	1.880E+02	0.50
2.200E+01	2.200E+01	2.200E+01	9.400E+00	2.178E+03	2.420E+02	0.49
3.300E+01	3.300E+01	3.300E+01	1.100E+01	1.777E+03	3.060E+02	0.48
5.700E+01	4.300E+01	4.300E+01	1.000E+01	2.190E+03	5.980E+02	0.46
5.700E+01	5.700E+01	5.700E+01	1.400E+01	2.190E+03	8.520E+02	0.41

Table B-7. Poisson's ratio calculated from P- and S-wave velocity models determined for the Receiver Sation East site.

P wave - d2bot, pvel, for file: RSEP.VEL

2.90000	394.000
7.00000	453.000
15.0000	563.000
59.5000	742.000
82.0000	2519.00

S wave - d2bot, svel, for file: RSES.VEL

2.90000	191.000
7.00000	296.000
15.0000	248.000
59.5000	519.000
82.0000	543.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.900E+00	2.900E+00	2.900E+00	2.900E+00	3.940E+02	1.910E+02	0.35
7.000E+00	7.000E+00	7.000E+00	4.100E+00	4.530E+02	2.960E+02	0.13
1.500E+01	1.500E+01	1.500E+01	8.000E+00	5.630E+02	2.480E+02	0.38
5.950E+01	5.950E+01	5.950E+01	4.450E+01	7.420E+02	5.190E+02	0.02
8.200E+01	8.200E+01	8.200E+01	2.250E+01	2.519E+03	5.430E+02	0.48

Table B-8. Poisson's ratio calculated from P- and S-wave velocity models determined for the Sylmar Converter East site.

P wave - d2bot, pvel, for file: ESCP.VEL

2.40000	390.000
10.0000	1729.00
52.7000	1935.00
91.4000	2054.00

S wave - d2bot, svel, for file: ESCS.VEL

2.40000	244.000
10.0000	296.000
24.7000	419.000
52.7000	511.000
59.4000	710.000
77.4000	687.000
91.4000	530.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.400E+00	2.400E+00	2.400E+00	2.400E+00	3.900E+02	2.440E+02	0.18
1.000E+01	1.000E+01	1.000E+01	7.600E+00	1.729E+03	2.960E+02	0.48
5.270E+01	2.470E+01	2.470E+01	1.470E+01	1.935E+03	4.190E+02	0.48
5.270E+01	5.270E+01	5.270E+01	2.800E+01	1.935E+03	5.110E+02	0.46
9.140E+01	5.940E+01	5.940E+01	6.700E+00	2.054E+03	7.100E+02	0.43
9.140E+01	7.740E+01	7.740E+01	1.800E+01	2.054E+03	6.870E+02	0.44
9.140E+01	9.140E+01	9.140E+01	1.400E+01	2.054E+03	5.300E+02	0.46

Table B-9. Poisson's ratio calculated from P- and S-wave velocity models determined for the Sylmar Converter East #2 site.

P wave - d2bot, pvel, for file: ESC2P.VEL

2.00000	479.000
5.00000	708.000
9.40000	1197.00
59.5000	1876.00

S wave - d2bot, svel, for file: ESC2S.VEL

6.10000	210.000
9.40000	252.000
15.2000	265.000
22.9000	298.000
29.0000	414.000
38.4000	458.000
41.8000	421.000
47.0000	439.000
59.5000	450.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.000E+00	6.100E+00	2.000E+00	2.000E+00	4.790E+02	2.100E+02	0.38
5.000E+00	6.100E+00	5.000E+00	3.000E+00	7.080E+02	2.100E+02	0.45
9.400E+00	6.100E+00	6.100E+00	1.100E+00	1.197E+03	2.100E+02	0.48
9.400E+00	9.400E+00	9.400E+00	3.300E+00	1.197E+03	2.520E+02	0.48
5.950E+01	1.520E+01	1.520E+01	5.800E+00	1.876E+03	2.650E+02	0.49
5.950E+01	2.290E+01	2.290E+01	7.700E+00	1.876E+03	2.980E+02	0.49
5.950E+01	2.900E+01	2.900E+01	6.100E+00	1.876E+03	4.140E+02	0.47
5.950E+01	3.840E+01	3.840E+01	9.400E+00	1.876E+03	4.580E+02	0.47
5.950E+01	4.180E+01	4.180E+01	3.400E+00	1.876E+03	4.210E+02	0.47
5.950E+01	4.700E+01	4.700E+01	5.200E+00	1.876E+03	4.390E+02	0.47
5.950E+01	5.950E+01	5.950E+01	1.250E+01	1.876E+03	4.500E+02	0.47

Table B-10. Poisson's ratio calculated from P- and S-wave velocity models determined for the Tarzana (downhole location) site.

P wave - d2bot, pvel, for file: TARP.VEL

3.60000	271.000
10.0000	477.000
20.0000	797.000
59.5000	1712.00

S wave - d2bot, svel, for file: TARS.VEL

3.60000	147.000
13.1000	200.000
30.0000	380.000
44.2000	473.000
59.5000	508.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
3.600E+00	3.600E+00	3.600E+00	3.600E+00	2.710E+02	1.470E+02	0.29
1.000E+01	1.310E+01	1.000E+01	6.400E+00	4.770E+02	2.000E+02	0.39
2.000E+01	1.310E+01	1.310E+01	3.100E+00	7.970E+02	2.000E+02	0.47
2.000E+01	3.000E+01	2.000E+01	6.900E+00	7.970E+02	3.800E+02	0.35
5.950E+01	3.000E+01	3.000E+01	1.000E+01	1.712E+03	3.800E+02	0.47
5.950E+01	4.420E+01	4.420E+01	1.420E+01	1.712E+03	4.730E+02	0.46
5.950E+01	5.950E+01	5.950E+01	1.530E+01	1.712E+03	5.080E+02	0.45

Table B-11. Poisson's ratio calculated from P- and S-wave velocity models determined for the Wadsworth VA North site.

P wave - d2bot, pvel, for file: WVANP.VEL

4.90000	490.000
10.0000	868.000
22.0000	716.000
46.3000	1822.00
53.0000	1703.00
61.6000	2840.00
74.4000	1378.00
89.5000	2137.00

S wave - d2bot, svel, for file: WVANS.VEL

4.90000	286.000
10.0000	367.000
34.1000	440.000
40.9000	424.000
46.3000	621.000
53.0000	337.000
61.6000	697.000
89.5000	429.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
4.900E+00	4.900E+00	4.900E+00	4.900E+00	4.900E+02	2.860E+02	0.24
1.000E+01	1.000E+01	1.000E+01	5.100E+00	8.680E+02	3.670E+02	0.39
2.200E+01	3.410E+01	2.200E+01	1.200E+01	7.160E+02	4.400E+02	0.20
4.630E+01	3.410E+01	3.410E+01	1.210E+01	1.822E+03	4.400E+02	0.47
4.630E+01	4.090E+01	4.090E+01	6.800E+00	1.822E+03	4.240E+02	0.47
4.630E+01	4.630E+01	4.630E+01	5.400E+00	1.822E+03	6.210E+02	0.43
5.300E+01	5.300E+01	5.300E+01	6.700E+00	1.703E+03	3.370E+02	0.48
6.160E+01	6.160E+01	6.160E+01	8.600E+00	2.840E+03	6.970E+02	0.47
7.440E+01	8.950E+01	7.440E+01	1.280E+01	1.378E+03	4.290E+02	0.45
8.950E+01	8.950E+01	8.950E+01	1.510E+01	2.137E+03	4.290E+02	0.48

Table B-12. Poisson's ratio calculated from P- and S-wave velocity models determined for the Wadsworth VA South site.

P wave - d2bot, pvel, for file: WVASP.VEL

2.40000	324.000
6.00000	684.000
13.0000	932.000
87.0000	1768.00

S wave - d2bot, svel, for file: WVASS.VEL

2.40000	184.000
6.00000	393.000
13.0000	574.000
25.0000	420.000
29.0000	548.000
47.3000	449.000
87.0000	479.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.400E+00	2.400E+00	2.400E+00	2.400E+00	3.240E+02	1.840E+02	0.26
6.000E+00	6.000E+00	6.000E+00	3.600E+00	6.840E+02	3.930E+02	0.25
1.300E+01	1.300E+01	1.300E+01	7.000E+00	9.320E+02	5.740E+02	0.19
8.700E+01	2.500E+01	2.500E+01	1.200E+01	1.768E+03	4.200E+02	0.47
8.700E+01	2.900E+01	2.900E+01	4.000E+00	1.768E+03	5.480E+02	0.45
8.700E+01	4.730E+01	4.730E+01	1.830E+01	1.768E+03	4.490E+02	0.47
8.700E+01	8.700E+01	8.700E+01	3.970E+01	1.768E+03	4.790E+02	0.46

P wave - d2bot, pvel, for file: WTPP.VEL
22.0000 742.000
99.5000 1689.00

S wave - d2bot, svel, for file: WTPS.VEL
22.0000 195.000
41.0000 410.000
99.5000 377.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.200E+01	2.200E+01	2.200E+01	2.200E+01	7.420E+02	1.950E+02	0.46
9.950E+01	4.100E+01	4.100E+01	1.900E+01	1.689E+03	4.100E+02	0.47
9.950E+01	9.950E+01	9.950E+01	5.850E+01	1.689E+03	3.770E+02	0.47