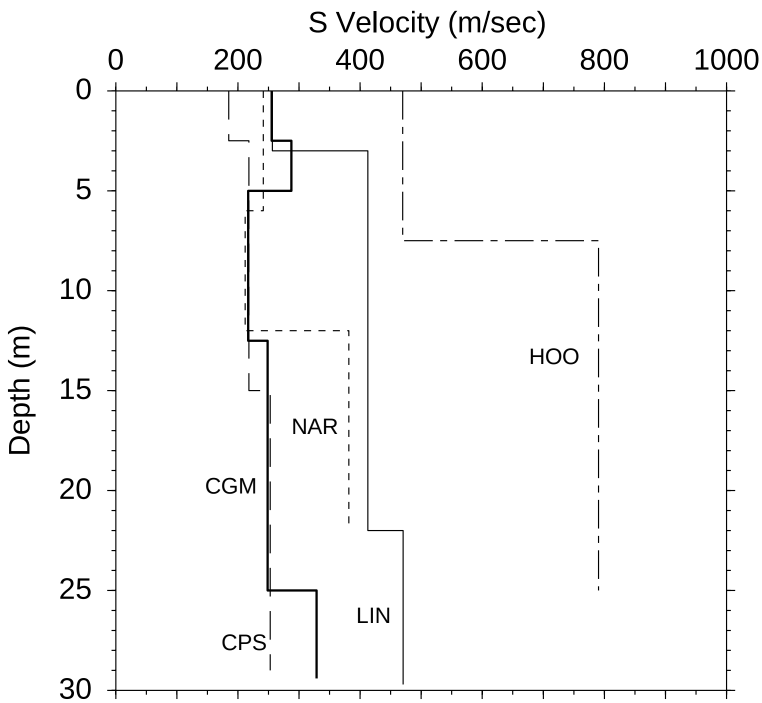
U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

BOREHOLE P- AND S-WAVE VELOCITY AT THIRTEEN STATIONS IN SOUTHERN CALIFORNIA

by

James F. Gibbs[1], David M. Boore[1], John C. Tinsley[1], and Charles S. Mueller[2]



U.S. Geological Survey Open-File Report OF 01-506

[1]Menlo Park, CA 94025
[2]Denver, CO 80225

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BOREHOLE P- AND S-WAVE VELOCITY AT THIRTEEN SITES IN SOUTHERN CALIFORNIA

by

James F. Gibbs, David M. Boore, John C. Tinsley, and Charles S. Mueller

INTRODUCTION

The U.S. Geological Survey (USGS), as part of a program to aquire seismic velocity data at locations of strong-ground motion in earthquakes (e.g. Gibbs, et al., 2000), has investigated thirteen additional sites in the Southern California region. Of the thirteen sites, twelve are in the vicinity of Whittier, California and one is located in San Bernardino, California.

Several deployments of temporary seismographs were made after the Whittier Narrows, California earthquake of 1 October 1987 (Mueller et al., 1988). A deployment, between 2 October and 9 November 1987, was the motivation for selection of six of the drill sites. Temporary portable seismographs at Hoover School (HOO), Lincoln School (LIN), Corps of Engineers Station (NAR), Olive Junior High School (OLV), Santa Anita Golf Course (SAG) and Southwestern Academy (SWA), recorded significant aftershock data. These portable sites with the exception of Santa Anita Golf Course were co-sited with strong-motion recorders.

Stations at HOO, Lincoln School Whittier (WLB), Saint Paul High School (STP), Alisos Adult School (EXC), Cerritos College Gymnasium (CGM), Cerritos College Physical Science Building (CPS), and Cerritos College Police Building (CPB) were part of an array of digital strong-motion stations deployed from "bedrock" in Whittier to near the deepest part of the Los Angeles basin in Norwalk. Although development and siting of this new array (patially installed at the time of this writing) was generally motivated by the Whittier Narrows earthquake, these new sites (with the exception of HOO) were not part of any Whittier Narrows aftershock deployments. A similar new digital strong-motion site was installed at the San Bernardino Fire Station during the same time frame.

Velocity data were obtained to depths of about 90 meters at two sites, 30 meters at seven sites, and 18 to 25 meters at four sites. Lithology data from the analysis of cuttings and samples, was obtained from the two 90-meter deep holes and from five of the shallower holes to supplement the velocity interpretation. The two 90-meter boreholes (SB1, CPB) have been instrumented with borehole seismometers for continuous monitoring of earthquake activity (Rogers, et al., 1998). No drill samples or cuttings were obtained from the other six sites but driller's logs were scanned for major changes noted there. The velocity models at those sites were interpreted using only the measured data and major changes in the driller's log as noted above.

The sites are shown in Figure 1 and listed in Table 1, which gives references to information regarding the strong-motion data. Several hundred strong-motion records of the main-shock were written by this moderate size earthquake ($M_L = 5.9$) making it important from a scientific and engineering prospective (Brady et al., 1988, Shakal et al., 1988).

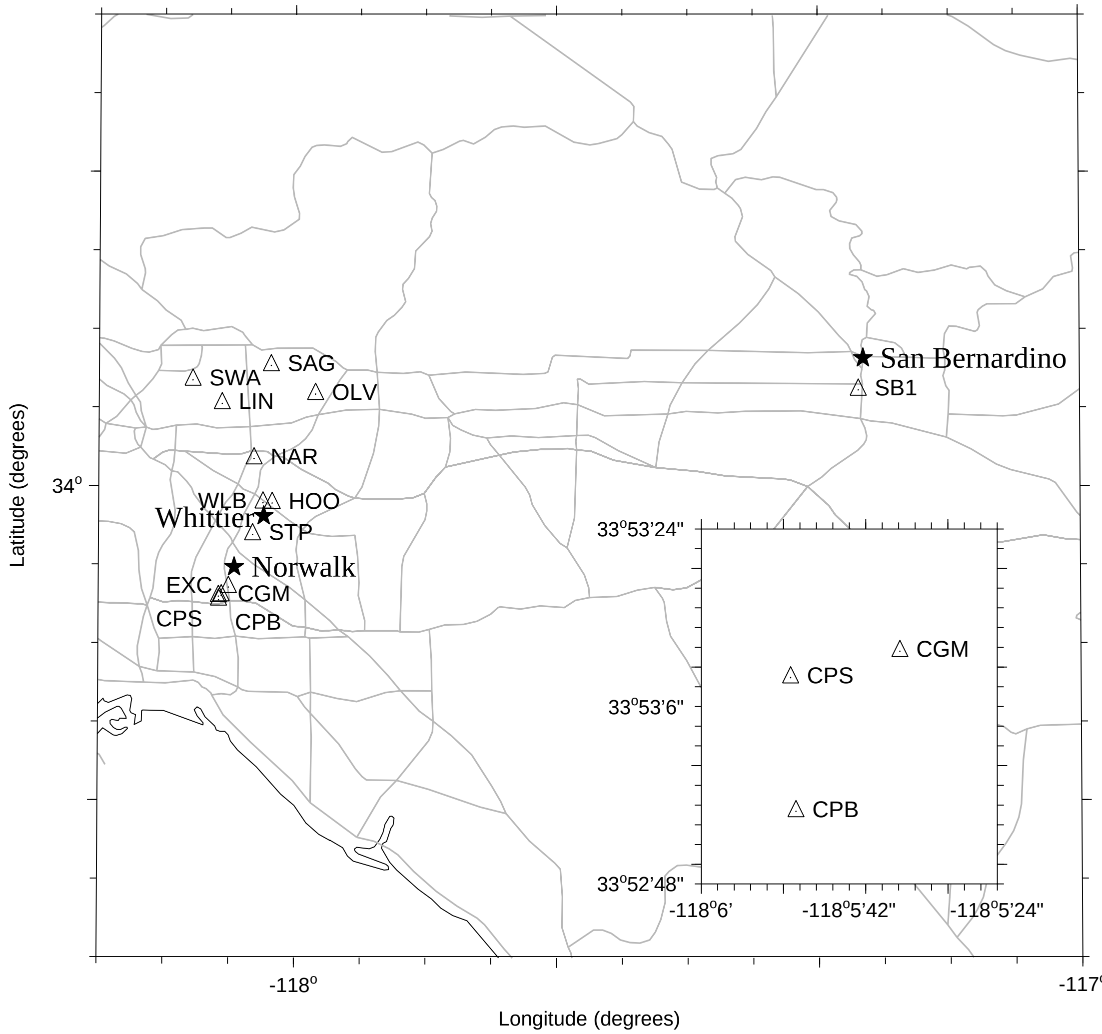

Figure 1. Regional map showing the locations of boreholes (triangles) included in this report. Inset shows the locations of the Cerritos College boreholes at an expanded scale. Locations of roads and cities are approximate.

Table 1. Site names, three letter codes, and coordinates using the North American Datums of 1927 (NAD27) and 1983 (NAD83).

Station	StaCode	Lat:NAD27	Long:NAD27	Lat:NAD83	Long:NAD83
Cerritos College Gymnasium	CGM	33.88663	-118.09329	33.88664	-118.09419
Cerritos College Physical Sci. Bldg.	CPS	33.88589	-118.09698	33.88590	-118.09788
Cerritos College Police Bldg.	CPB	33.88212	-118.09680	33.88213	-118.09770
Corps of Engineers Station *	NAR	34.03219	-118.05225	34.03220	-118.05315
Hoover School *	HOO	33.98491	-118.02889	33.98492	-118.02979
Lincoln School *	LIN	34.09043	-118.09305	34.09044	-118.09395
Lincoln School Whittier	WLB	33.98535	-118.04061	33.98536	-118.04151
Los Alisos Adult School	EXC	33.89559	-118.08428	33.89560	-118.08518
Olive Junior High School *	OLV	34.10073	-117.97409	34.10074	-117.97499
San Bernardino Fire Station	SB1	34.10534	-117.28201	34.10535	-117.28289
Santa Anita Golf Course	SAG	34.13096	-118.03074	34.13097	-118.03164
South Western Academy *	SWA	34.11533	-118.13046	34.11534	-118.13136
St. Paul High School	STP	33.95158	-118.05369	33.95159	-118.05459

* Strong-motion accelerograph located near borehole (see location maps in Appendix A).

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 meters 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 offsets varied from 2 to 4 meters depending on available space and depth of the borehole. Shallow holes (30 meters or less) were offset 2 or 3 meters.

Downhole measurements were made at 2.5-meter intervals at ten locations and at 2-meter spacing at three of the shallower boreholes. The measurements were made by moving a three-component geophone to each depth and clamping it to the casing by an electrically-activated lever arm. A second three-component geophone was placed on the surface near the shear source used to verify timing of the triggered recorder. The data were recorded on diskettes using a 12-channel recording system.

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-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 at the two sites (CBP, SB1) where geologic information was available. At five sites (CGM, CPS, EXC, STP, WLB) simplified lithology, determined from drill cuttings, was used to supplement the velocity determinations. At the remaining six sites (NAR, HOO, LIN, OLV, SAG, SWA) the velocity models were determined without the benefit of lithology or electric 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. 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

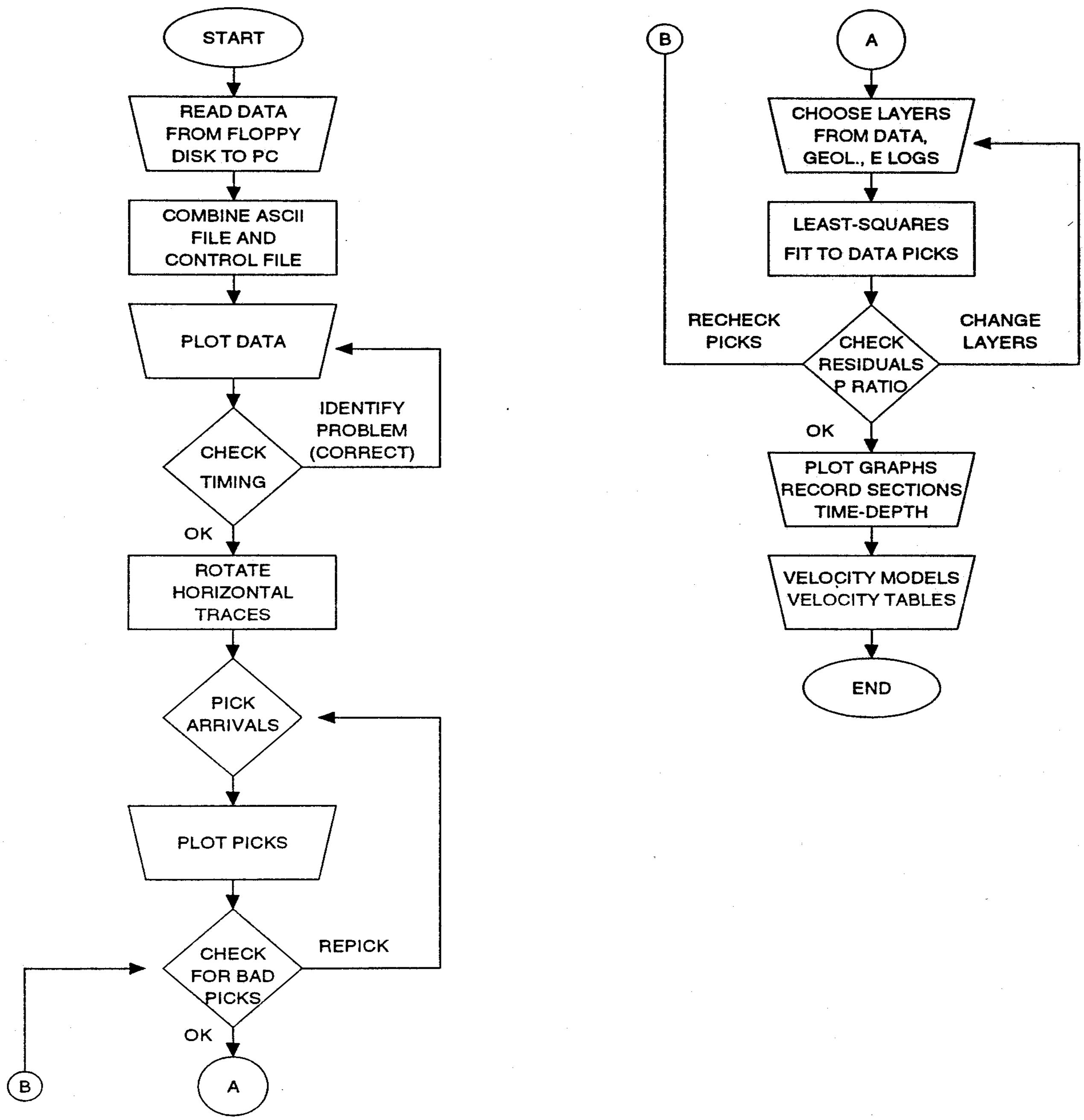

Figure 2. Flow-chart outlining the data processing and steps in the interpretation.

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.

For example, at San Bernardino Fire Station several velocity models were tried to get Poisson's ratio into the accepted range. We were forced to average the P-wave velocity over the top 8.5 meters to get the ratio from a negative value to a value of 0.04. The preferred model in which the S-velocity follows the lithology (in general, the S-wave velocity is a better indicator of lithology than P-wave velocity) is included in Appendix A.

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, 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.

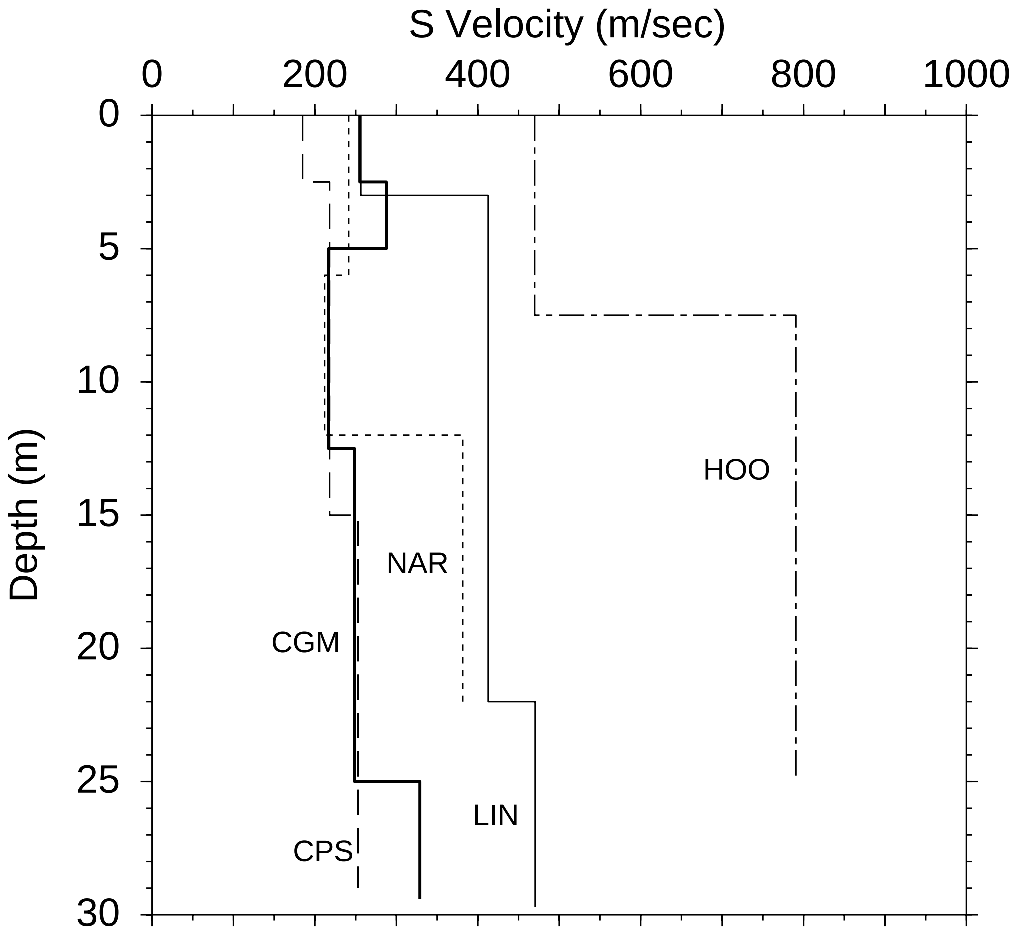

Figure 3. S-wave velocity models shown on the same figure for comparison.

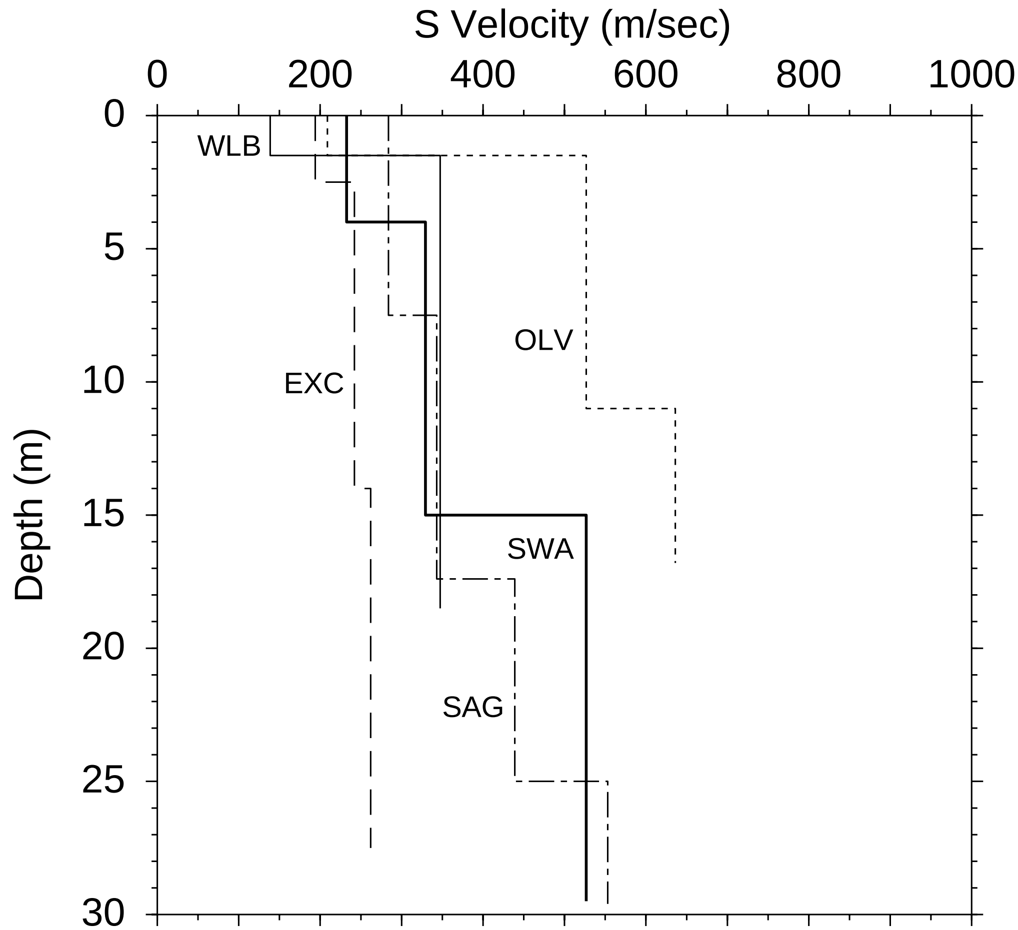

Figure 4. S-wave velocity models shown on the same figure for comparison.

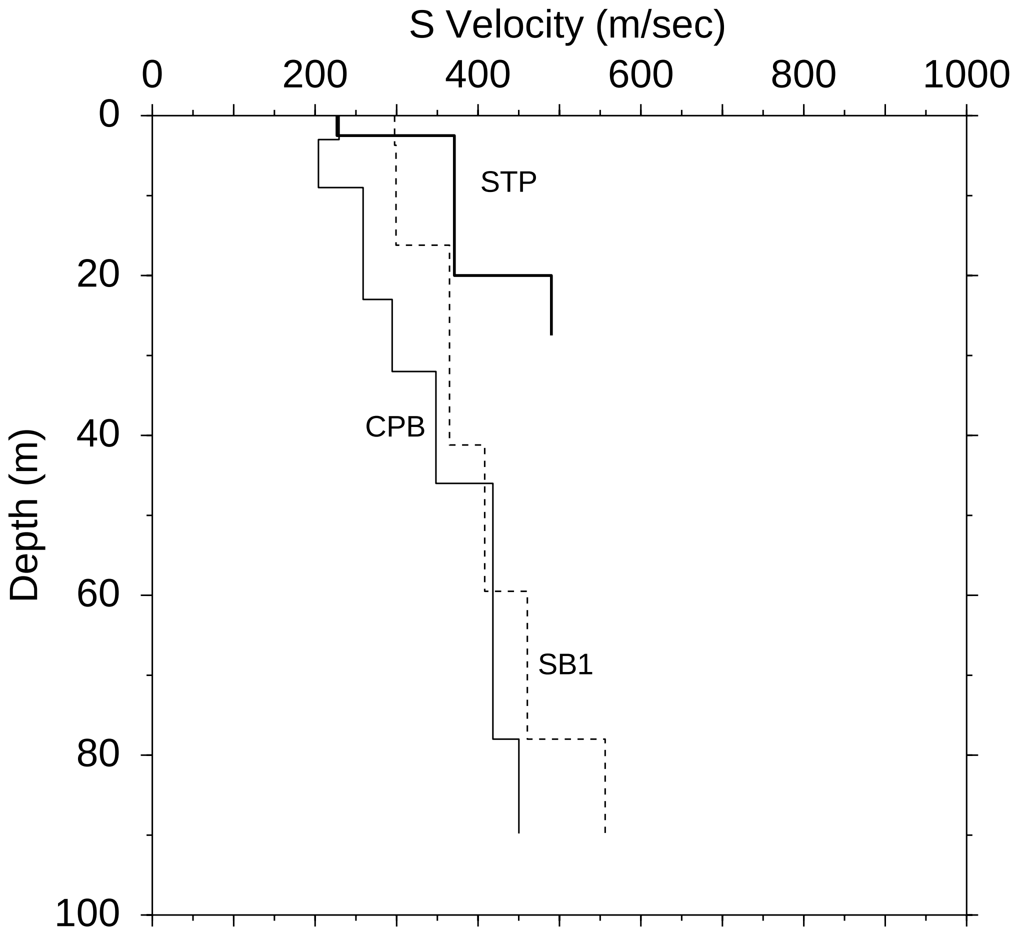

Figure 5. S-wave velocity models shown on same figure for comparison.

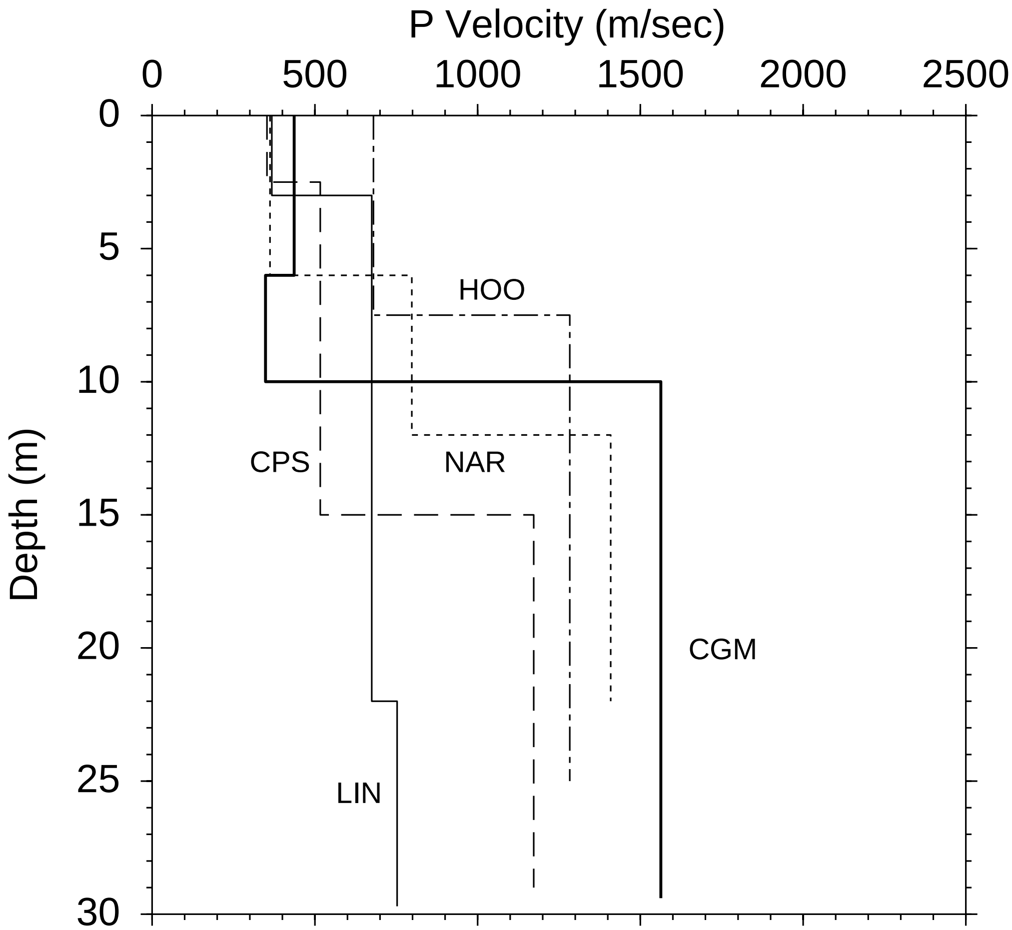

Figure 6. P-wave velocity models shown on the same figure for comparison.

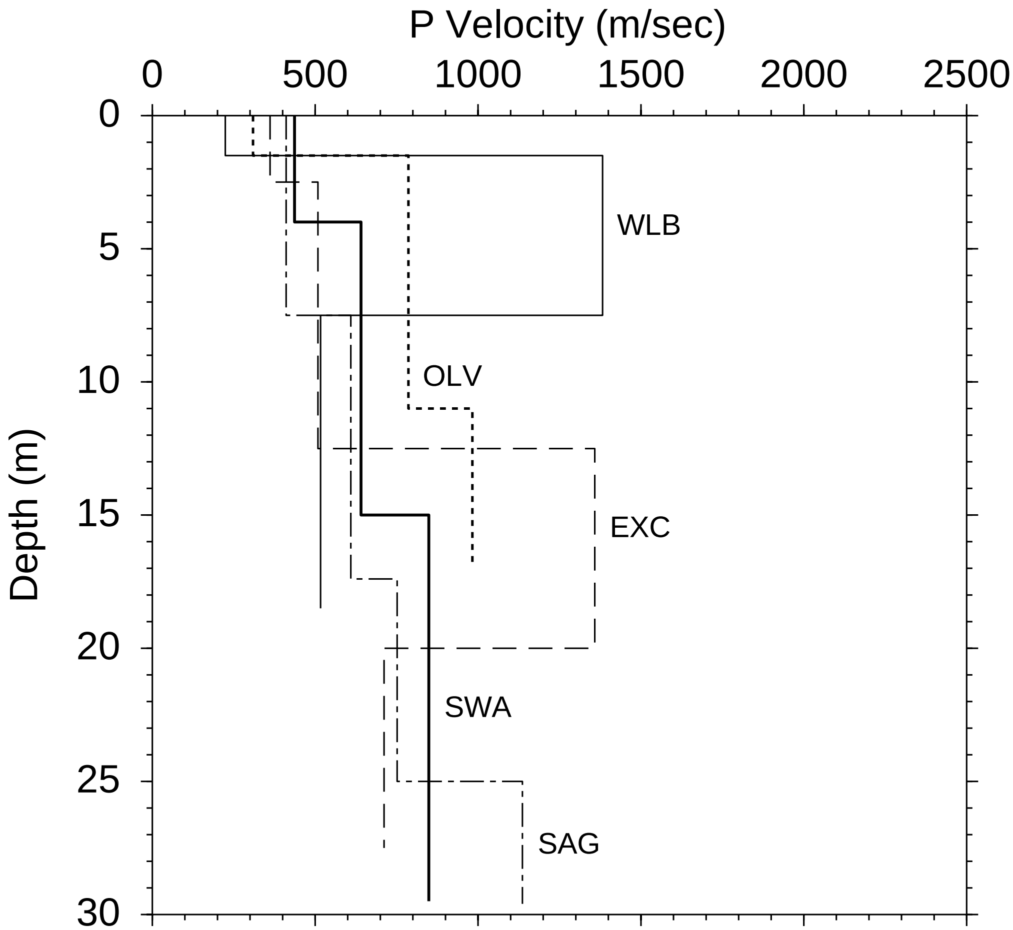

Figure 7. P-wave velocity models shown on the same figure for comparison.

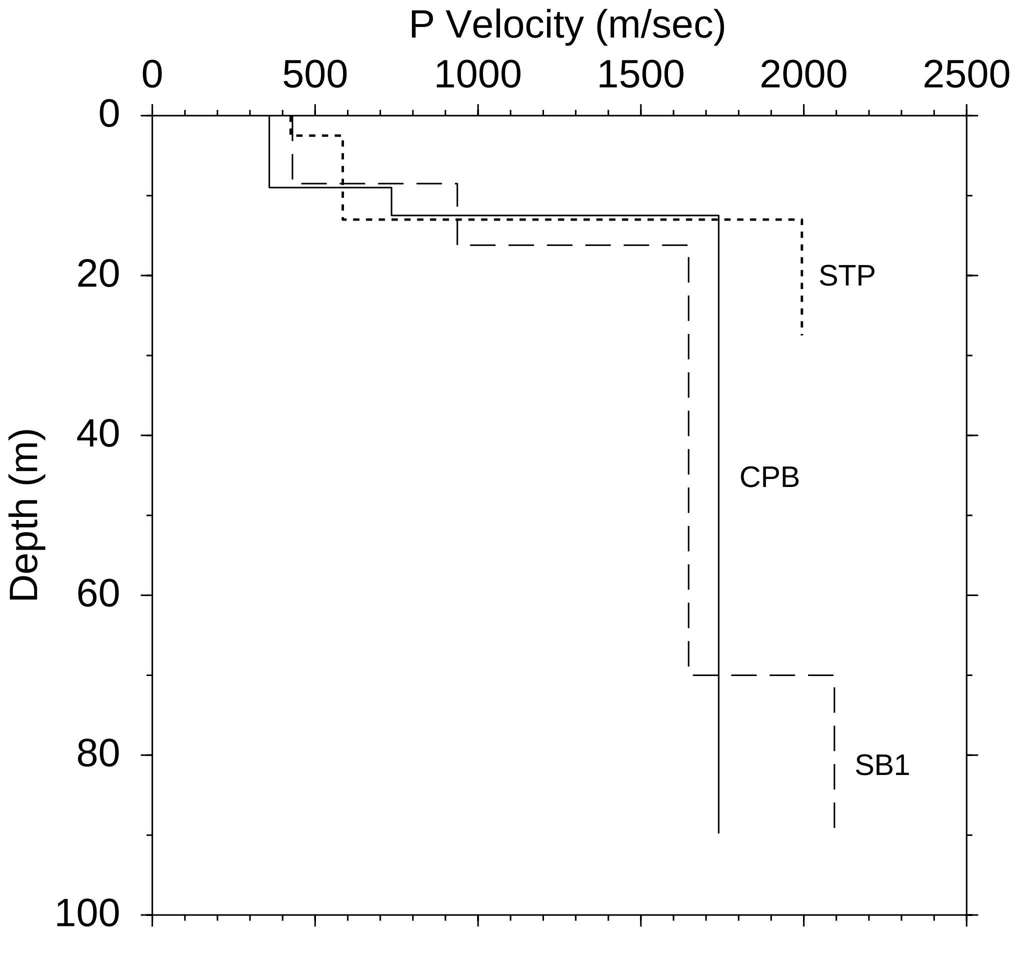

Figure 8. P-wave velocity models shown on the same figure for comparison.

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 Sebak at Cerritos College; Warren Thomas at Corps of Engineers Station; Margie Leon and Ray Rodriguez at Hoover School; Jack Feldman at Lincoln School; Stephen Finkle at Lincoln School Whittier; Mr. Hengler at Los Alisos Adult School; Daniel at Olive Junior High School; Richard McGreevy at San Bernardino Fire Station; Dave Cuellar, Terry Moeller, and Tom Dittmar at Santa Anita Golf Course; Charles Craig at South Western Academy; Father Robert Gallagher at St. Paul High School. We also thank Allen Foss of the U.S. Geological Survey for his help with the P- and S-wave logging.

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APPENDIX—A

Detailed Results

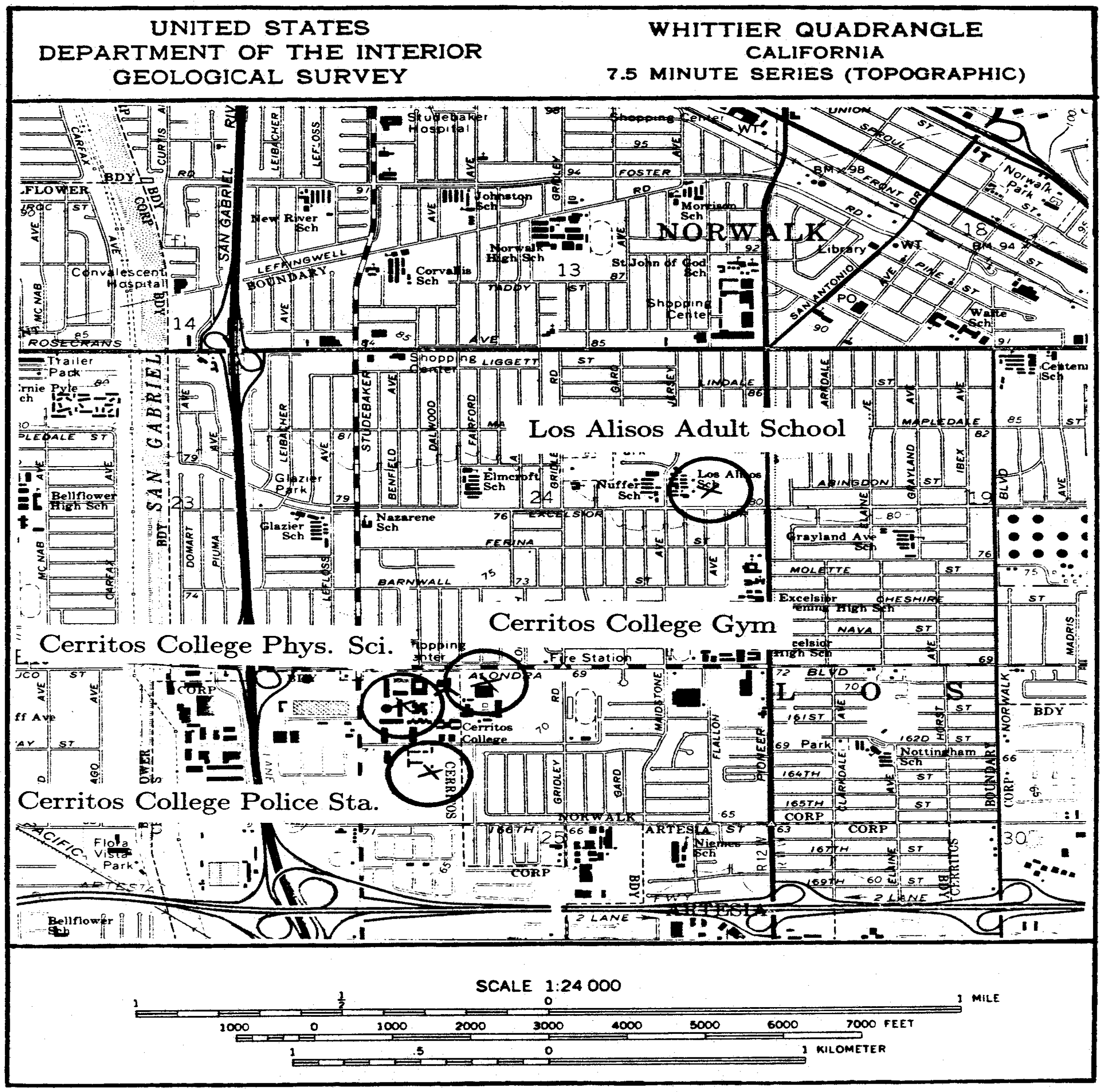

Figure A-1. Site location map for the borehole at Cerritos College Gymnasium.

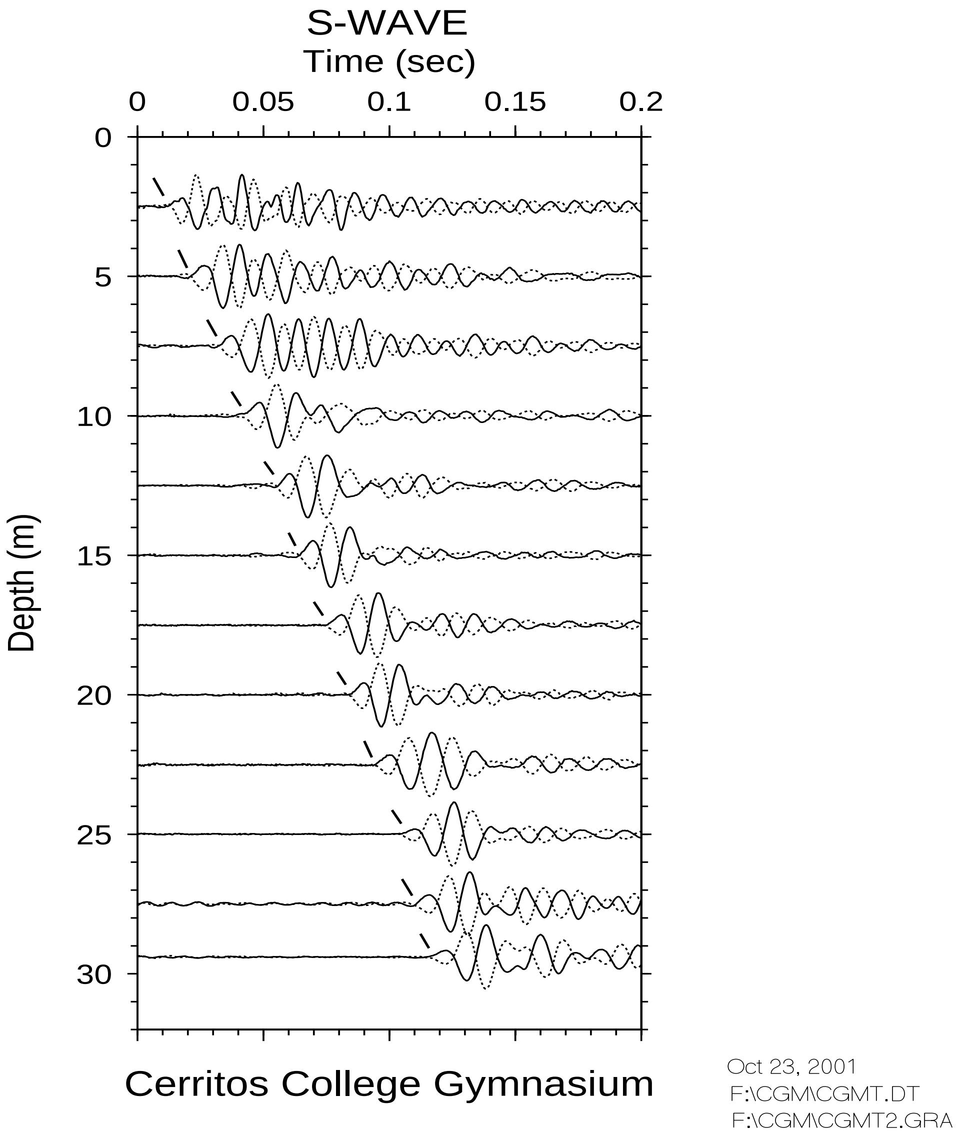

Figure A-2. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

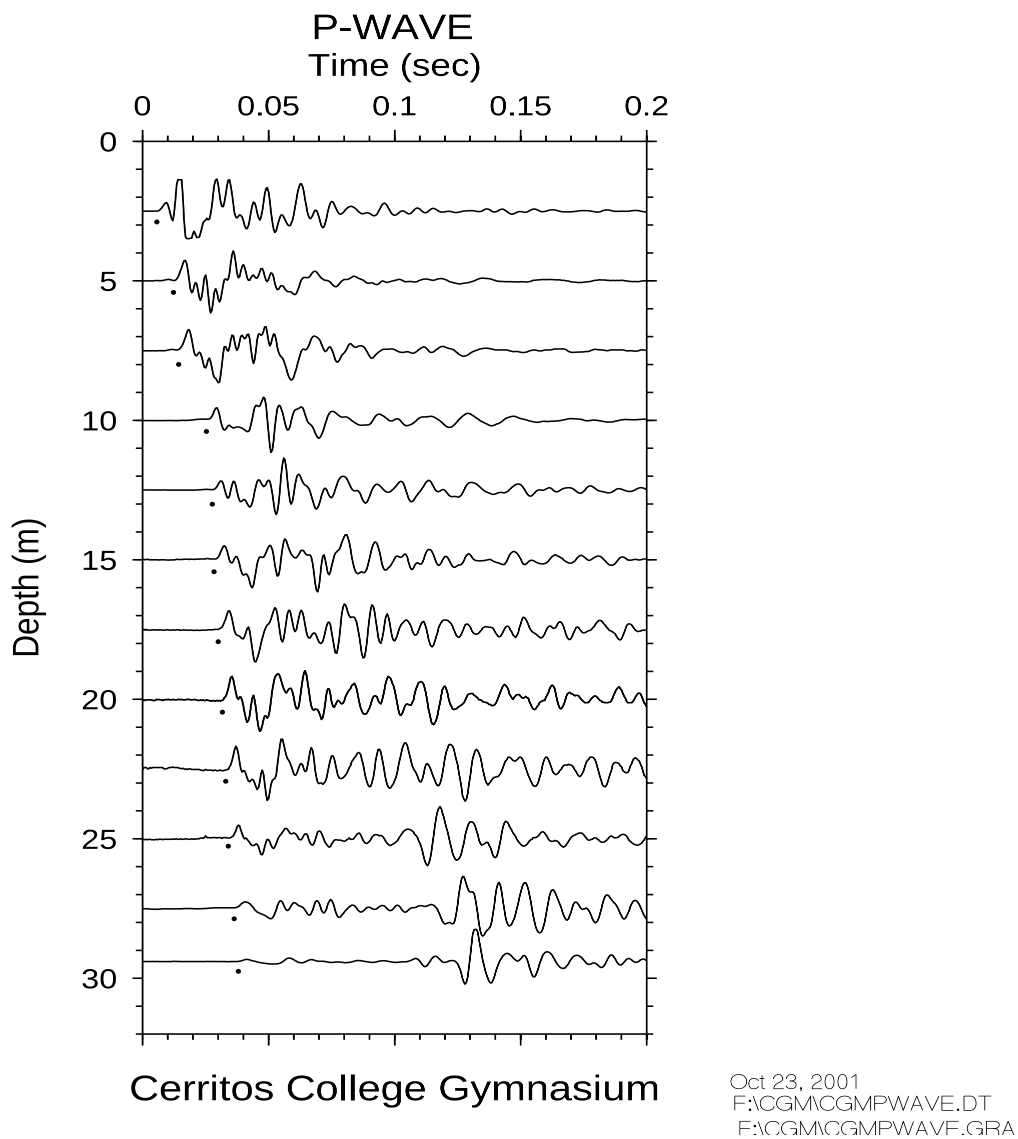

Figure A-3. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

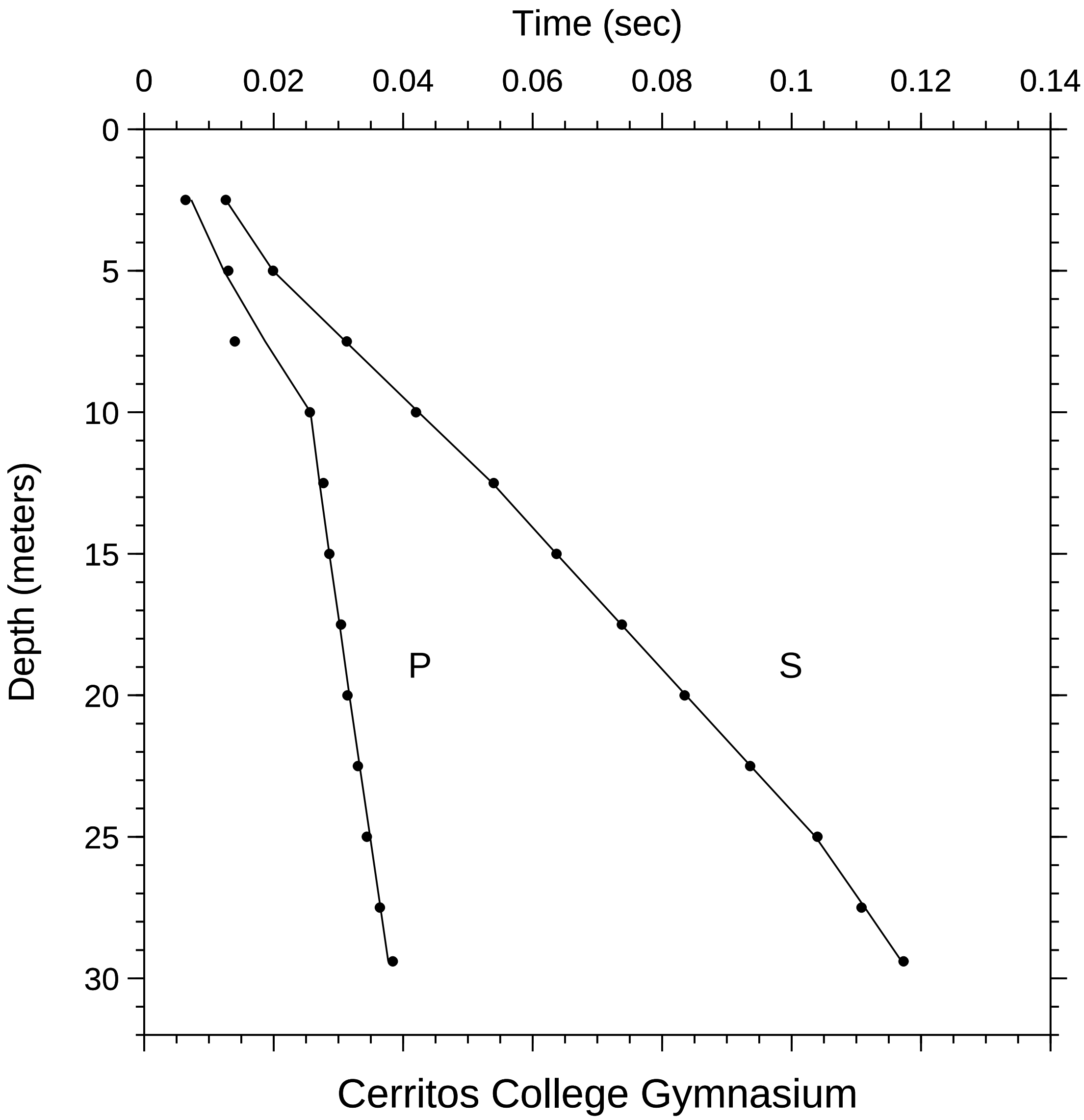

Figure A-4. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

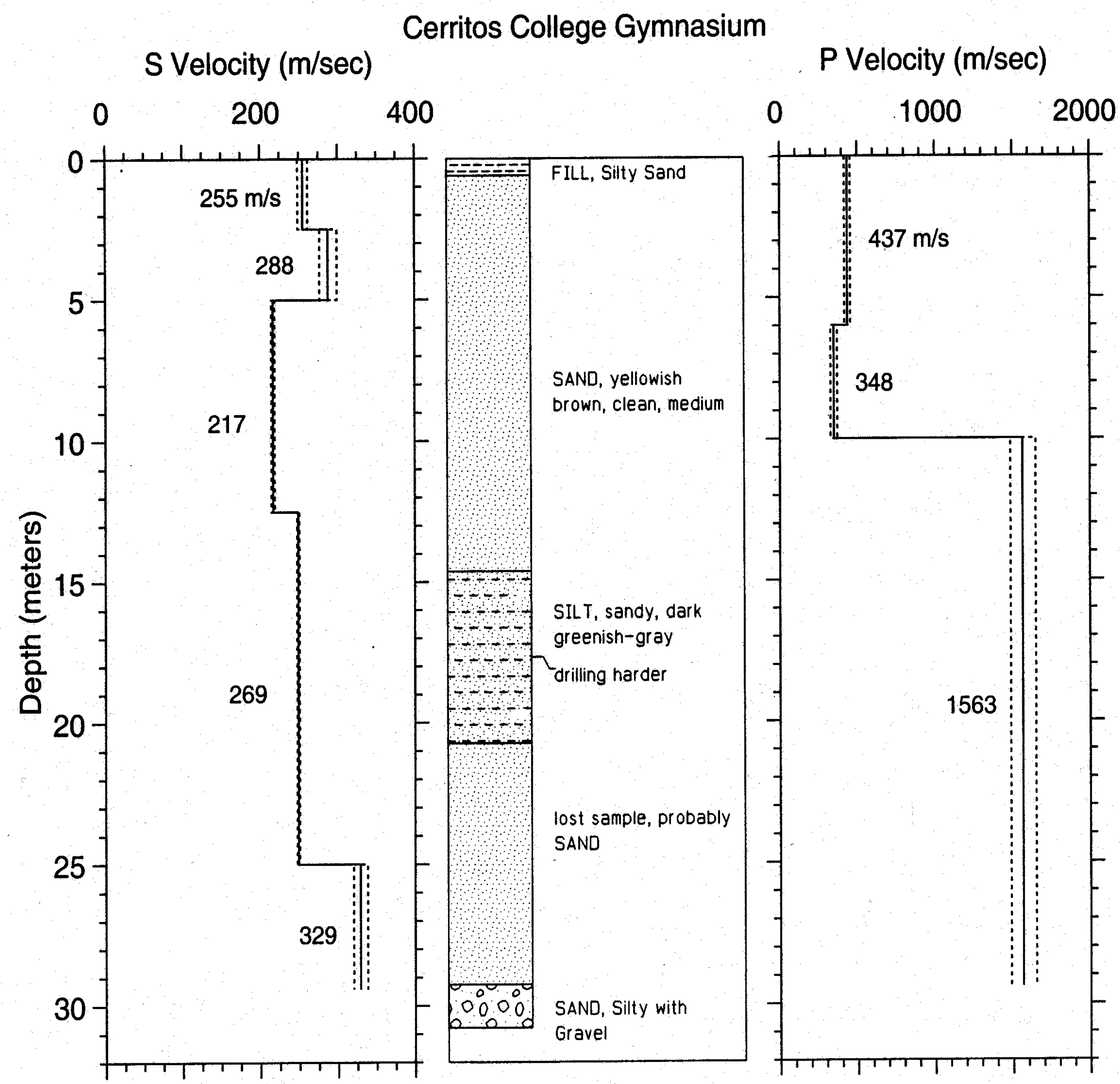

Figure A-5. S- and P-wave velocity profiles with dashed lines representing plus and minus one standard deviation. Generalized geologic log is shown for correlation with velocities.

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

Location: Cerritos College Gymnasium: S Coordinates: 33.88663 -118.09329 Hole_Code: 296
hoffset = 2.00 travel-time file: F:\CGM\CGMS.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0126	0.0098	255	1	0.0000
5.0	16.4	0.0199	0.0185	270	1	0.0000
7.5	24.6	0.0313	0.0300	250	1	0.0002
10.0	32.8	0.0420	0.0415	241	1	-0.0004
12.5	41.0	0.0540	0.0530	236	1	0.0002
15.0	49.2	0.0637	0.0631	238	1	0.0000
17.5	57.4	0.0738	0.0731	239	1	0.0001
20.0	65.6	0.0835	0.0832	240	1	-0.0002
22.5	73.8	0.0936	0.0932	241	1	-0.0001
25.0	82.0	0.1040	0.1032	242	1	0.0003
27.5	90.2	0.1108	0.1108	248	1	-0.0005
29.4	96.5	0.1173	0.1166	252	1	0.0003

nlayers = 5

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)
2.5	2.5	255	249	262	8.2	8.2	837	817	858
5.0	2.5	288	277	299	16.4	8.2	943	908	981
12.5	7.5	217	215	219	41.0	24.6	711	704	718
25.0	12.5	249	247	250	82.0	41.0	816	811	822
29.4	4.4	329	320	338	96.5	14.4	1079	1050	1109

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: Cerritos College Gymnasium: P Coordinates: 33.88663 -118.09329 Hole_Code: 296
hoffset = 2.00 travel-time file: F:\CGM\CGMP.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0064	0.0057	437	1	-0.0009
5.0	16.4	0.0130	0.0114	437	1	0.0007
7.5	24.6	0.0140	0.0180	416	5	-0.0047
10.0	32.8	0.0256	0.0252	396	1	-0.0001
12.5	41.0	0.0277	0.0268	466	1	0.0006
15.0	49.2	0.0286	0.0284	528	1	-0.0001
17.5	57.4	0.0304	0.0300	583	1	0.0002
20.0	65.6	0.0314	0.0316	632	1	-0.0004
22.5	73.8	0.0330	0.0332	677	1	-0.0003
25.0	82.0	0.0344	0.0348	718	1	-0.0005
27.5	90.2	0.0364	0.0364	755	1	-0.0001
29.4	96.5	0.0384	0.0376	781	1	0.0007

nlayers = 3

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
6.0	6.0	437	418	456	19.7	19.7	1432	1372	1497
10.0	4.0	348	328	371	32.8	13.1	1142	1075	1219
29.4	19.4	1563	1486	1648	96.5	63.6	5128	4877	5407

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

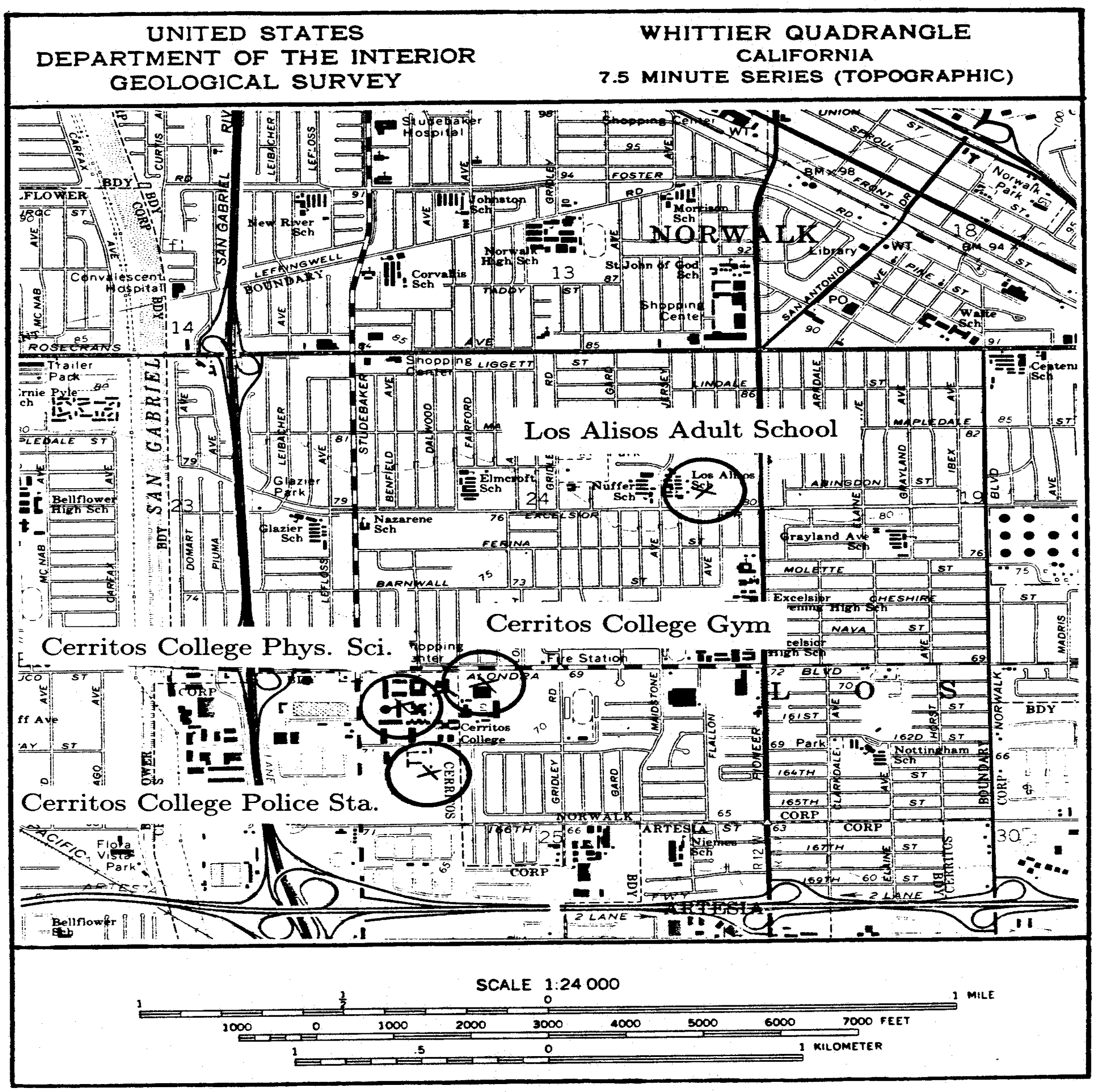

Figure A-6. Site location map for the borehole at Cerritos College Physical Science Building.

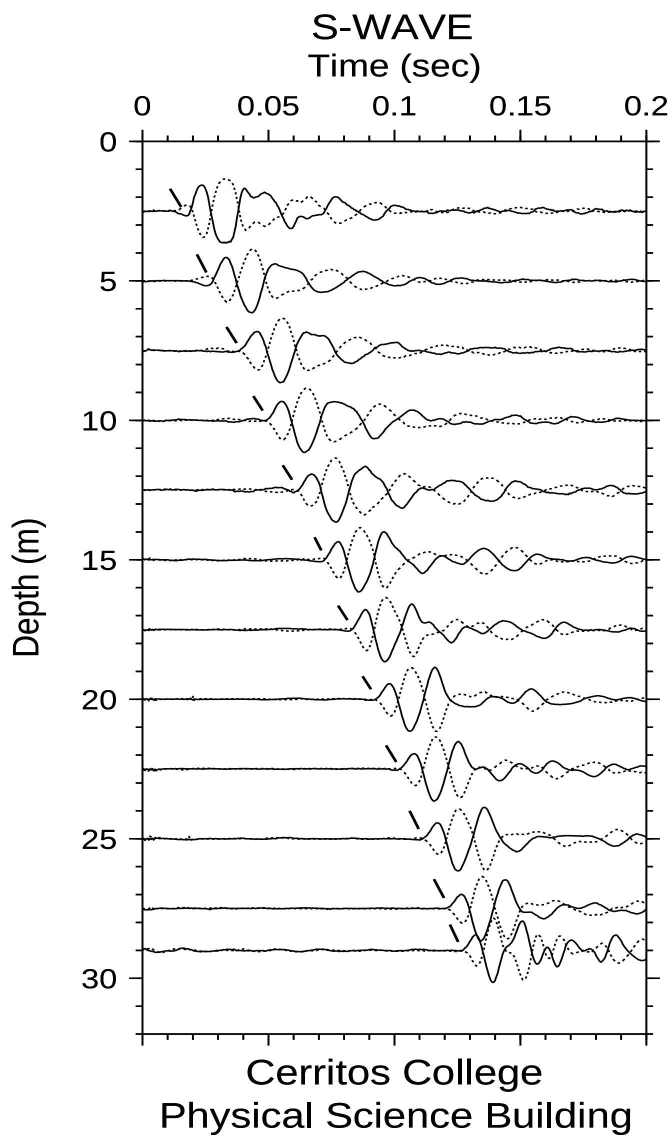

Figure A-7. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

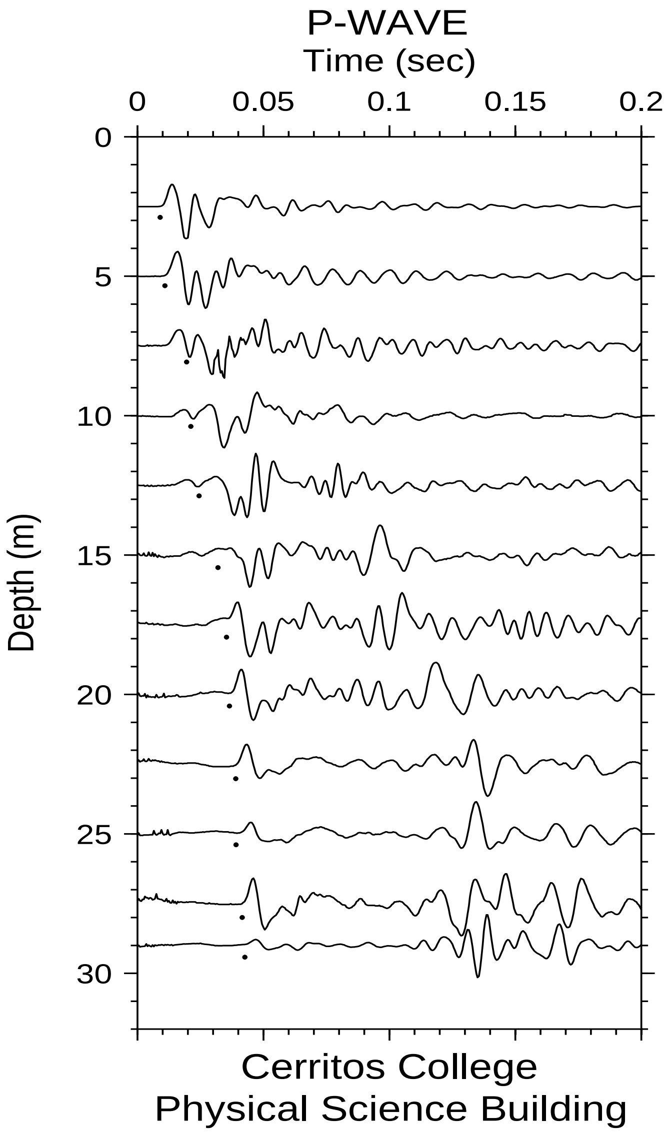

Figure A-8. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

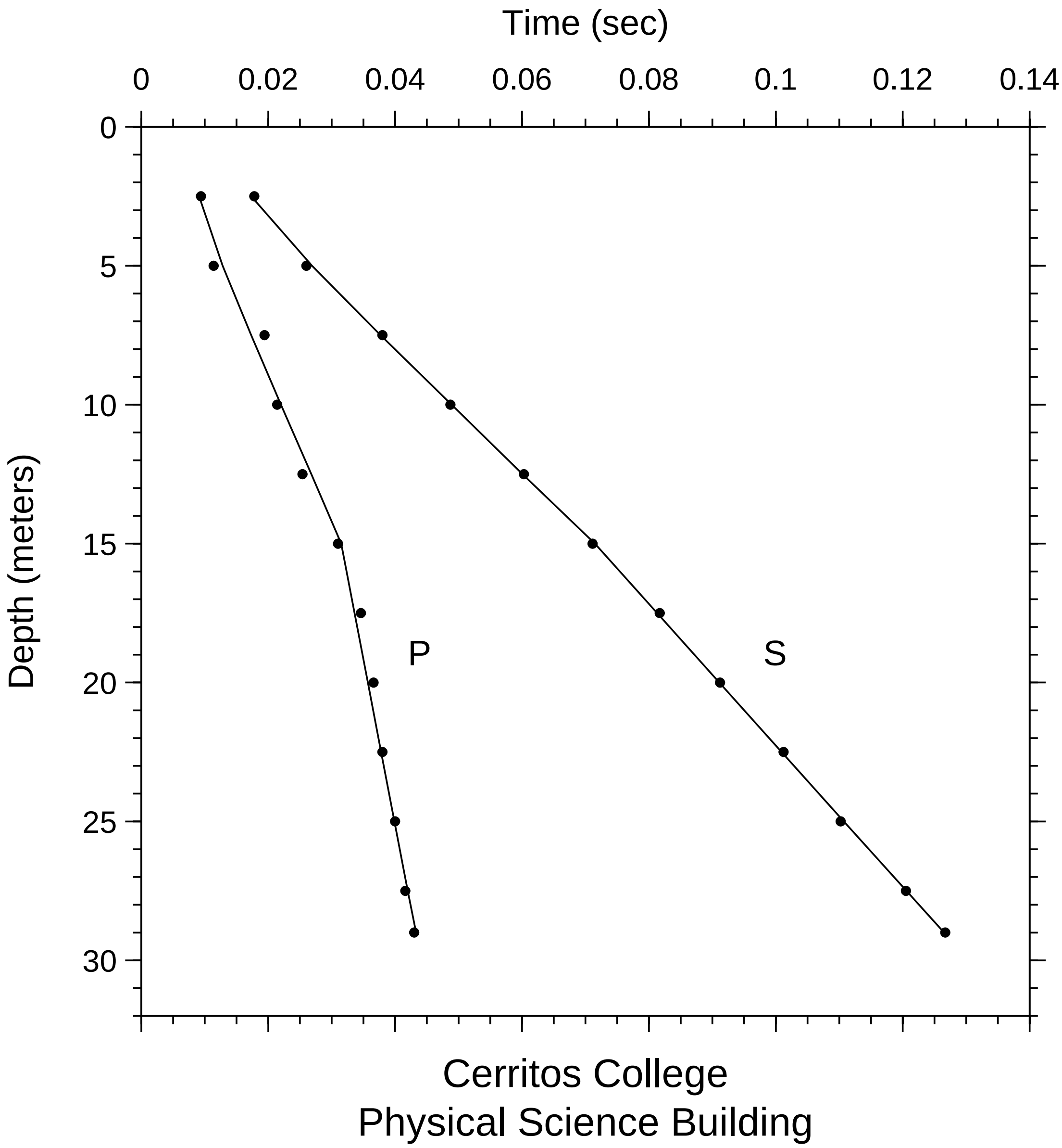

Figure A-9. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

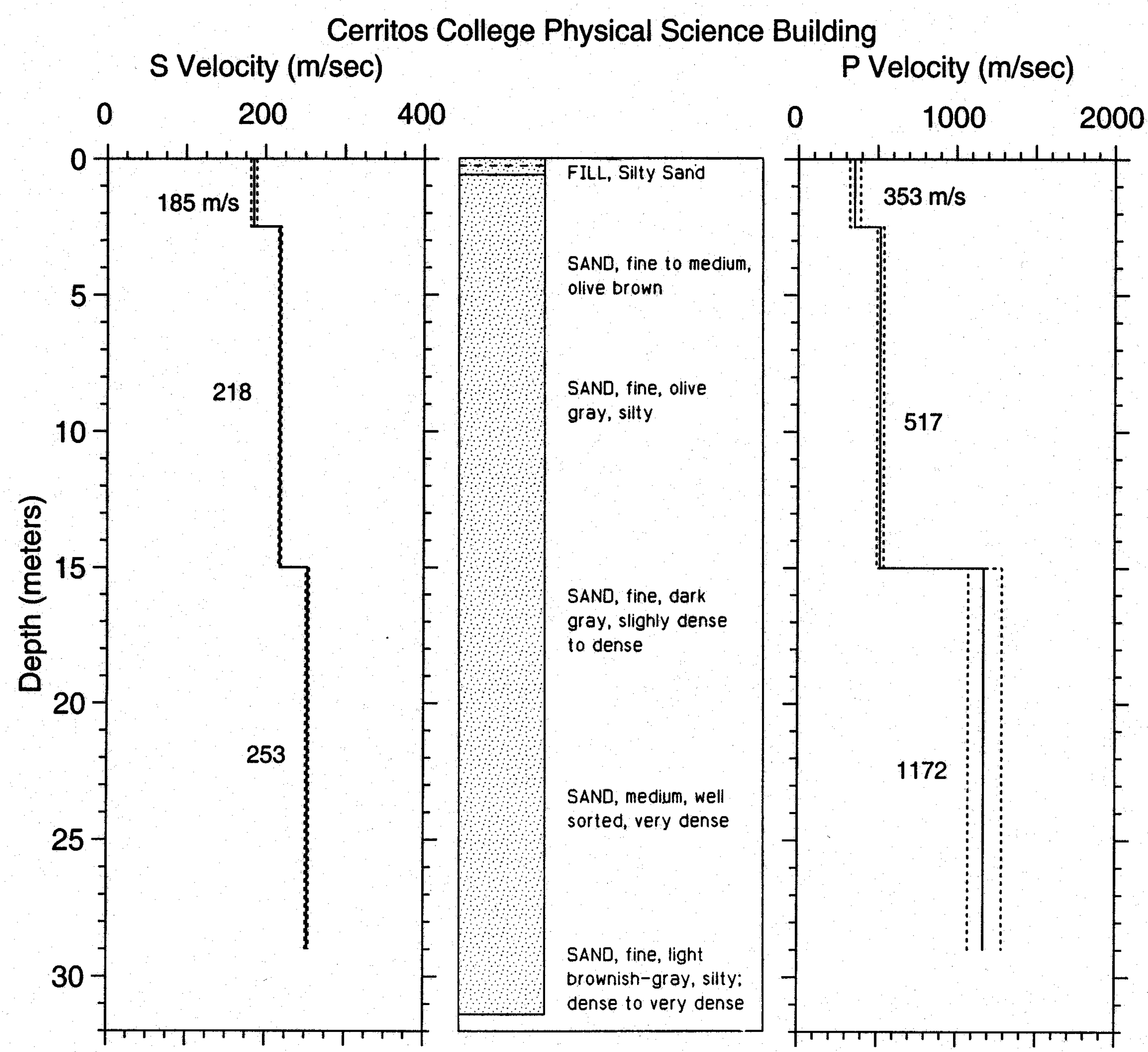

Figure A-10. S- and P-wave velocity profiles with generalized geologic log. Dashed lines represent plus and minus one standard deviation.

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

Location: Physical Sciences Building: S Coordinates: 33.88589 -118.09700 Hole_Code: 297
hoffset = 2.00 travel-time file: F:\CPS\CPSS.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0178	0.0135	185	1	0.0005
5.0	16.4	0.0260	0.0250	200	1	-0.0009
7.5	24.6	0.0380	0.0364	206	1	0.0003
10.0	32.8	0.0487	0.0479	209	1	-0.0002
12.5	41.0	0.0603	0.0594	210	1	0.0002
15.0	49.2	0.0711	0.0709	212	1	-0.0004
17.5	57.4	0.0817	0.0807	217	1	0.0004
20.0	65.6	0.0912	0.0906	221	1	0.0001
22.5	73.8	0.1012	0.1005	224	1	0.0003
25.0	82.0	0.1102	0.1104	226	1	-0.0005
27.5	90.2	0.1205	0.1203	229	1	-0.0001
29.0	95.1	0.1267	0.1262	230	1	0.0002

nlayers = 3

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)
2.5	2.5	185	181	189	8.2	8.2	607	594	620
15.0	12.5	218	216	220	49.2	41.0	715	710	721
29.0	14.0	253	251	255	95.1	45.9	830	823	836

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

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

Location: Physical Sciences Building: P Coordinates: 33.88589 -118.09700 Hole_Code: 297
hoffset = 2.00 travel-time file: F:\CPS\CPSP.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0094	0.0071	353	1	0.0003
5.0	16.4	0.0114	0.0119	420	1	-0.0014
7.5	24.6	0.0194	0.0168	448	1	0.0021
10.0	32.8	0.0214	0.0216	463	1	-0.0006
12.5	41.0	0.0254	0.0264	473	1	-0.0014
15.0	49.2	0.0310	0.0313	480	1	-0.0005
17.5	57.4	0.0346	0.0334	524	1	0.0010
20.0	65.6	0.0366	0.0355	563	1	0.0009
22.5	73.8	0.0380	0.0377	597	1	0.0002
25.0	82.0	0.0400	0.0398	628	1	0.0001
27.5	90.2	0.0416	0.0419	656	1	-0.0004
29.0	95.1	0.0430	0.0432	671	1	-0.0003

nlayers = 3

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)
2.5	2.5	353	322	390	8.2	8.2	1158	1057	1280
15.0	12.5	517	495	540	49.2	41.0	1695	1626	1771
29.0	14.0	1172	1076	1287	95.1	45.9	3845	3530	4223

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
```

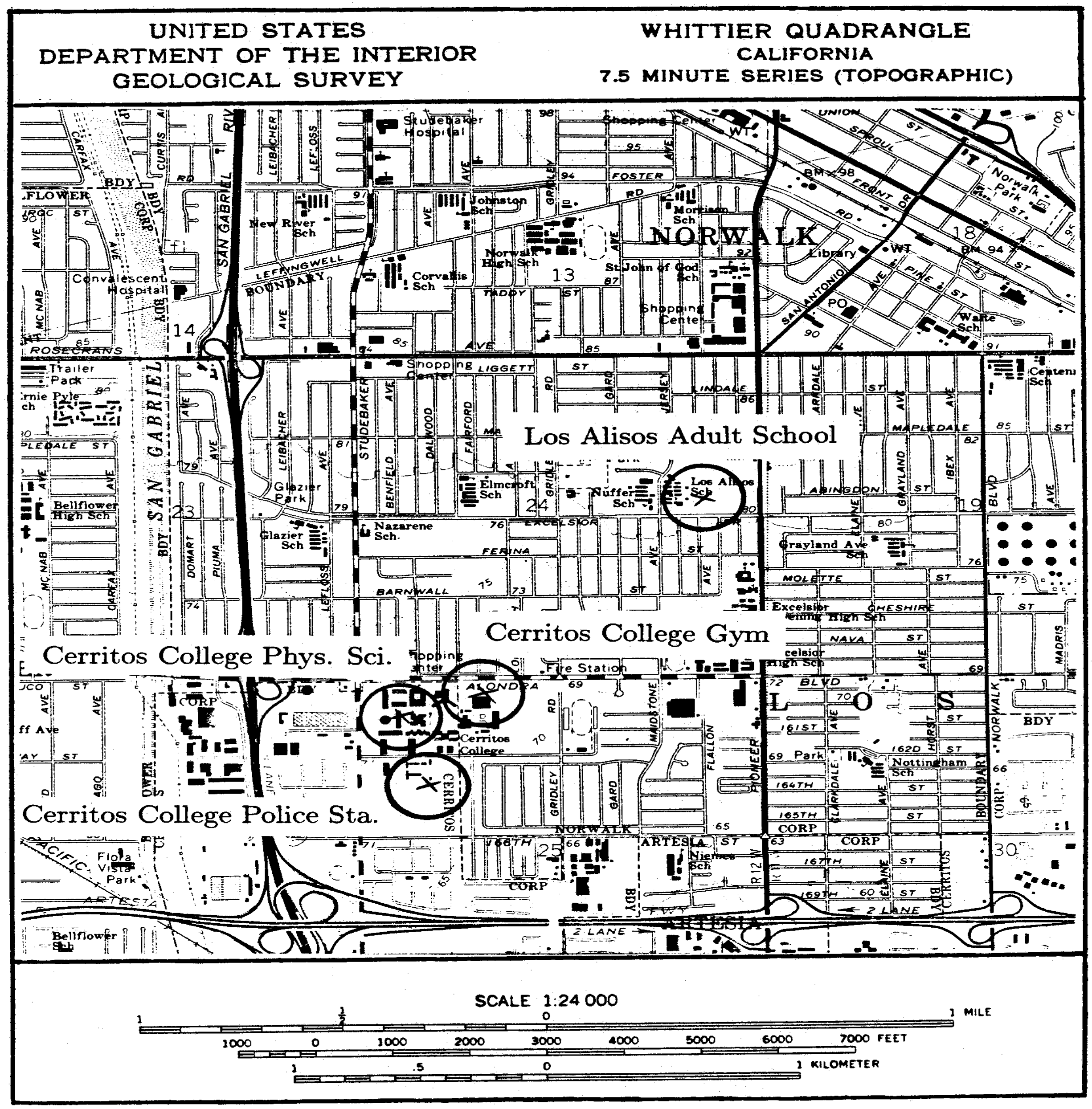

Figure A-11. Site location map for the borehole at Cerritos College Police Building.

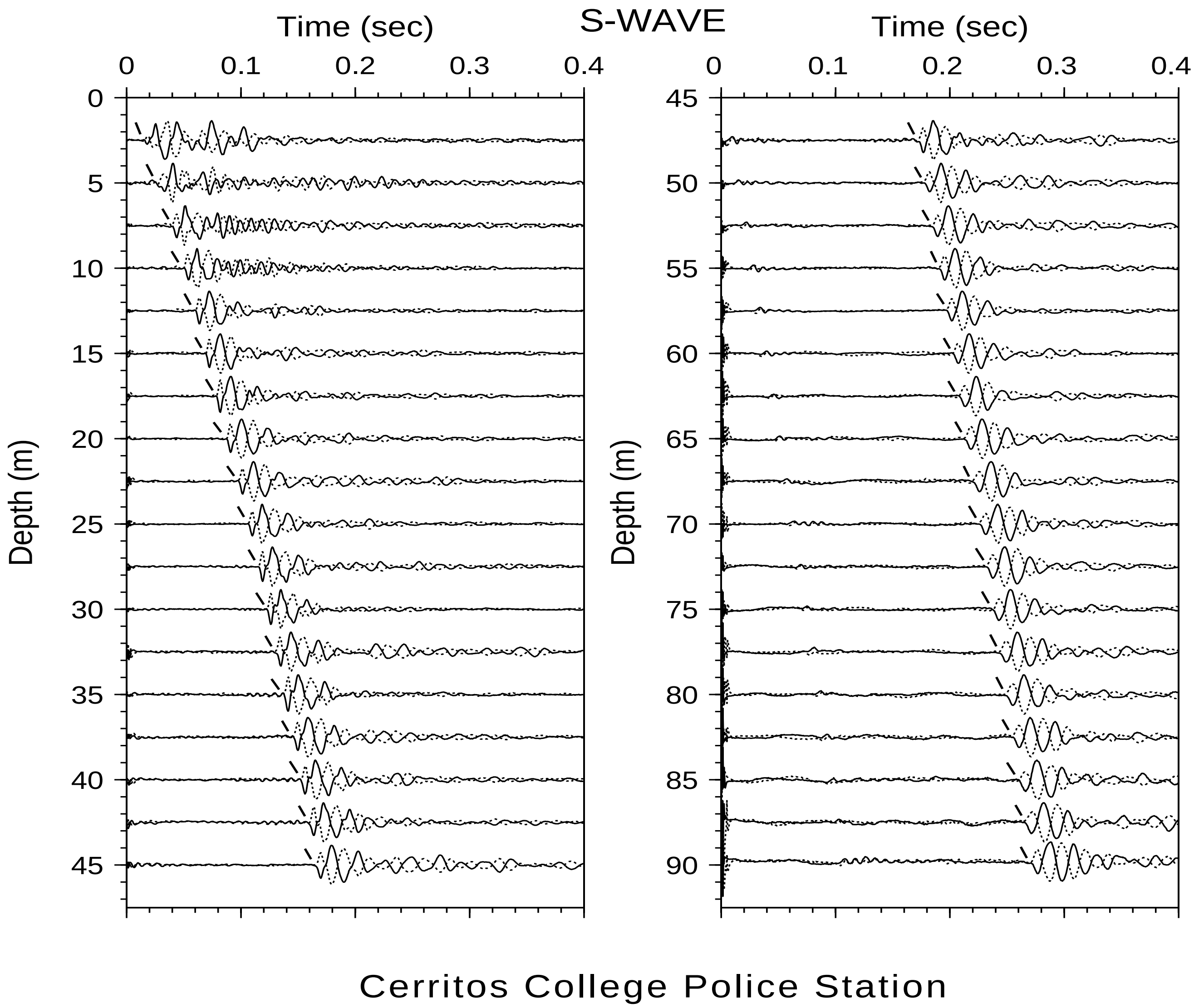

Figure A-12. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

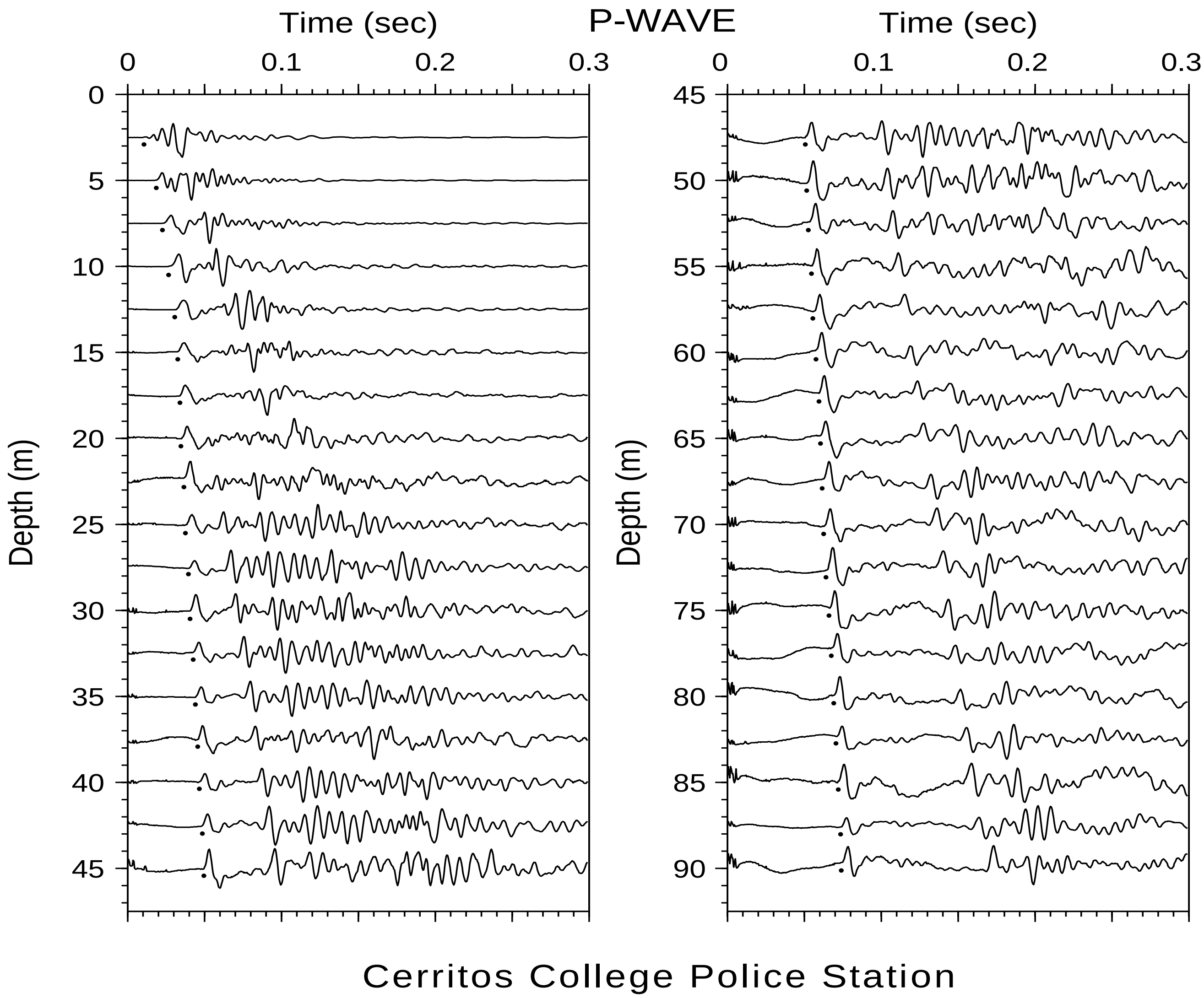

Figure A-13. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

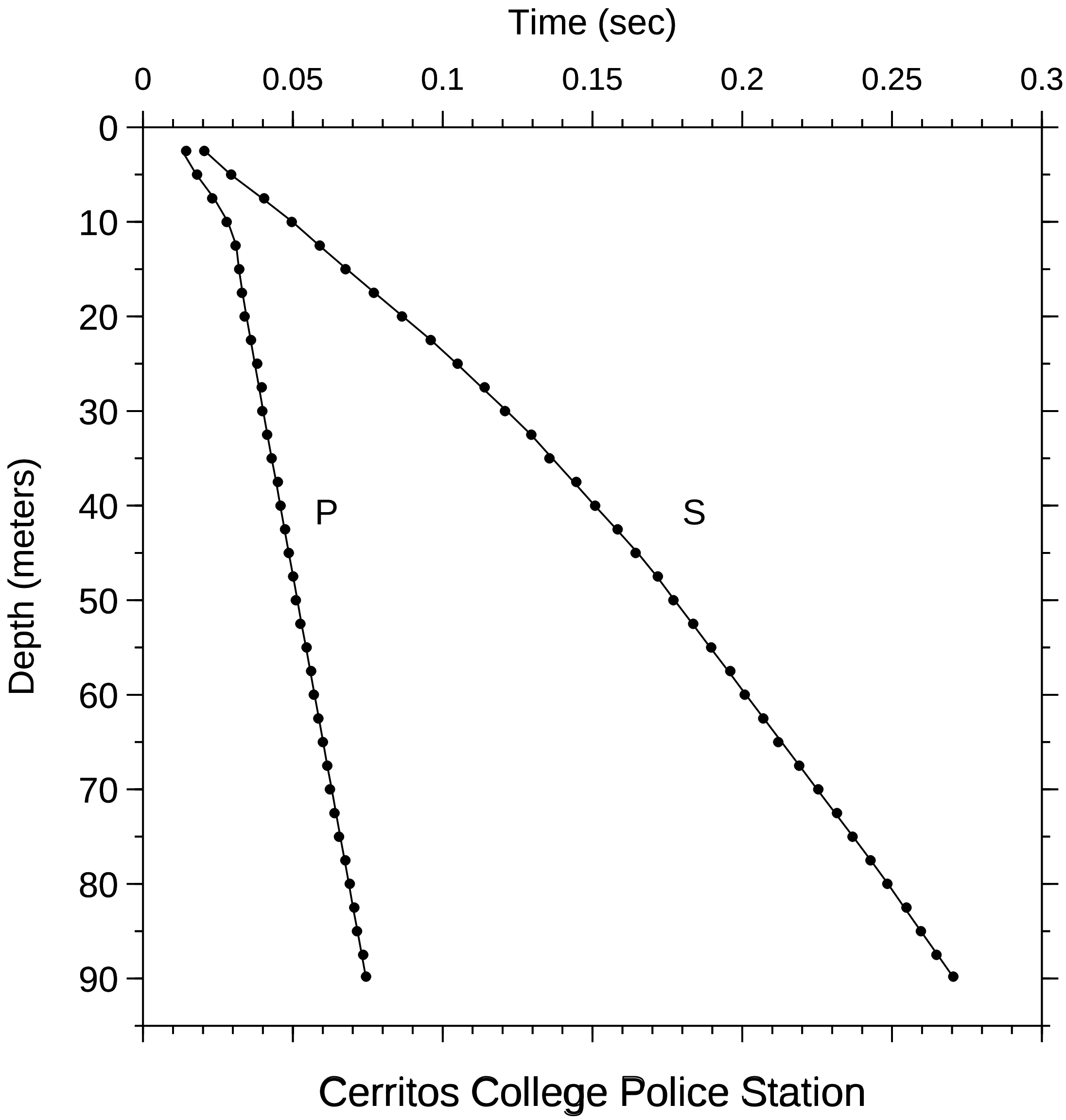

Figure A-14. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

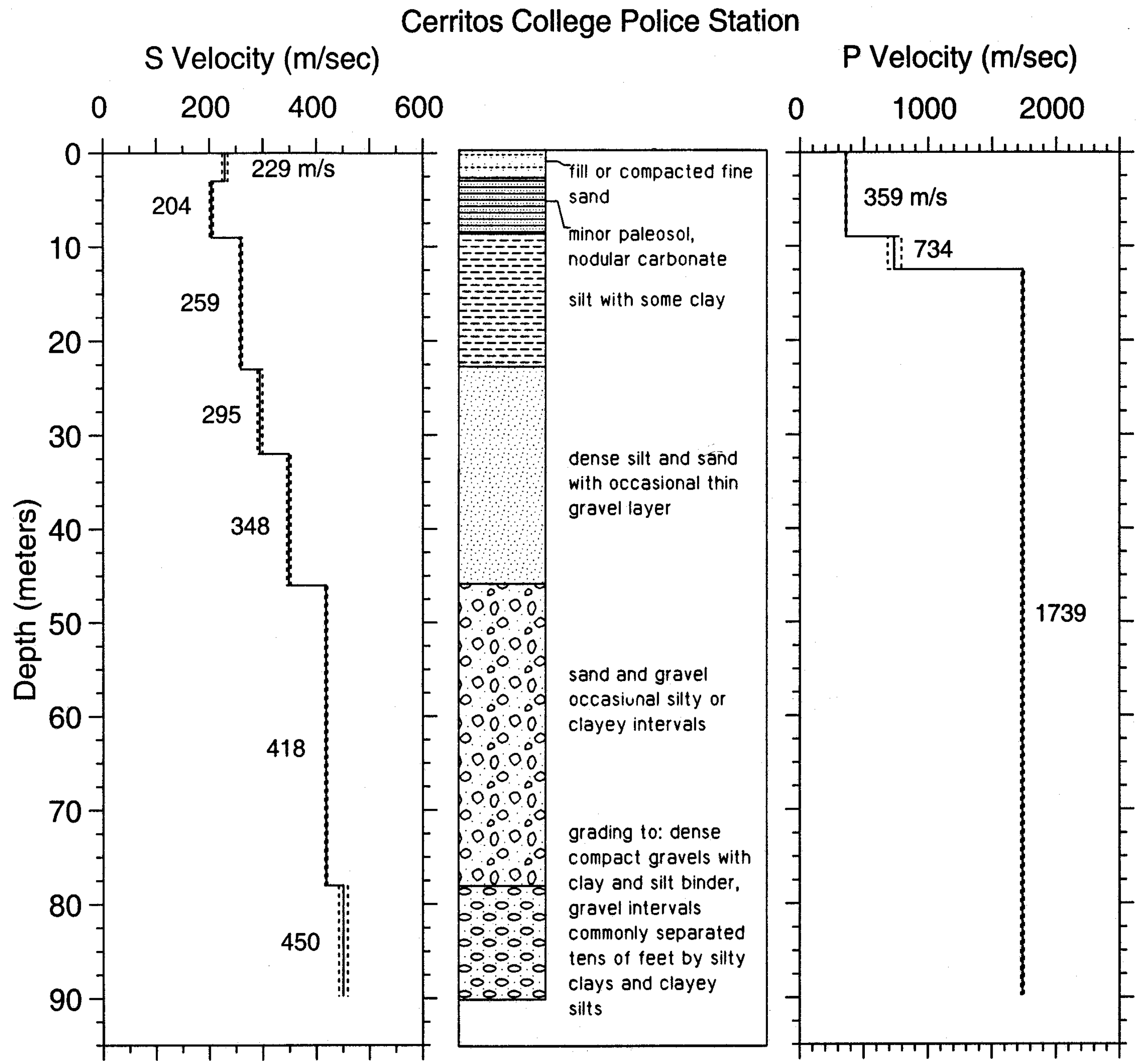

Figure A-15. Velocity profiles for the borehole at Cerritos College Police Building. Generalized geology is shown for correlation with velocities. Dashed lines are one standard deviation.

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

Location: Cerritos Police Building: S Coordinates: 33.88212 -118.09680 Hole_Code: 283
hoffset = 4.00 travel-time file: F:\CPB\CPBS.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0204	0.0109	229	1	-0.0002
5.0	16.4	0.0294	0.0229	218	1	0.0001
7.5	24.6	0.0404	0.0352	213	1	0.0006
10.0	32.8	0.0496	0.0464	216	1	-0.0003
12.5	41.0	0.0590	0.0560	223	1	0.0002
15.0	49.2	0.0676	0.0657	228	1	-0.0004
17.5	57.4	0.0770	0.0753	232	1	-0.0003
20.0	65.6	0.0864	0.0850	235	1	-0.0003
22.5	73.8	0.0960	0.0946	238	1	-0.0001
25.0	82.0	0.1050	0.1033	242	1	0.0003
27.5	90.2	0.1140	0.1118	246	1	0.0010
30.0	98.4	0.1208	0.1203	249	1	-0.0006
32.5	106.6	0.1296	0.1285	253	1	0.0001
35.0	114.8	0.1356	0.1357	258	1	-0.0010
37.5	123.0	0.1446	0.1429	262	1	0.0009
40.0	131.2	0.1509	0.1501	267	1	0.0001
42.5	139.4	0.1584	0.1572	270	1	0.0004
45.0	147.6	0.1644	0.1644	274	1	-0.0007
47.5	155.8	0.1718	0.1709	278	1	0.0003
50.0	164.0	0.1770	0.1769	283	1	-0.0004
52.5	172.2	0.1836	0.1829	287	1	0.0002
55.0	180.4	0.1896	0.1888	291	1	0.0003
57.5	188.6	0.1960	0.1948	295	1	0.0007
60.0	196.9	0.2008	0.2008	299	1	-0.0004
62.5	205.1	0.2070	0.2068	302	1	-0.0002
65.0	213.3	0.2120	0.2128	306	1	-0.0011
67.5	221.5	0.2190	0.2187	309	1	-0.0001
70.0	229.7	0.2254	0.2247	311	1	0.0004
72.5	237.9	0.2316	0.2307	314	1	0.0006
75.0	246.1	0.2368	0.2367	317	1	-0.0002
77.5	254.3	0.2428	0.2427	319	1	-0.0001
80.0	262.5	0.2484	0.2483	322	1	-0.0002
82.5	270.7	0.2548	0.2539	325	1	0.0007
85.0	278.9	0.2596	0.2594	328	1	0.0000
87.5	287.1	0.2648	0.2650	330	1	-0.0004
89.8	294.6	0.2704	0.2701	332	1	0.0001

nlayers = 7

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)
3.0	3.0	229	224	235	9.8	9.8	752	735	770
9.0	6.0	204	201	207	29.5	19.7	669	658	680
23.0	14.0	259	256	262	75.5	45.9	849	841	858
32.0	9.0	295	290	299	105.0	29.5	966	951	982
46.0	14.0	348	345	352	150.9	45.9	1143	1131	1156
78.0	32.0	418	416	420	255.9	105.0	1372	1365	1380
89.8	11.8	450	442	459	294.6	38.7	1477	1450	1505

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

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

Location: Cerritos Police Building: P Coordinates: 33.88212 -118.09680 Hole_Code: 283
hoffset = 4.00 travel-time file: F:\CPB\CPBP.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0144	0.0070	359	1	0.0013
5.0	16.4	0.0180	0.0139	359	1	0.0002
7.5	24.6	0.0231	0.0209	359	1	-0.0006
10.0	32.8	0.0279	0.0264	378	1	-0.0004
12.5	41.0	0.0309	0.0298	419	1	-0.0002
15.0	49.2	0.0321	0.0313	480	1	0.0001
17.5	57.4	0.0330	0.0327	535	1	-0.0002
20.0	65.6	0.0339	0.0342	586	1	-0.0006
22.5	73.8	0.0360	0.0356	632	1	0.0001
25.0	82.0	0.0381	0.0370	675	1	0.0008
27.5	90.2	0.0396	0.0385	715	1	0.0009
30.0	98.4	0.0398	0.0399	752	1	-0.0003
32.5	106.6	0.0414	0.0413	786	1	-0.0001
35.0	114.8	0.0429	0.0428	818	1	0.0000
37.5	123.0	0.0450	0.0442	848	1	0.0006
40.0	131.2	0.0459	0.0457	876	1	0.0001
42.5	139.4	0.0474	0.0471	903	1	0.0002
45.0	147.6	0.0486	0.0485	927	1	0.0000
47.5	155.8	0.0501	0.0500	951	1	0.0000
50.0	164.0	0.0510	0.0514	973	1	-0.0005
52.5	172.2	0.0525	0.0528	994	1	-0.0004
55.0	180.4	0.0546	0.0543	1013	1	0.0002
57.5	188.6	0.0561	0.0557	1032	1	0.0003
60.0	196.9	0.0570	0.0572	1050	1	-0.0002
62.5	205.1	0.0585	0.0586	1067	1	-0.0002
65.0	213.3	0.0600	0.0600	1083	1	-0.0001
67.5	221.5	0.0615	0.0615	1098	1	0.0000
70.0	229.7	0.0624	0.0629	1113	1	-0.0006
72.5	237.9	0.0639	0.0643	1127	1	-0.0005
75.0	246.1	0.0654	0.0658	1140	1	-0.0004
77.5	254.3	0.0675	0.0672	1153	1	0.0002
80.0	262.5	0.0690	0.0687	1165	1	0.0003
82.5	270.7	0.0705	0.0701	1177	1	0.0004
85.0	278.9	0.0714	0.0715	1188	1	-0.0002
87.5	287.1	0.0735	0.0730	1199	1	0.0005
89.8	294.6	0.0744	0.0743	1209	1	0.0001

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)
9.0	9.0	359	355	364	29.5	29.5	1179	1164	1193
12.5	3.5	734	685	792	41.0	11.5	2410	2247	2598
89.8	77.3	1739	1729	1749	294.6	253.6	5705	5671	5738

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

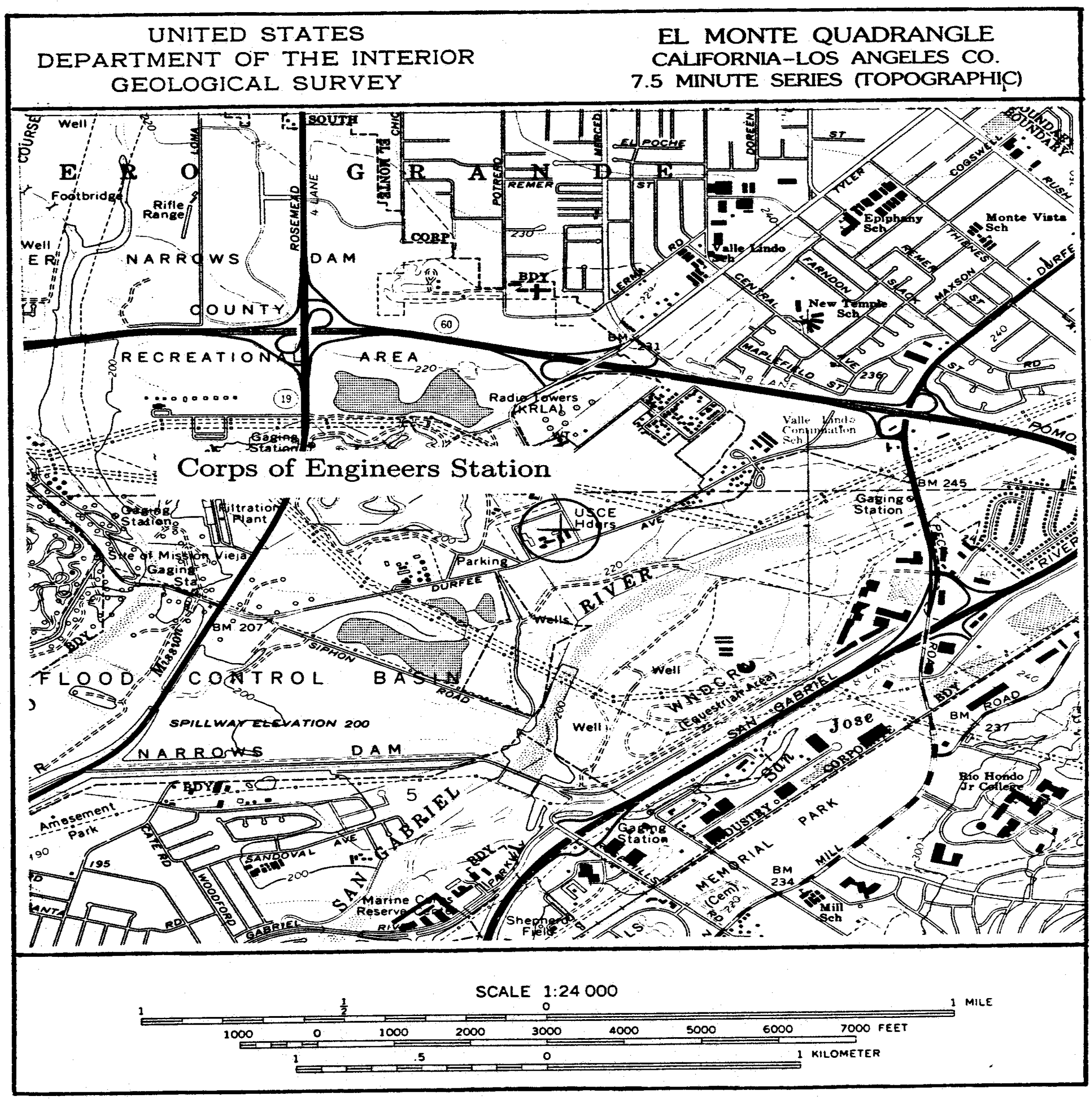

Figure A-16. Site location map for the borehole at Corps of Engineers Station. The accelerograph is located approximately 45 meters from the borehole.

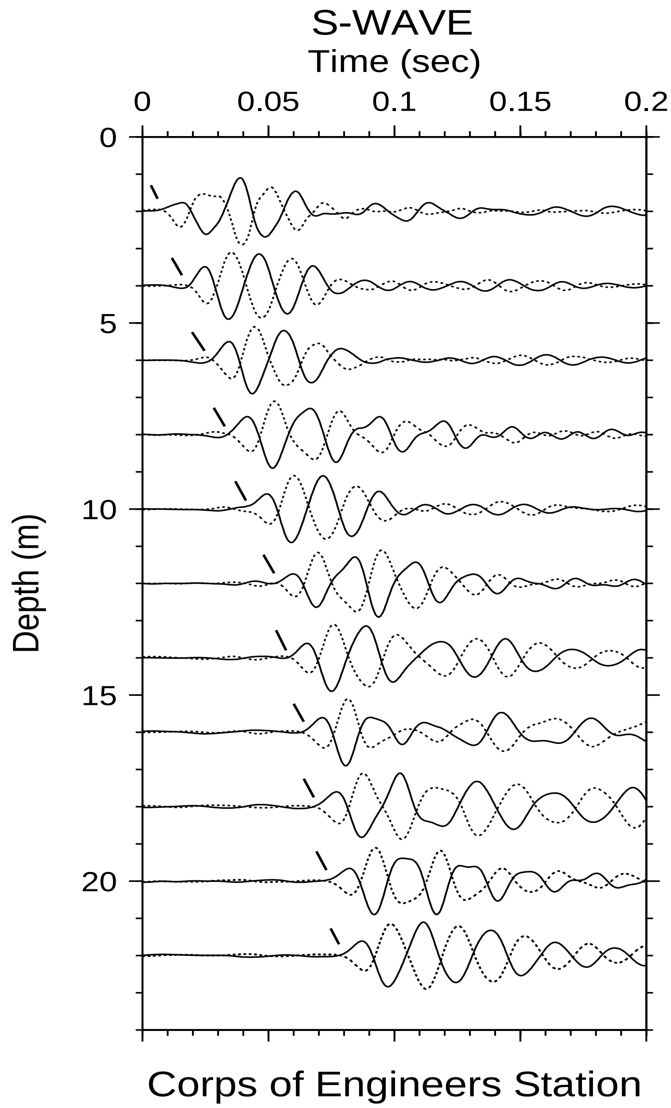

Figure A-17. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

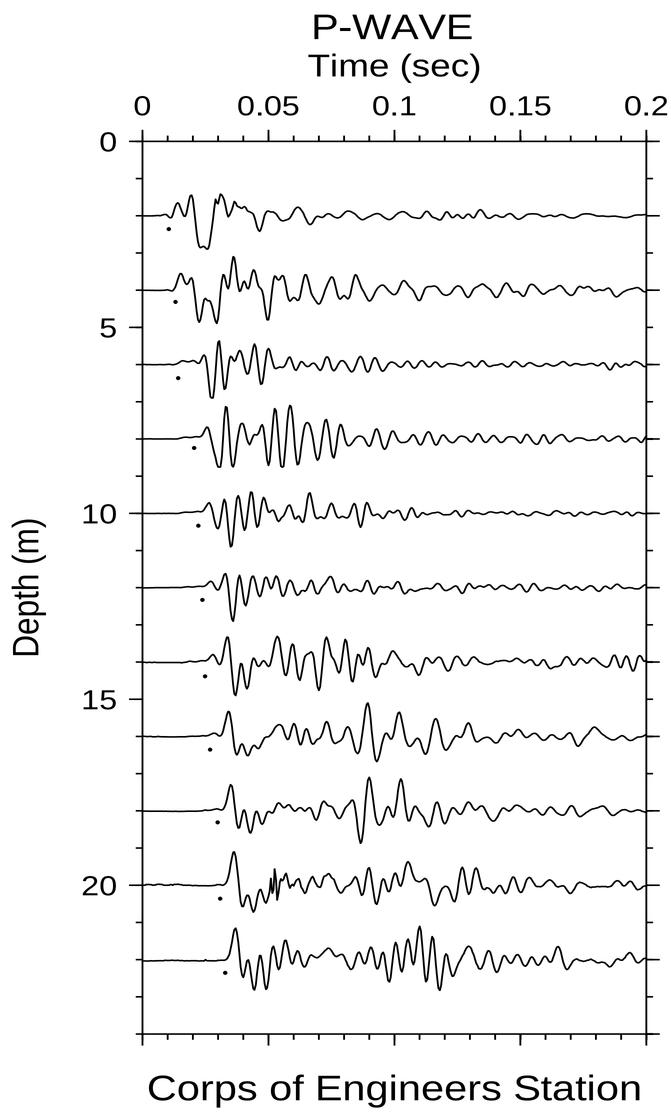

Figure A-18. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

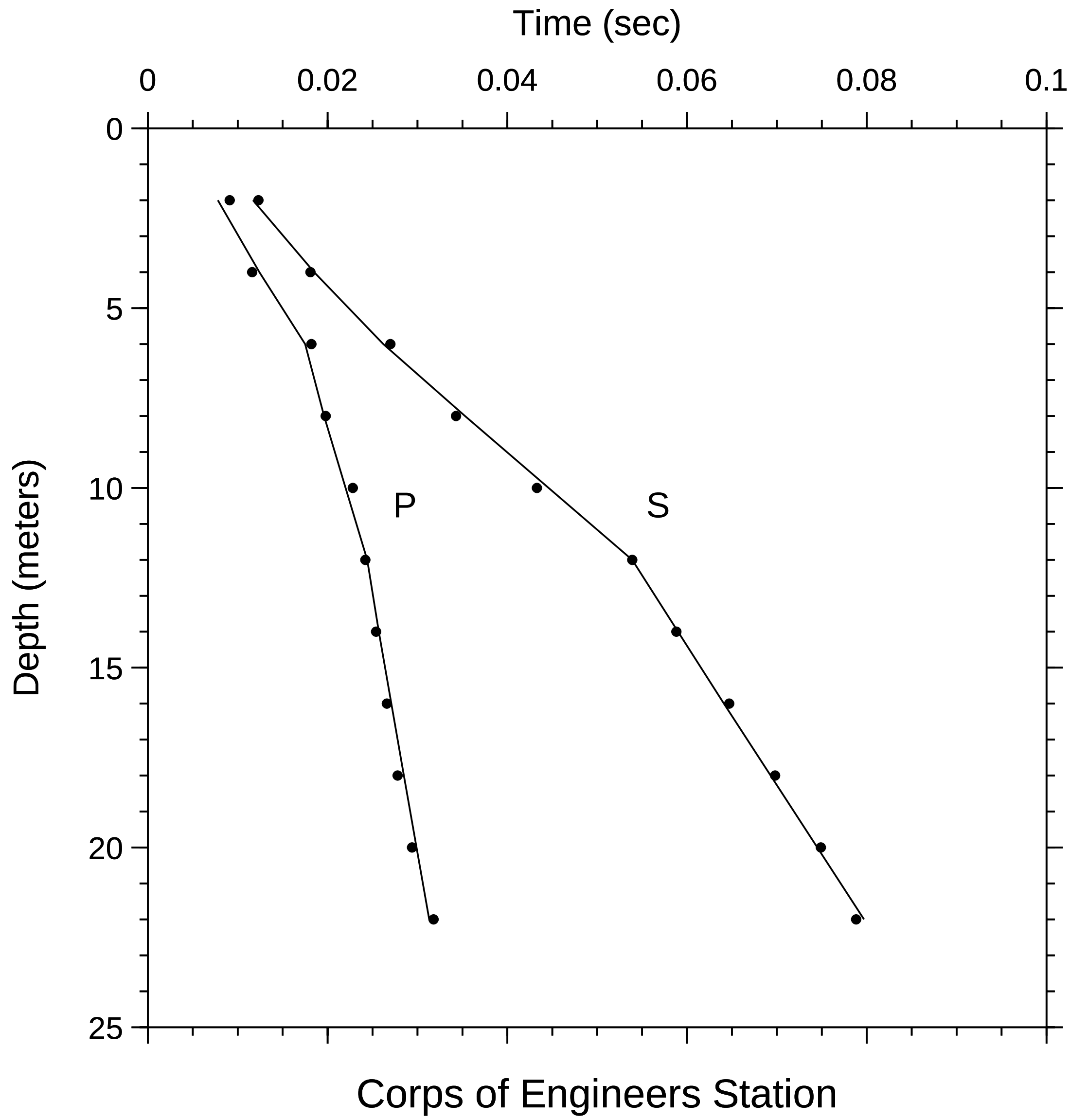

Figure A-19. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

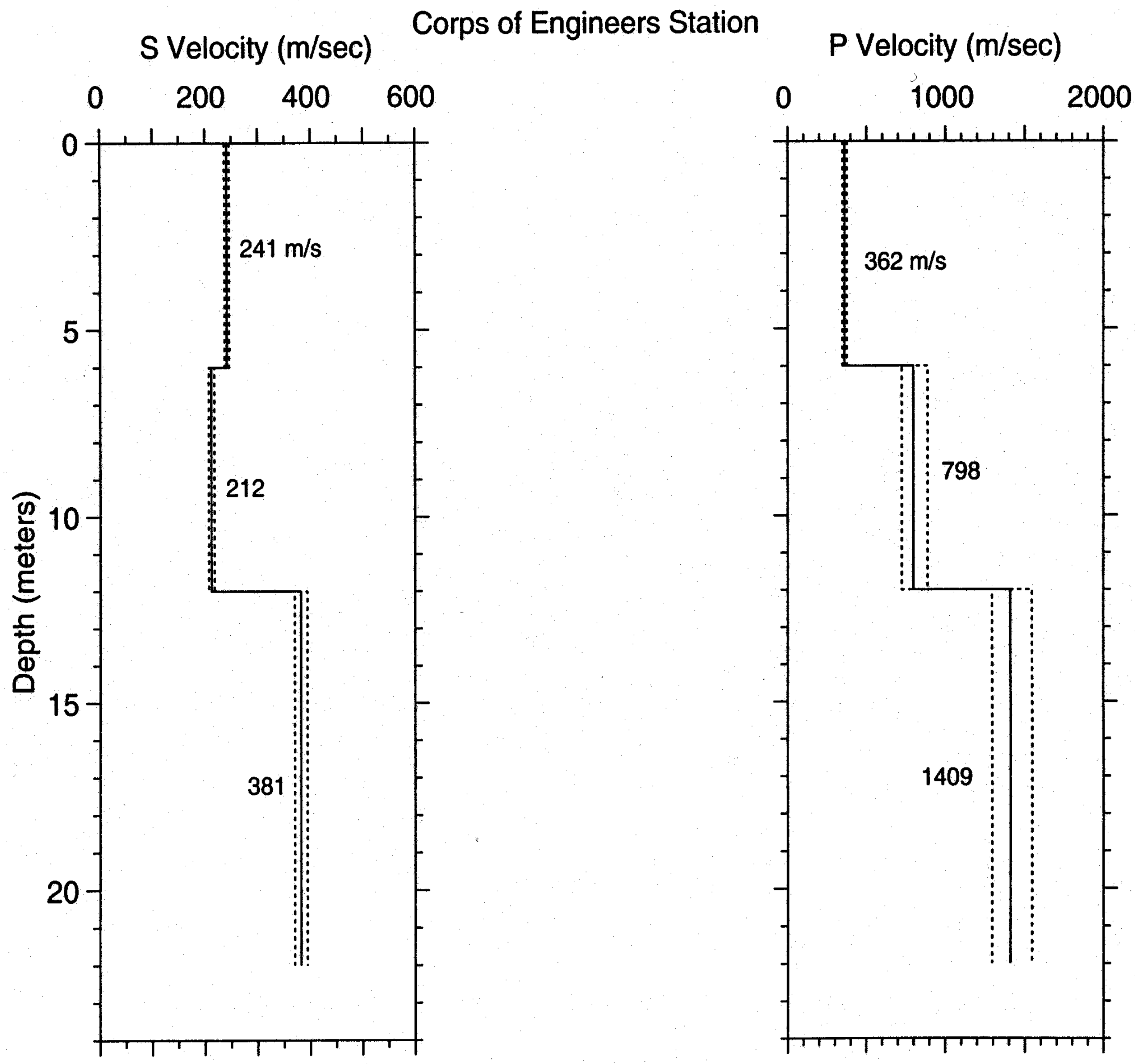

Figure A-20. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

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

Location: Corps of Engineers Station: S Coordinates: 34.03219 -118.05225 Hole_Code: 298
hoffset = 2.00 travel-time file: F:\NAR\NARS.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.0	6.6	0.0123	0.0083	241	1	0.0006
4.0	13.1	0.0181	0.0166	241	1	-0.0004
6.0	19.7	0.0270	0.0249	241	1	0.0008
8.0	26.2	0.0343	0.0343	233	1	-0.0010
10.0	32.8	0.0433	0.0438	228	2	-0.0012
12.0	39.4	0.0539	0.0532	226	1	0.0000
14.0	45.9	0.0588	0.0584	240	1	-0.0002
16.0	52.5	0.0647	0.0637	251	1	0.0006
18.0	59.1	0.0698	0.0689	261	1	0.0005
20.0	65.6	0.0749	0.0742	270	1	0.0004
22.0	72.2	0.0788	0.0794	277	1	-0.0009

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)
6.0	6.0	241	237	246	19.7	19.7	792	778	808
12.0	6.0	212	207	217	39.4	19.7	695	678	714
22.0	10.0	381	370	394	72.2	32.8	1252	1214	1292

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

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

Location: Corps of Engineers Station: P Coordinates: 34.03219 -118.05225 Hole_Code: 298
hoffset = 2.00 travel-time file: F:\NAR\NARP.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.0	6.6	0.0091	0.0055	362	2	0.0012
4.0	13.1	0.0116	0.0110	362	1	-0.0007
6.0	19.7	0.0182	0.0166	362	3	0.0008
8.0	26.2	0.0198	0.0191	419	3	0.0002
10.0	32.8	0.0228	0.0216	463	1	0.0009
12.0	39.4	0.0242	0.0241	498	1	-0.0001
14.0	45.9	0.0254	0.0255	549	1	-0.0004
16.0	52.5	0.0266	0.0269	594	3	-0.0005
18.0	59.1	0.0278	0.0284	635	2	-0.0007
20.0	65.6	0.0294	0.0298	672	1	-0.0004
22.0	72.2	0.0318	0.0312	705	1	0.0005

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)
6.0	6.0	362	349	376	19.7	19.7	1188	1146	1233
12.0	6.0	798	724	889	39.4	19.7	2618	2375	2915
22.0	10.0	1409	1294	1545	72.2	32.8	4622	4246	5070

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

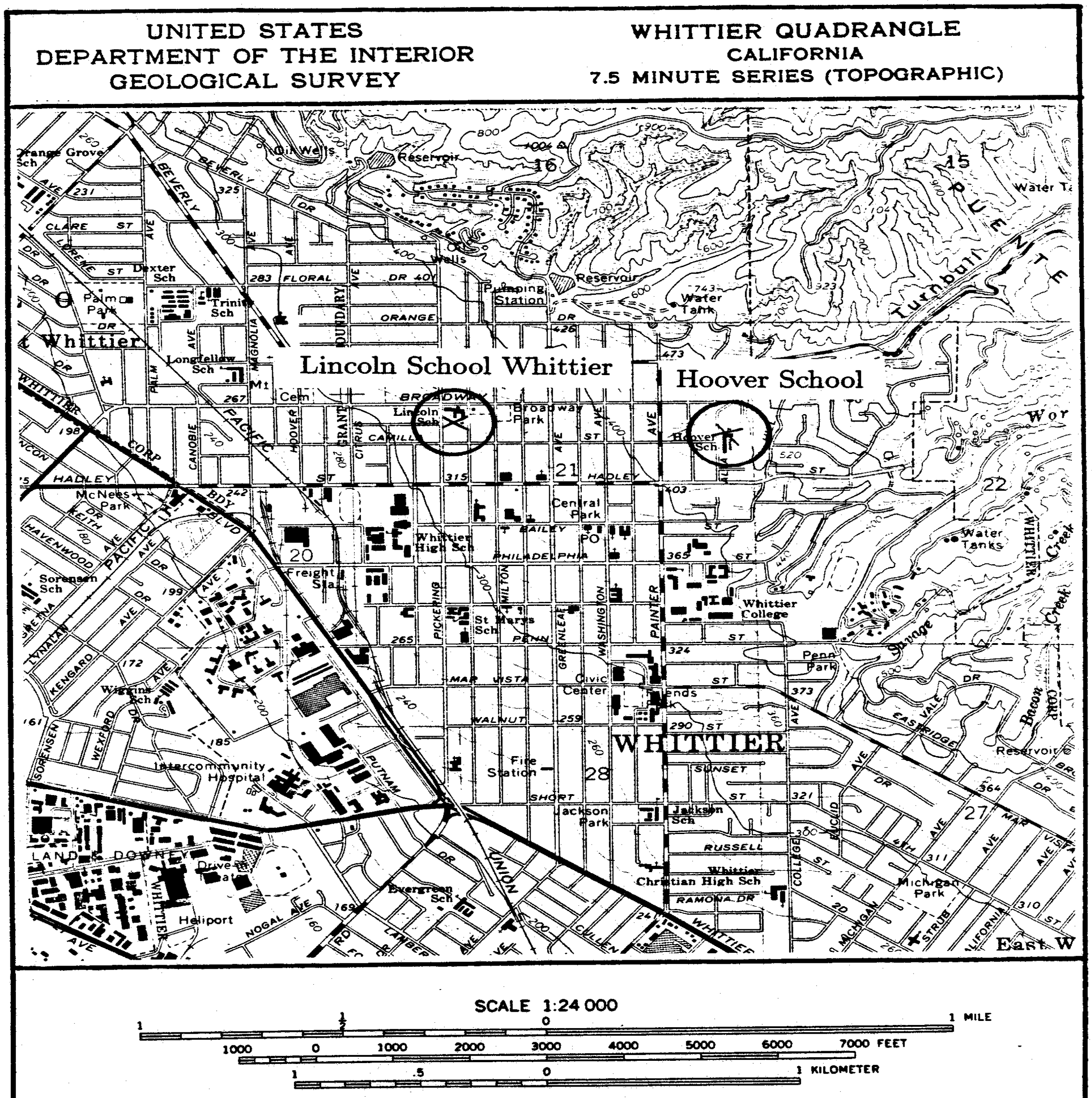

Figure A-21. Site location map for the borehole at Hoover School. The accelerograph is located approximately 30 meters from the borehole.

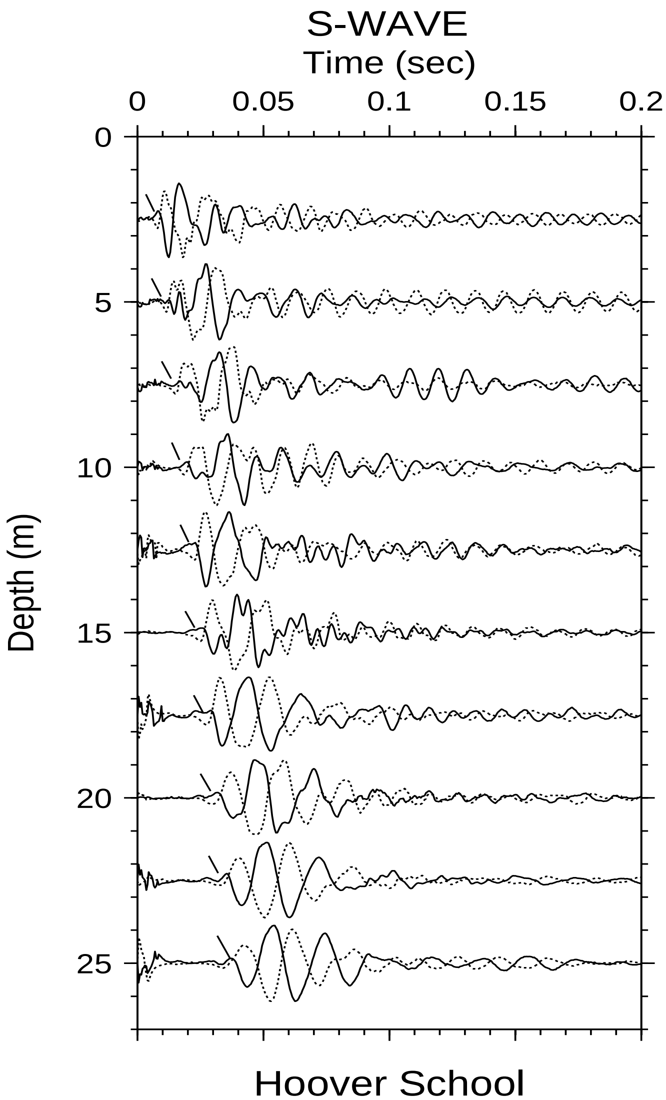

Figure A-22. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

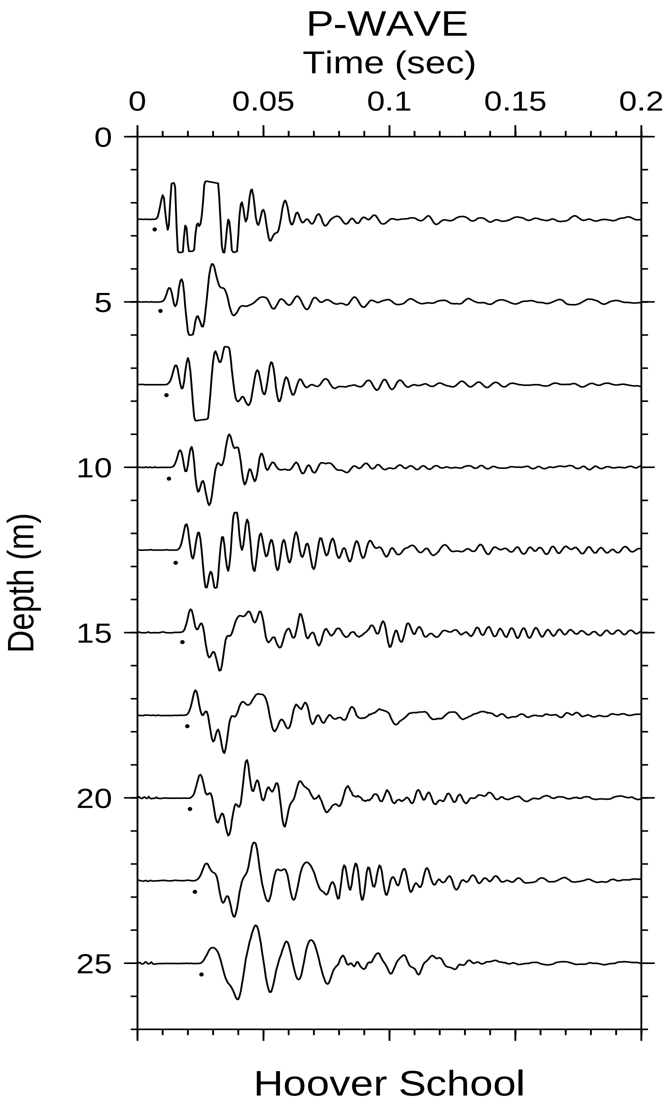

Figure A-23. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

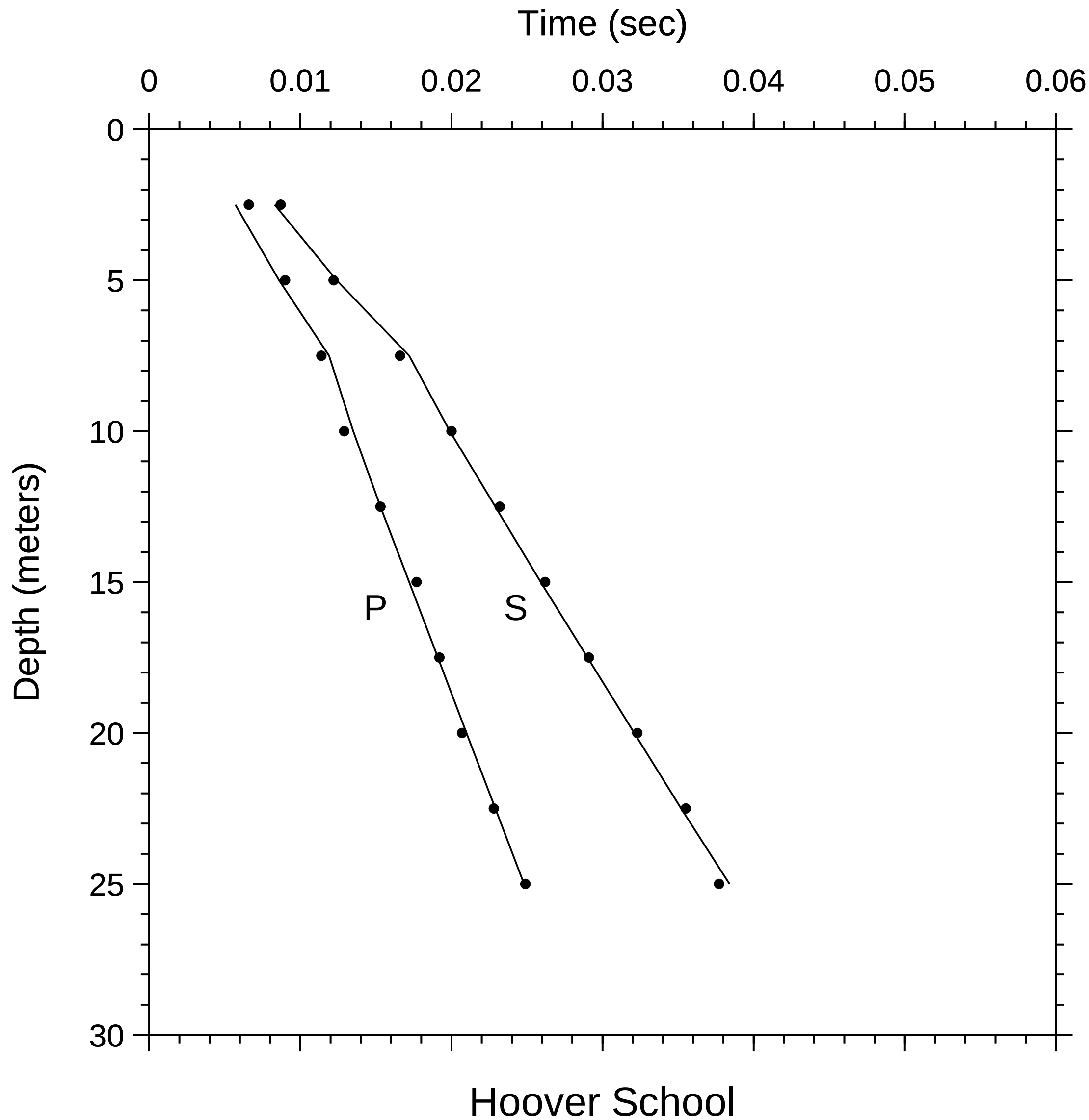

Figure A-24. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

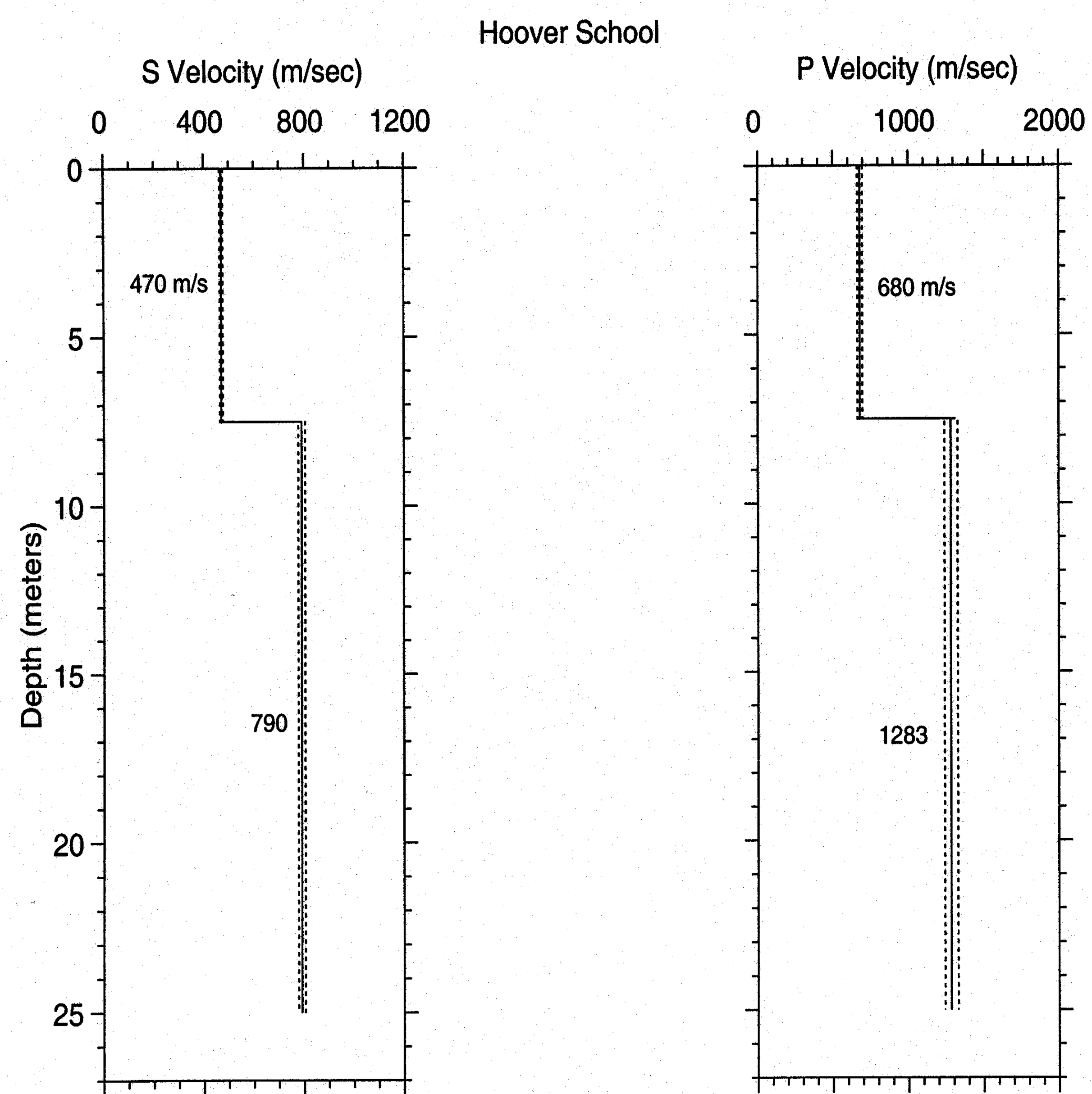

Figure A-25. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

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

Location: Hoover School: S Coordinates: 33.98491 -118.02890 Hole_Code: 299
hoffset = 3.00 travel-time file: F:\H00\H00S2.TT

nlayers = 2

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0087	0.0053	470	1	0.0004
5.0	16.4	0.0122	0.0106	470	1	-0.0002
7.5	24.6	0.0166	0.0160	470	1	-0.0006
10.0	32.8	0.0200	0.0191	523	1	0.0001
12.5	41.0	0.0232	0.0223	561	1	0.0003
15.0	49.2	0.0262	0.0255	589	1	0.0003
17.5	57.4	0.0291	0.0286	612	1	0.0001
20.0	65.6	0.0323	0.0318	629	1	0.0002
22.5	73.8	0.0355	0.0349	644	1	0.0003
25.0	82.0	0.0377	0.0381	656	1	-0.0007

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)
7.5	7.5	470	464	476	24.6	24.6	1542	1521	1563
25.0	17.5	790	777	804	82.0	57.4	2593	2549	2639

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

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

Location: Hoover School: P Coordinates: 33.98491 -118.02890 Hole_Code: 299
hoffset = 3.00 travel-time file: F:\HOO\HOOP2.TT

nlayers = 2

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0066	0.0037	680	1	0.0009
5.0	16.4	0.0090	0.0074	680	1	0.0004
7.5	24.6	0.0114	0.0110	680	1	-0.0005
10.0	32.8	0.0129	0.0130	771	1	-0.0006
12.5	41.0	0.0153	0.0149	837	1	0.0000
15.0	49.2	0.0177	0.0169	889	1	0.0005
17.5	57.4	0.0192	0.0188	930	1	0.0001
20.0	65.6	0.0207	0.0208	963	1	-0.0003
22.5	73.8	0.0228	0.0227	990	1	-0.0001
25.0	82.0	0.0249	0.0247	1013	1	0.0001

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)
7.5	7.5	680	664	697	24.6	24.6	2231	2179	2286
25.0	17.5	1283	1241	1328	82.0	57.4	4211	4072	4359

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

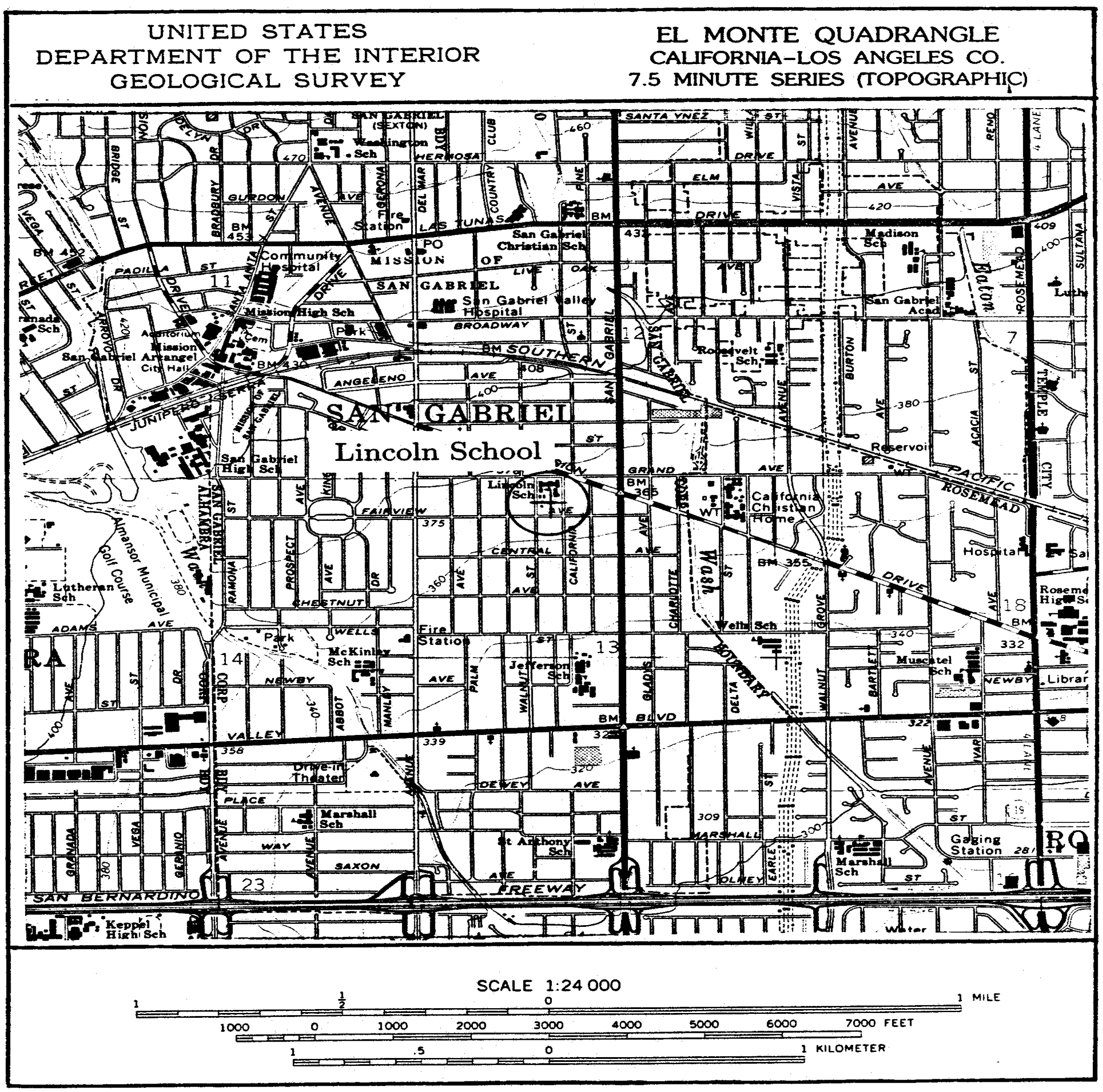

Figure A-26. Site location map for the borehole at Lincoln School. The accelerograph is located approximately 91 meters from the borehole.

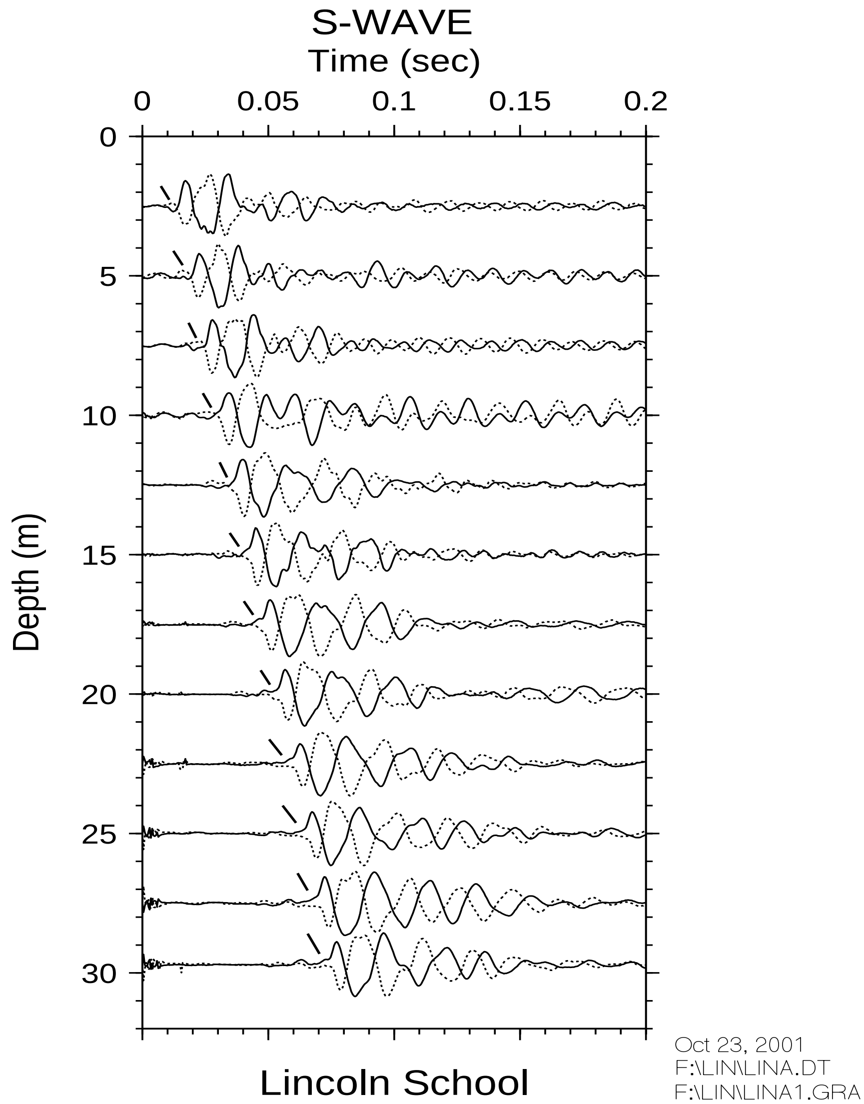

Figure A-27. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

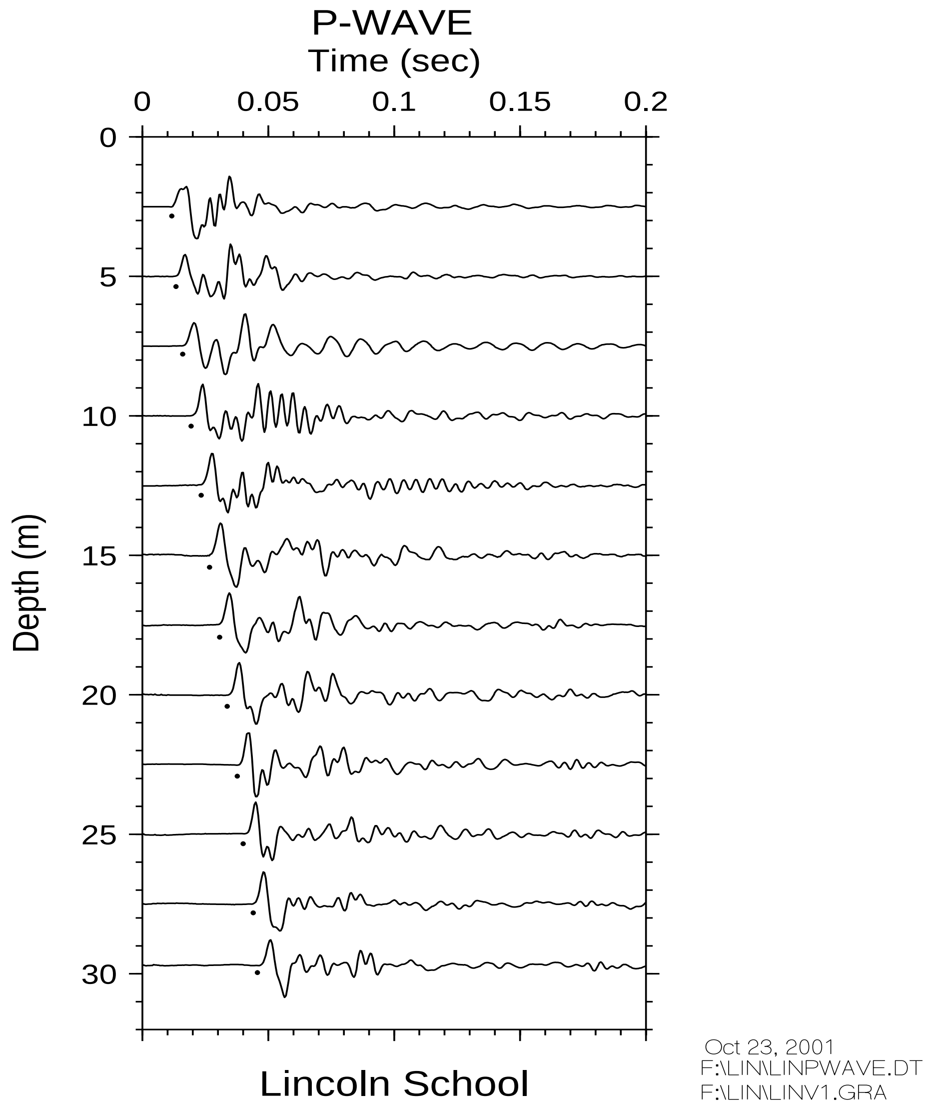

Figure A-28. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

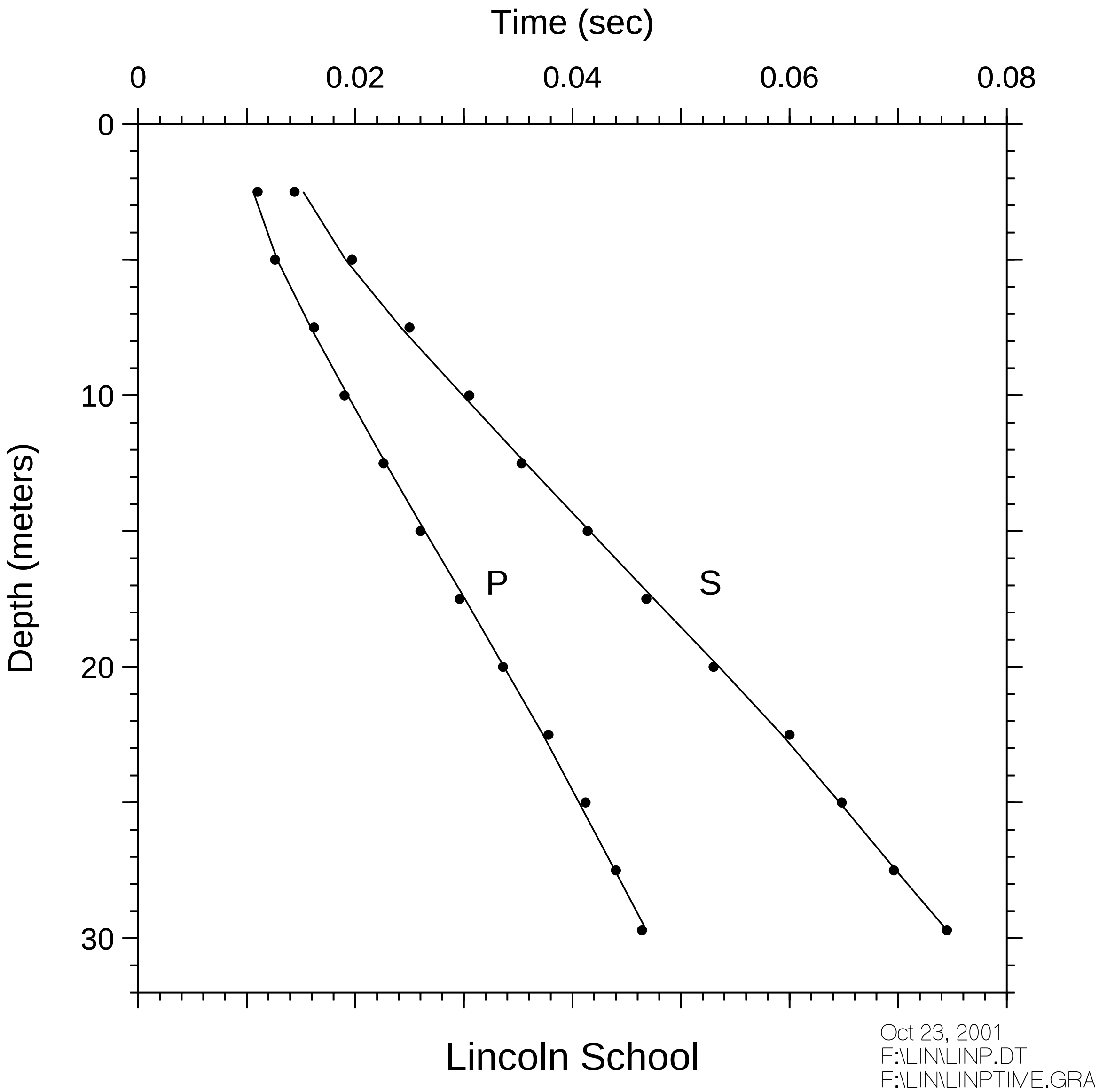

Figure A-29. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

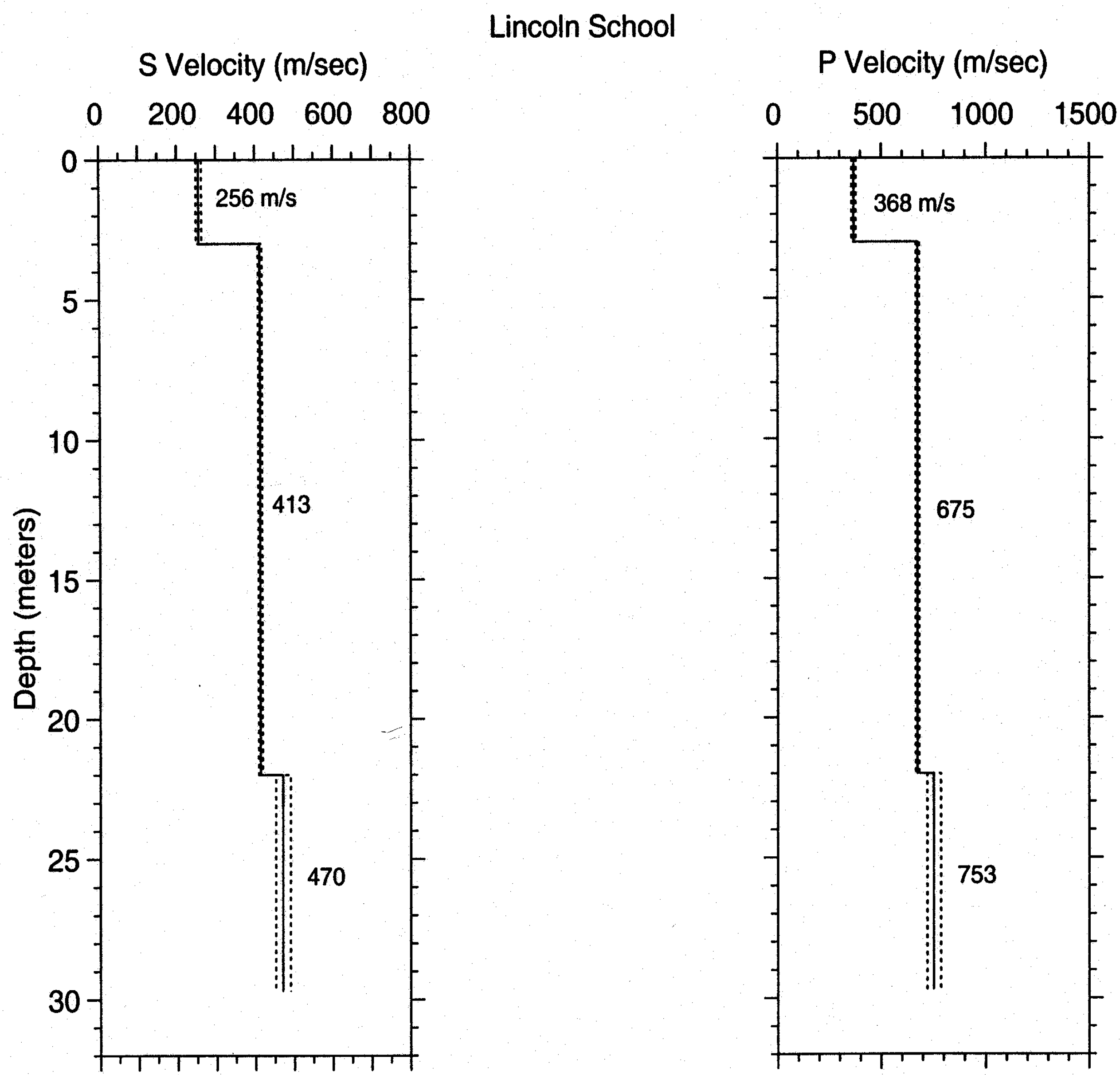

Figure A-30. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

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

Location: Lincoln School: S Coordinates: 34.09043 -118.09300 Hole_Code: 300
hoffset = 3.00 travel-time file: F:\LIN\LINS2.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0144	0.0098	256	1	-0.0008
5.0	16.4	0.0197	0.0166	302	1	0.0006
7.5	24.6	0.0250	0.0226	332	1	0.0008
10.0	32.8	0.0305	0.0287	349	1	0.0006
12.5	41.0	0.0353	0.0347	360	1	-0.0004
15.0	49.2	0.0414	0.0408	368	1	-0.0002
17.5	57.4	0.0468	0.0468	374	1	-0.0007
20.0	65.6	0.0530	0.0529	378	1	-0.0005
22.5	73.8	0.0600	0.0588	383	1	0.0007
25.0	82.0	0.0648	0.0641	390	1	0.0002
27.5	90.2	0.0696	0.0694	396	1	-0.0002
29.7	97.4	0.0745	0.0741	401	1	0.0000

nlayers = 3

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)
3.0	3.0	256	249	264	9.8	9.8	841	818	865
22.0	19.0	413	408	418	72.2	62.3	1354	1338	1371
29.7	7.7	470	452	490	97.4	25.3	1544	1484	1609

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

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

Location: Lincoln School: P Coordinates: 34.09044 -118.09306 Hole_Code: 300
hoffset = 3.00 travel-time file: F:\LIN\LINP.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0110	0.0068	368	1	0.0004
5.0	16.4	0.0126	0.0111	450	1	-0.0002
7.5	24.6	0.0162	0.0148	506	1	0.0003
10.0	32.8	0.0190	0.0185	540	1	-0.0003
12.5	41.0	0.0226	0.0222	562	1	-0.0002
15.0	49.2	0.0260	0.0259	578	1	-0.0004
17.5	57.4	0.0296	0.0296	591	1	-0.0004
20.0	65.6	0.0336	0.0333	600	1	-0.0001
22.5	73.8	0.0378	0.0370	609	1	0.0005
25.0	82.0	0.0412	0.0403	621	1	0.0006
27.5	90.2	0.0440	0.0436	631	1	0.0001
29.7	97.4	0.0464	0.0465	638	1	-0.0003

nlayers = 3

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)
3.0	3.0	368	358	378	9.8	9.8	1207	1175	1241
22.0	19.0	675	666	684	72.2	62.3	2213	2184	2243
29.7	7.7	753	722	787	97.4	25.3	2470	2367	2582

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

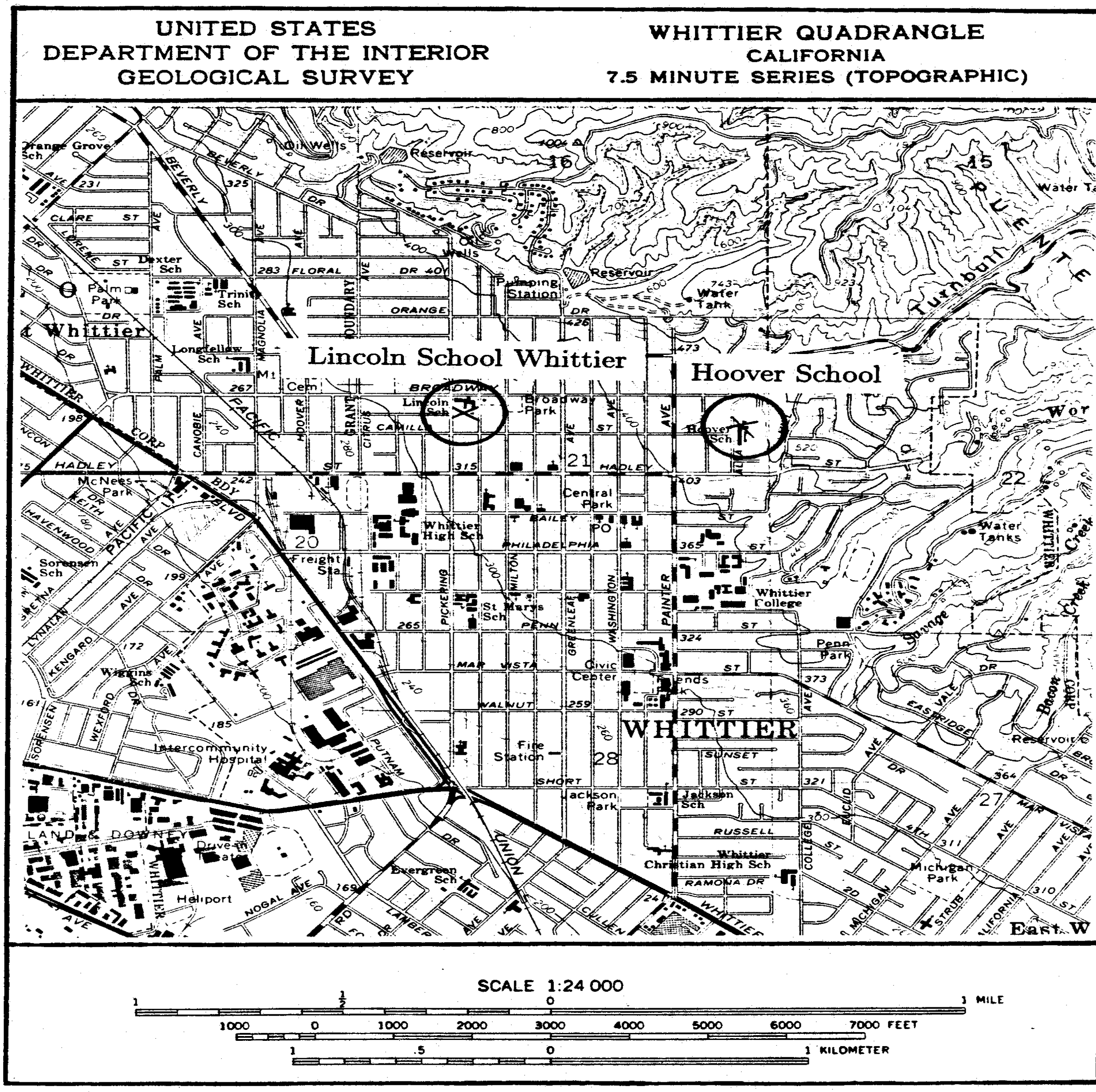

Figure A-31. Site location map for the borehole at Lincoln School Whittier.

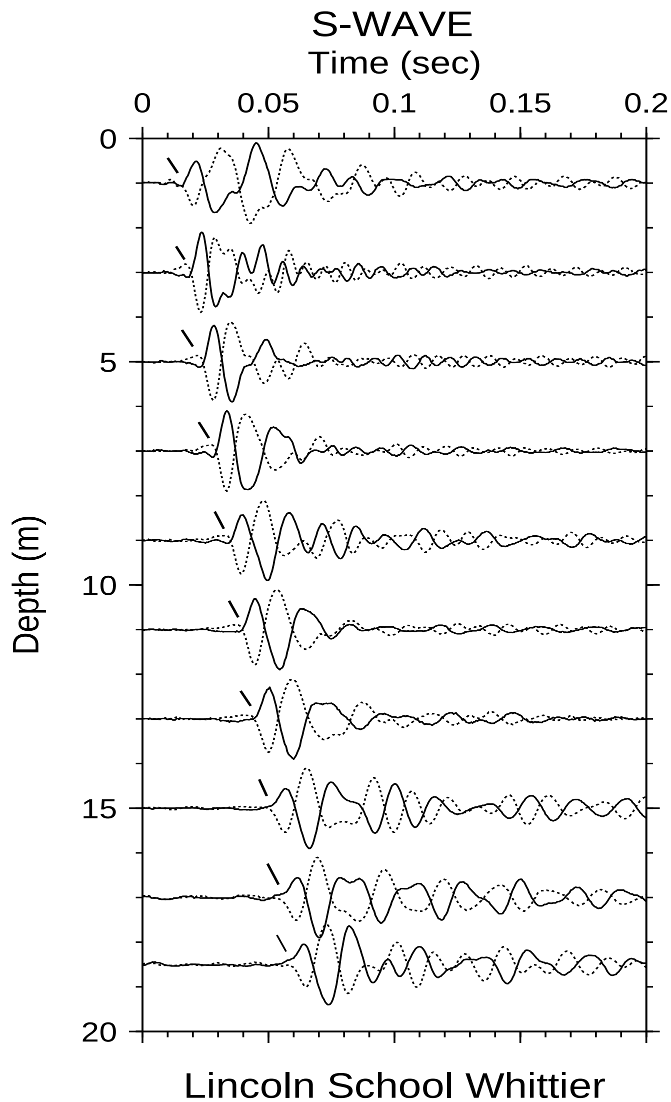

Figure A-32. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

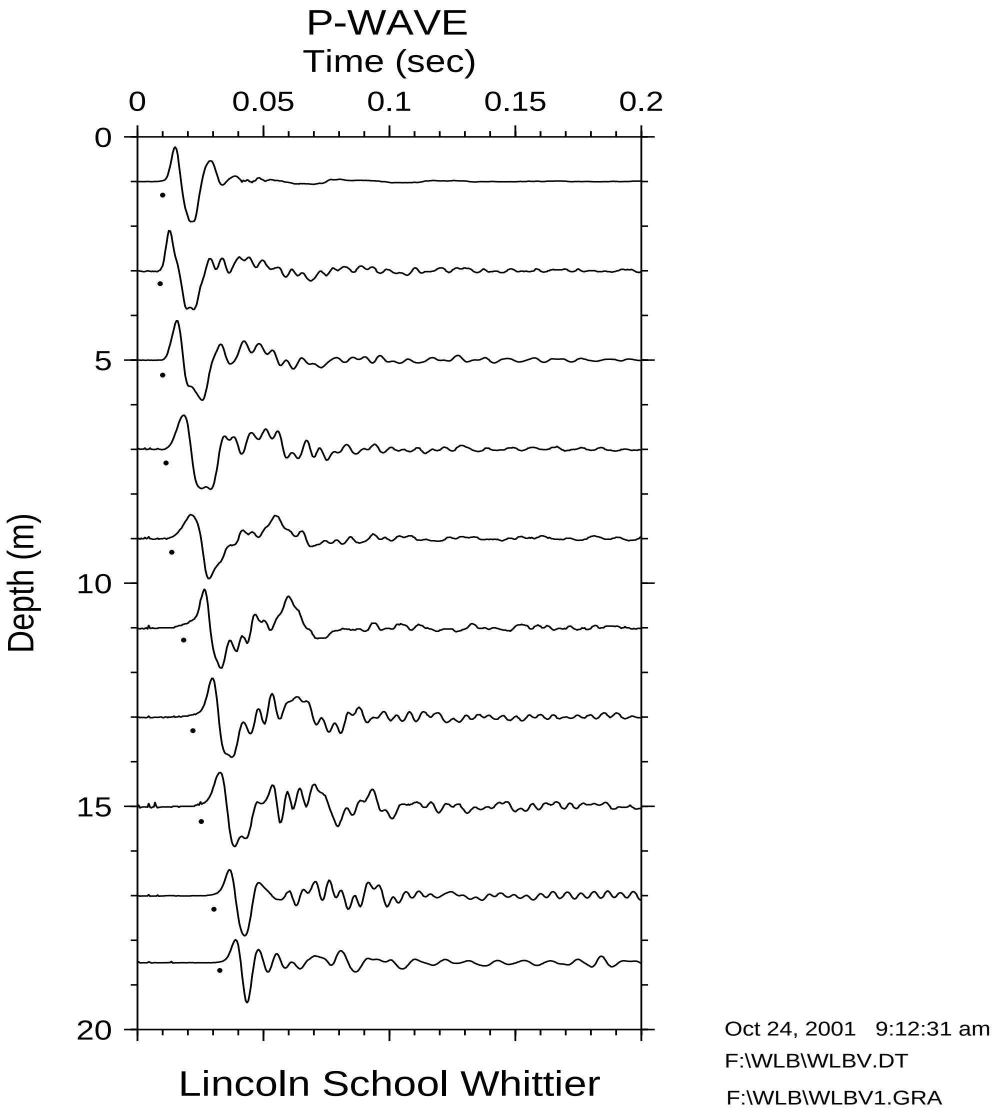

Figure A-33. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

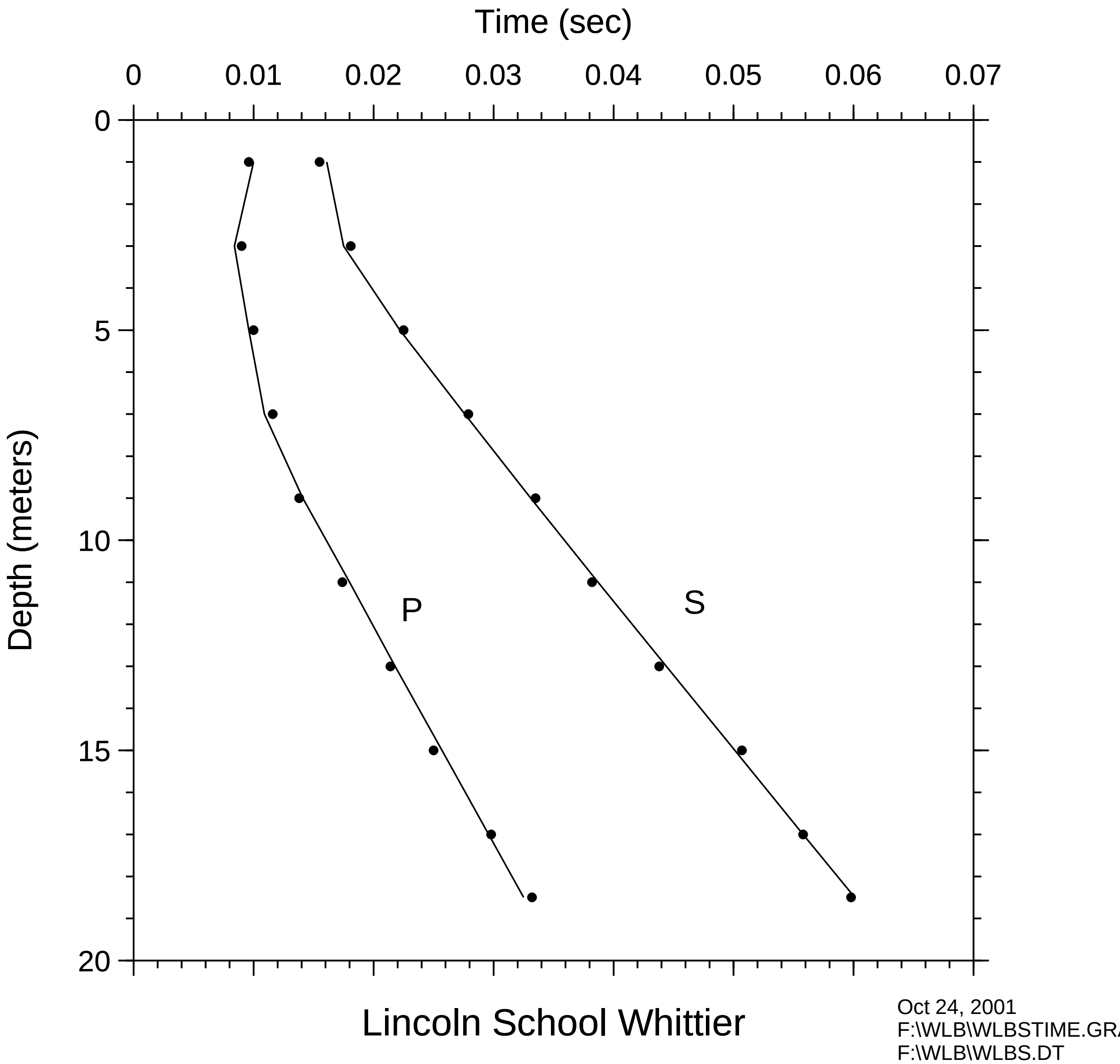

Figure A-34. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

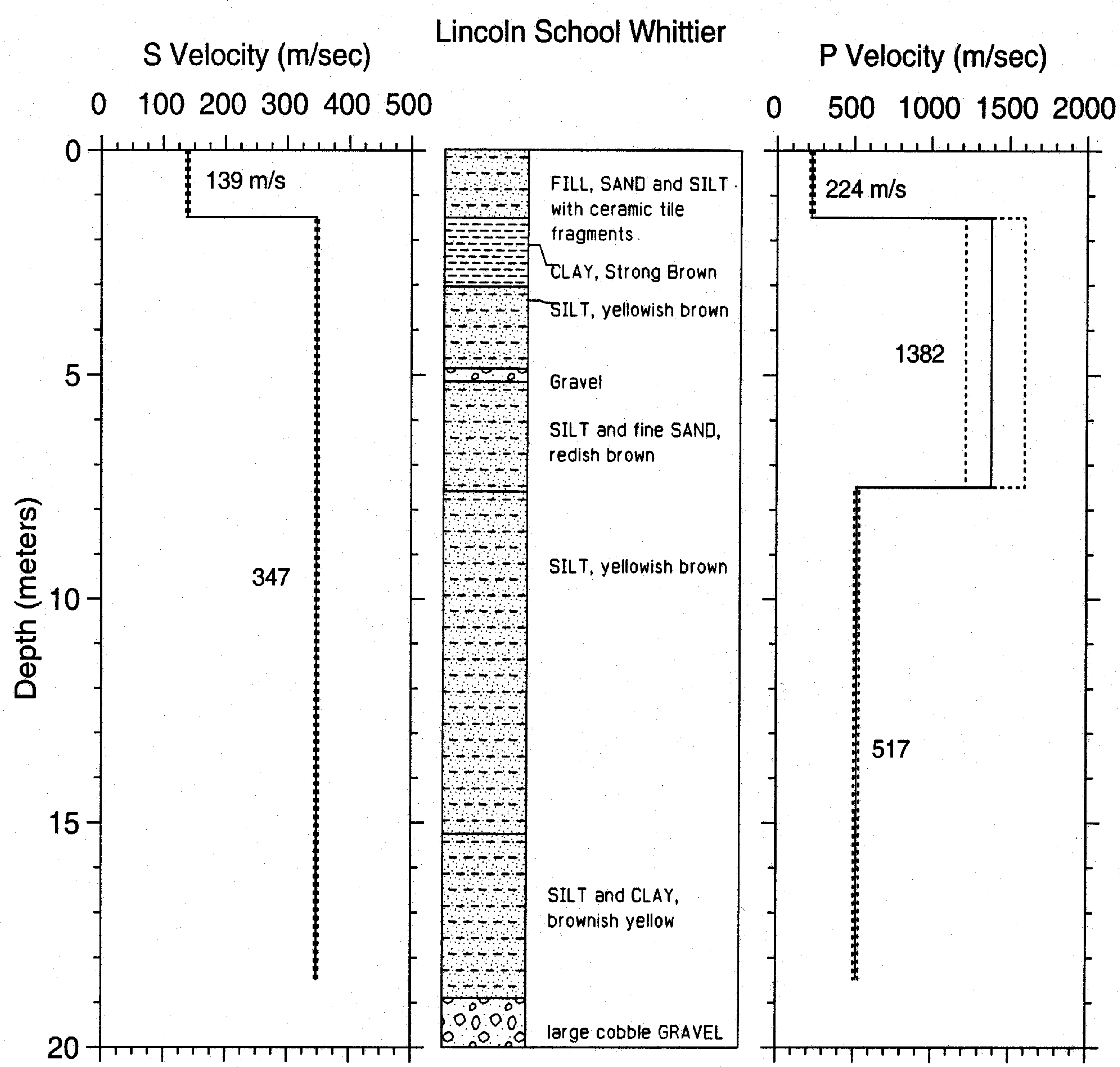

Figure A-35. S- and P-wave velocity profiles. Dashed lines represent one standard deviation. Lithology is shown for correlation with velocities.

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

Location: Lincoln School - Whittier: S Coordinates: 33.98535 -118.04060 Hole_Code: 301
hoffset = 2.00 travel-time file: F:\WLB\WLBS.TT

nlayers = 2

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
1.0	3.3	0.0155	0.0072	139	1	-0.0006
3.0	9.8	0.0181	0.0151	198	1	0.0006
5.0	16.4	0.0225	0.0209	239	1	0.0003
7.0	23.0	0.0279	0.0266	263	1	0.0003
9.0	29.5	0.0335	0.0324	278	1	0.0004
11.0	36.1	0.0382	0.0382	288	1	-0.0005
13.0	42.7	0.0438	0.0439	296	1	-0.0006
15.0	49.2	0.0507	0.0497	302	1	0.0007
17.0	55.8	0.0558	0.0555	307	1	0.0000
18.5	60.7	0.0598	0.0598	309	1	-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)
1.5	1.5	139	135	142	4.9	4.9	455	444	466
18.5	17.0	347	344	351	60.7	55.8	1140	1130	1150

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

ABLE A-14. S-wave arrival times and velocity summaries.

Location: Lincoln School Whittier: P Coordinates: 33.98535 -118.04060 Hole_Code: 301
hoffset = 2.00 travel-time file: F:\WLB\WLBVERT.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
1.0	3.3	0.0096	0.0045	224	1	-0.0004
3.0	9.8	0.0090	0.0078	386	1	0.0006
5.0	16.4	0.0100	0.0092	542	1	0.0004
7.0	23.0	0.0116	0.0107	656	1	0.0007
9.0	29.5	0.0138	0.0139	646	1	-0.0003
11.0	36.1	0.0174	0.0178	618	1	-0.0006
13.0	42.7	0.0214	0.0217	600	1	-0.0004
15.0	49.2	0.0250	0.0255	587	1	-0.0007
17.0	55.8	0.0298	0.0294	578	1	0.0002
18.5	60.7	0.0332	0.0323	572	1	0.0007

nlayers = 3

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)
1.5	1.5	224	212	238	4.9	4.9	736	695	782
7.5	6.0	1382	1217	1599	24.6	19.7	4535	3994	5245
18.5	11.0	517	501	533	60.7	36.1	1695	1644	1749

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
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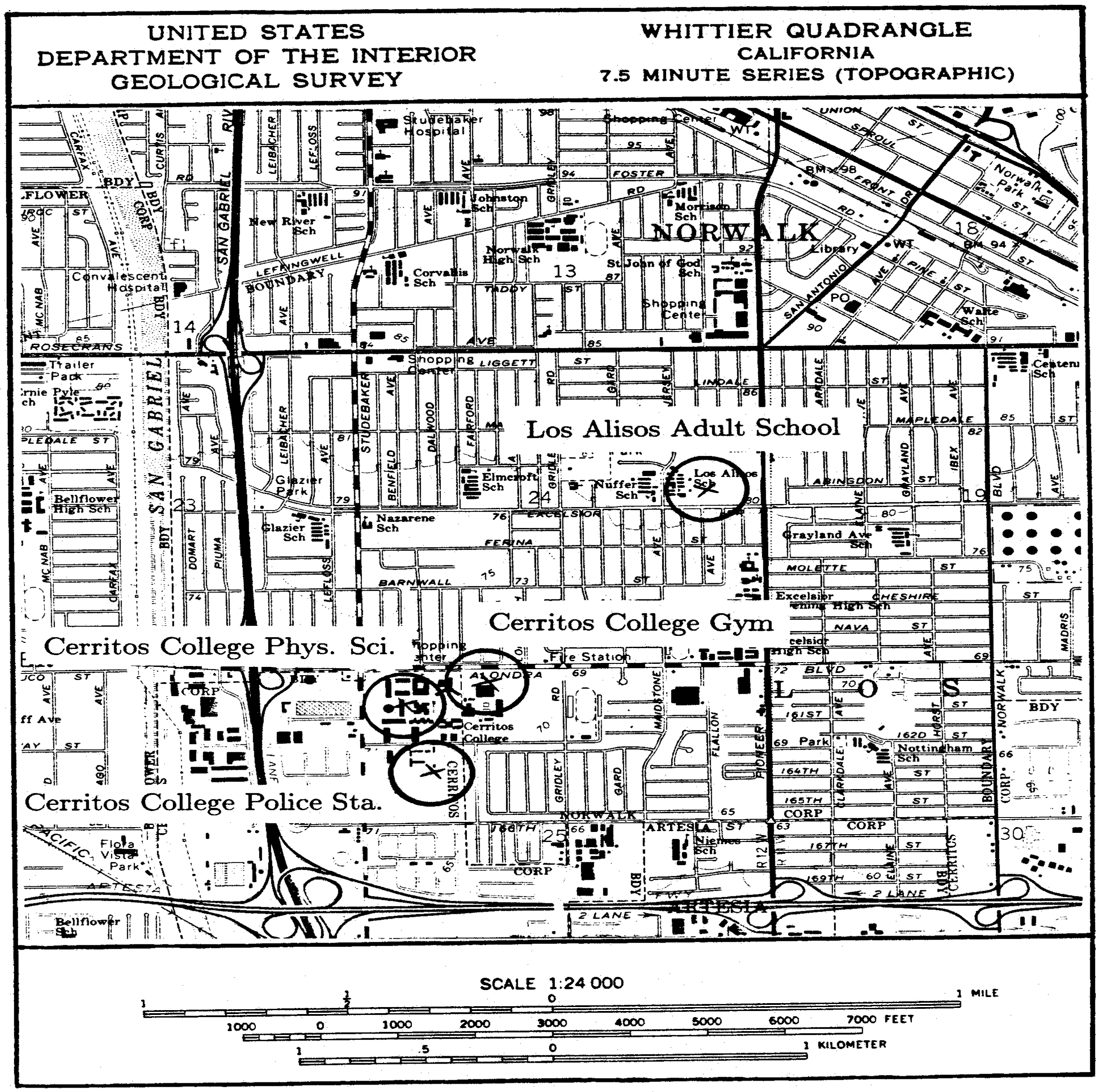

Figure A-36. Site location map for the borehole at Los Alisos Adult School.

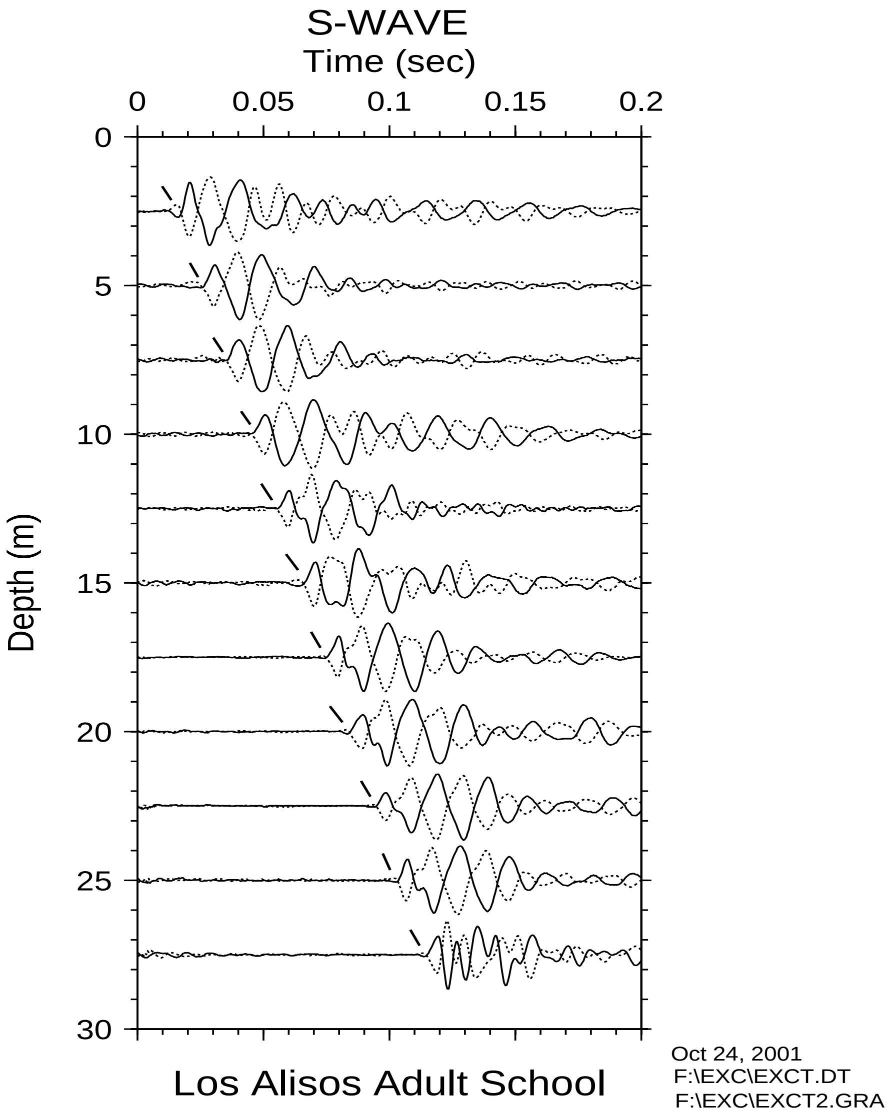

Figure A-37. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

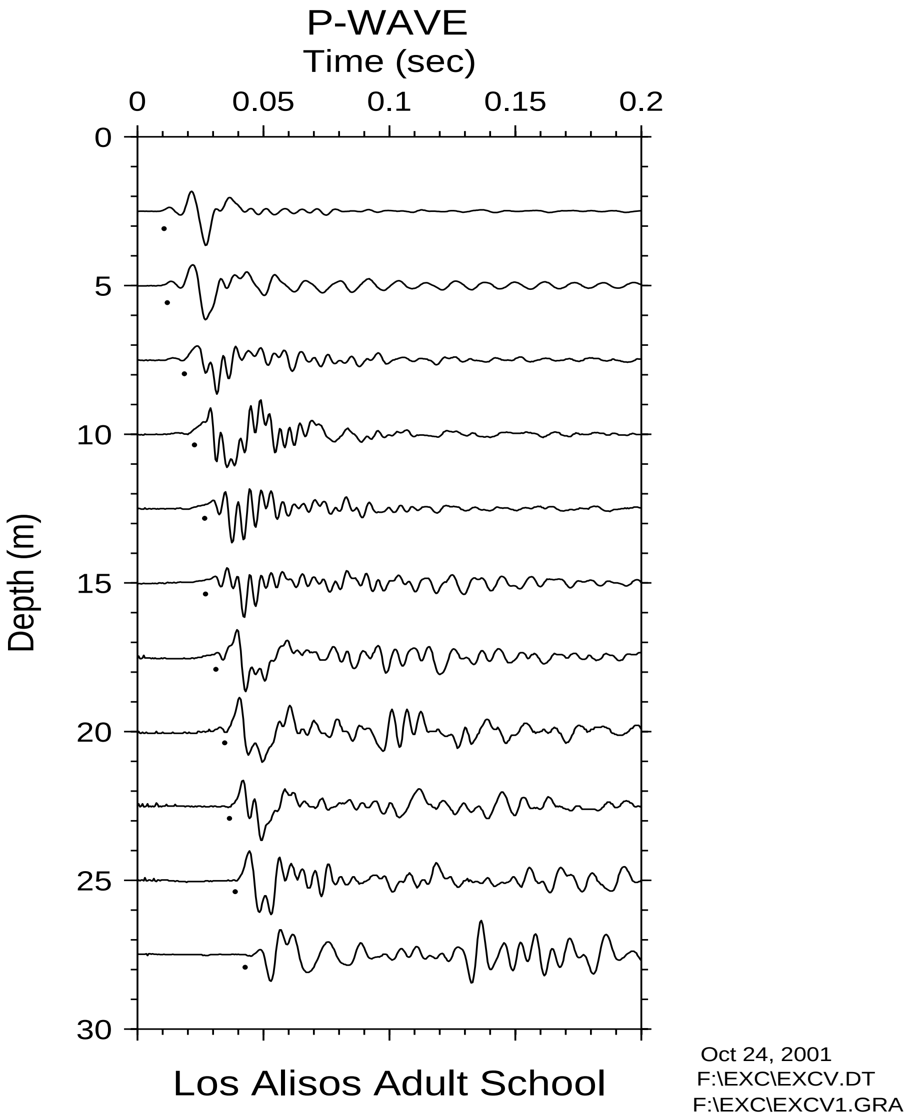

Figure A-38. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

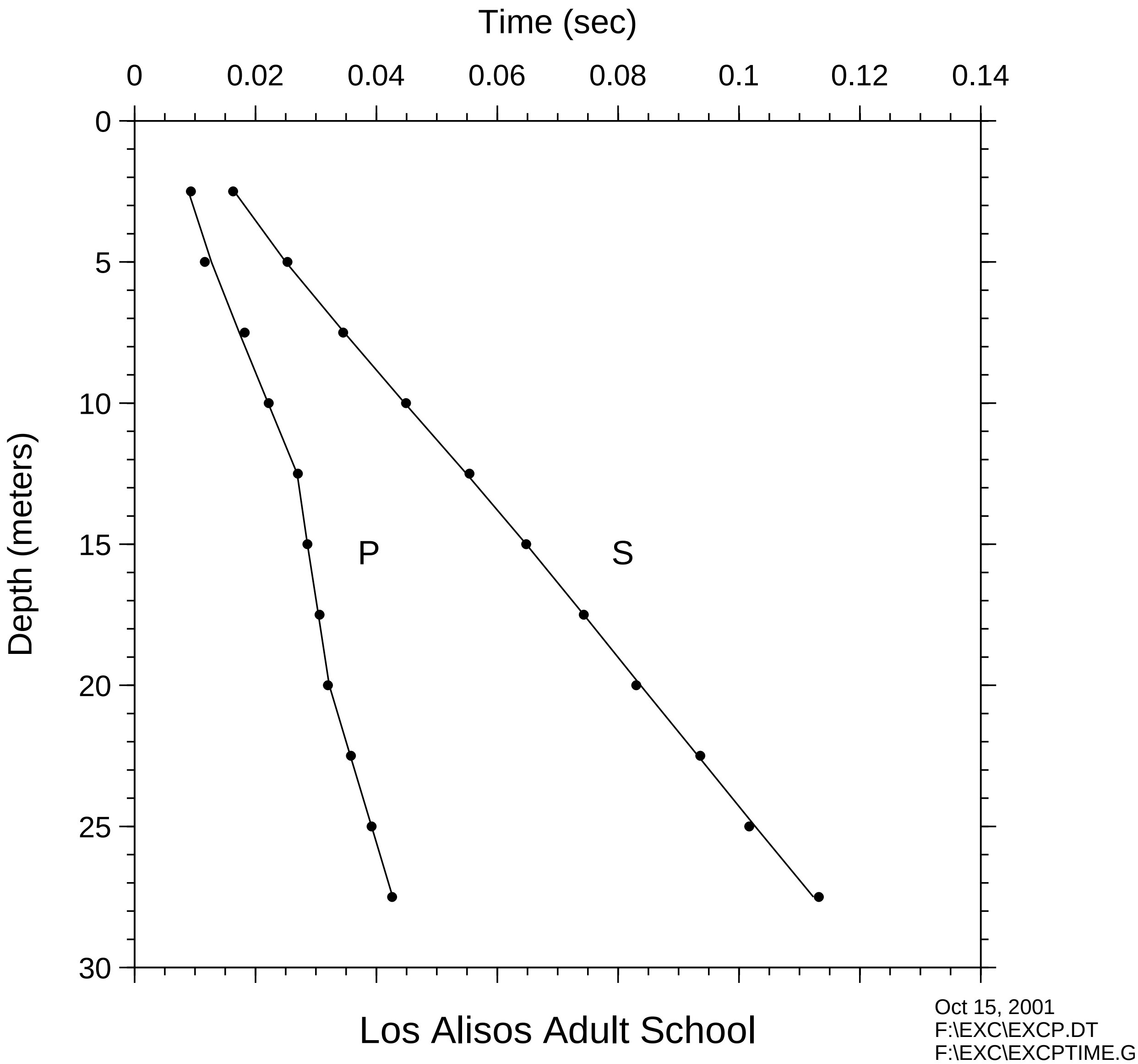

Figure A-39. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

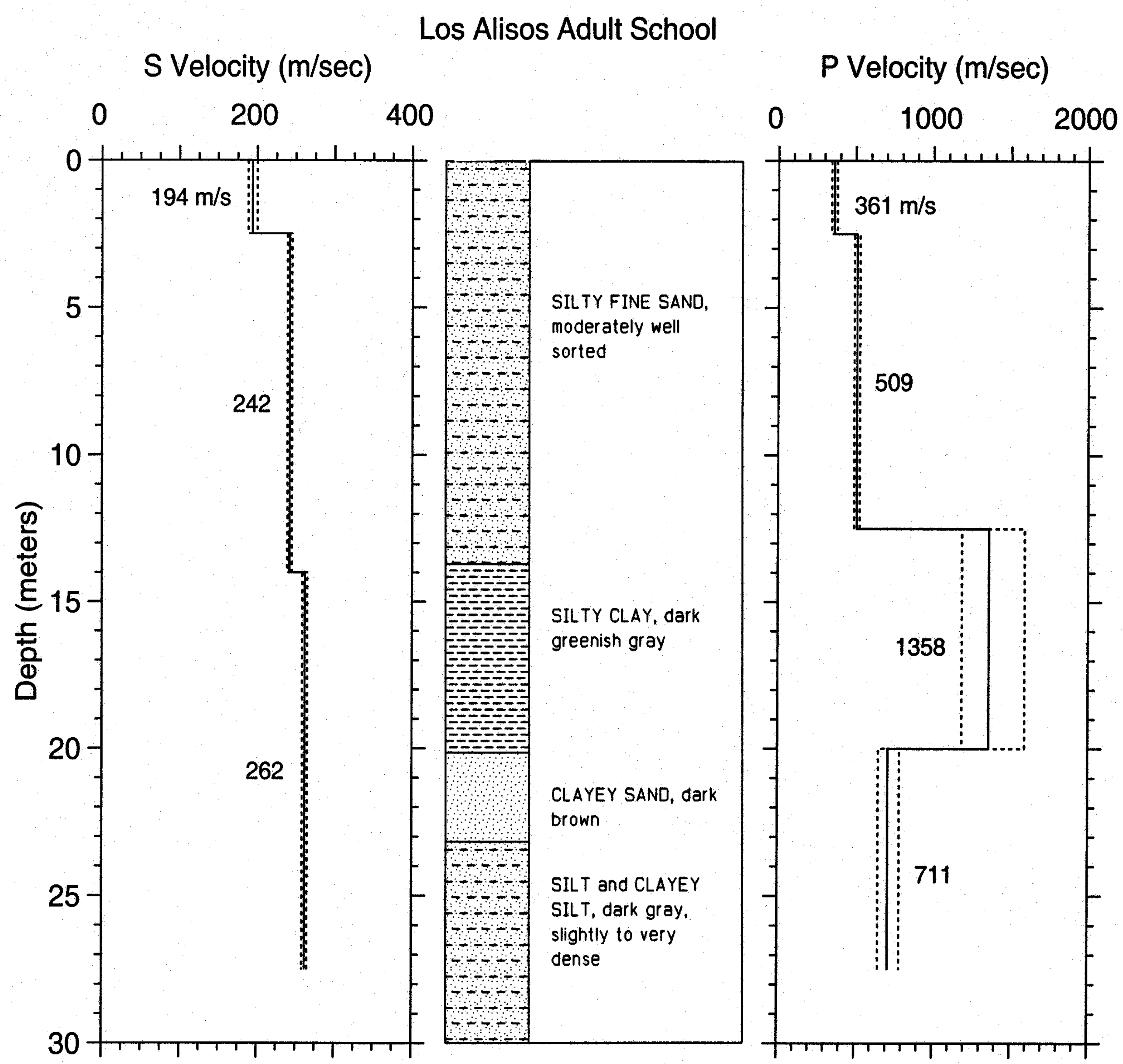

Figure A-40. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is shown for correlation with velocities.

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

Location: Los Alisos: S Coordinates: 33.89560 -118.08427 Hole_Code: 302

hoffset = 2.00 travel-time file: F:\EXC\EXCS.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0163	0.0129	194	1	-0.0002
5.0	16.4	0.0253	0.0232	215	1	0.0003
7.5	24.6	0.0345	0.0335	224	1	-0.0003
10.0	32.8	0.0449	0.0439	228	1	0.0001
12.5	41.0	0.0554	0.0542	231	1	0.0005
15.0	49.2	0.0648	0.0642	234	1	0.0000
17.5	57.4	0.0743	0.0738	237	1	0.0000
20.0	65.6	0.0830	0.0833	240	1	-0.0007
22.5	73.8	0.0936	0.0929	242	1	0.0003
25.0	82.0	0.1017	0.1024	244	1	-0.0010
27.5	90.2	0.1132	0.1119	246	1	0.0009

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)
2.5	2.5	194	188	200	8.2	8.2	636	618	656
14.0	11.5	242	239	245	45.9	37.7	794	784	804
27.5	13.5	262	259	265	90.2	44.3	859	849	870

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

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

Location: Los Alisos: P Coordinates: 33.89560 -118.08427 Hole_Code: 302
hoffset = 2.00 travel-time file: F:\EXC\EXCP.TT

nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0093	0.0069	361	2	0.0005
5.0	16.4	0.0116	0.0118	422	2	-0.0011
7.5	24.6	0.0182	0.0167	448	3	0.0009
10.0	32.8	0.0222	0.0217	462	4	0.0001
12.5	41.0	0.0270	0.0266	470	3	0.0001
15.0	49.2	0.0286	0.0284	528	3	-0.0001
17.5	57.4	0.0306	0.0303	578	3	0.0002
20.0	65.6	0.0320	0.0321	623	3	-0.0003
22.5	73.8	0.0358	0.0356	632	2	0.0001
25.0	82.0	0.0392	0.0391	639	2	0.0000
27.5	90.2	0.0426	0.0426	645	4	-0.0001

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)
2.5	2.5	361	344	380	8.2	8.2	1186	1129	1248
12.5	10.0	509	491	527	41.0	32.8	1669	1611	1730
20.0	7.5	1358	1185	1590	65.6	24.6	4456	3889	5218
27.5	7.5	711	650	785	90.2	24.6	2334	2133	2575

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

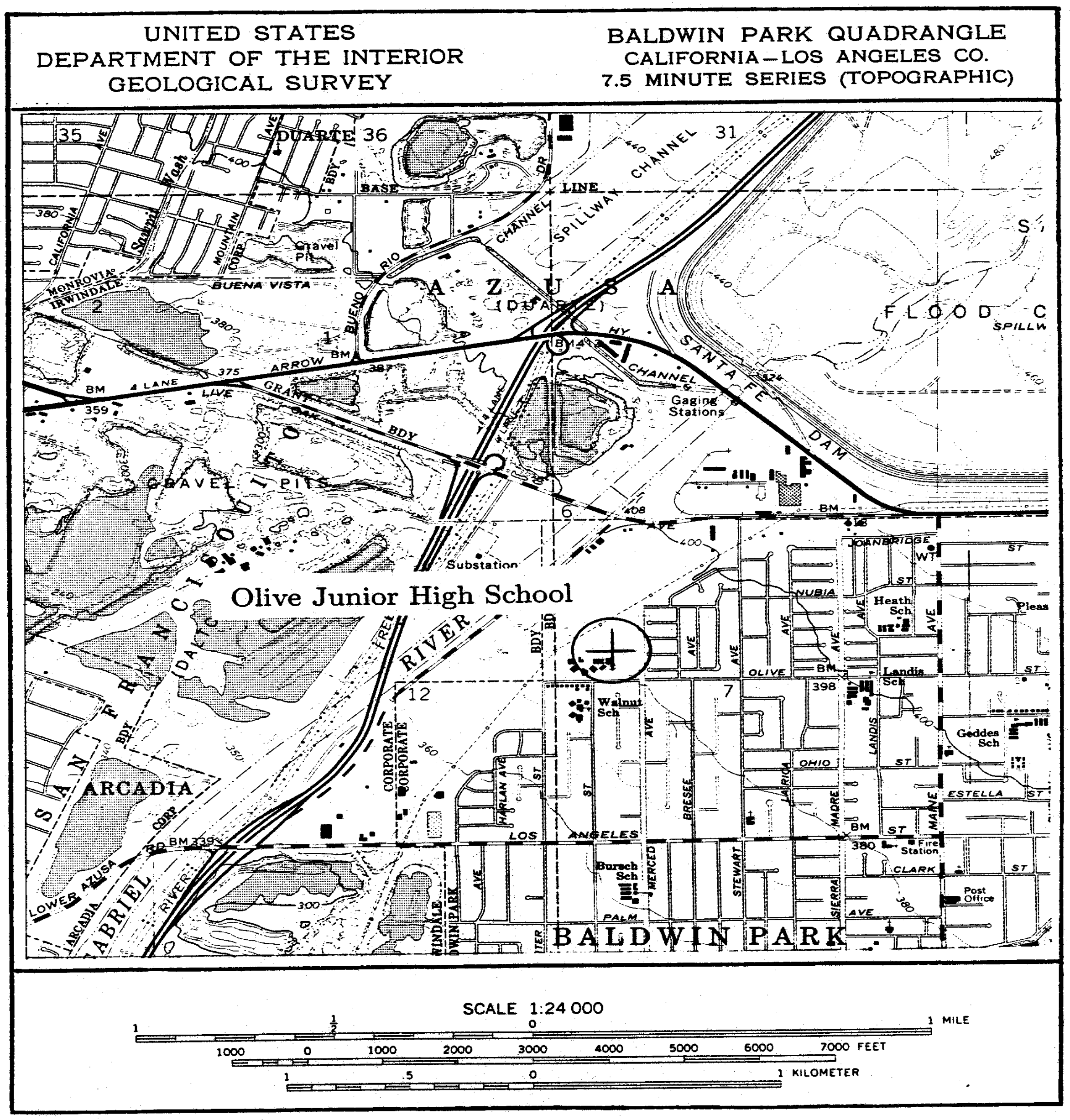

Figure A-41. Site location map for the borehole at Olive Junior High School. The accelerograph is located approximately 46 meters from the borehole.

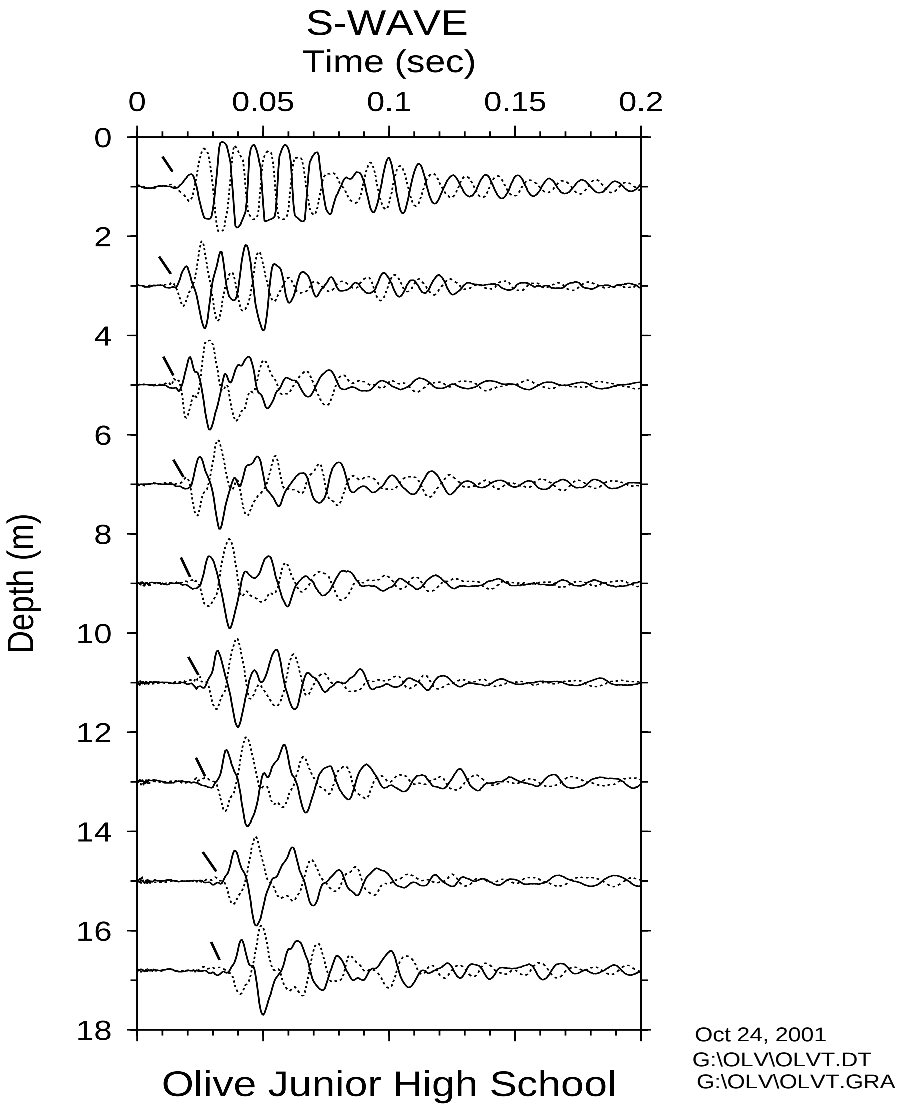

Figure A-42. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

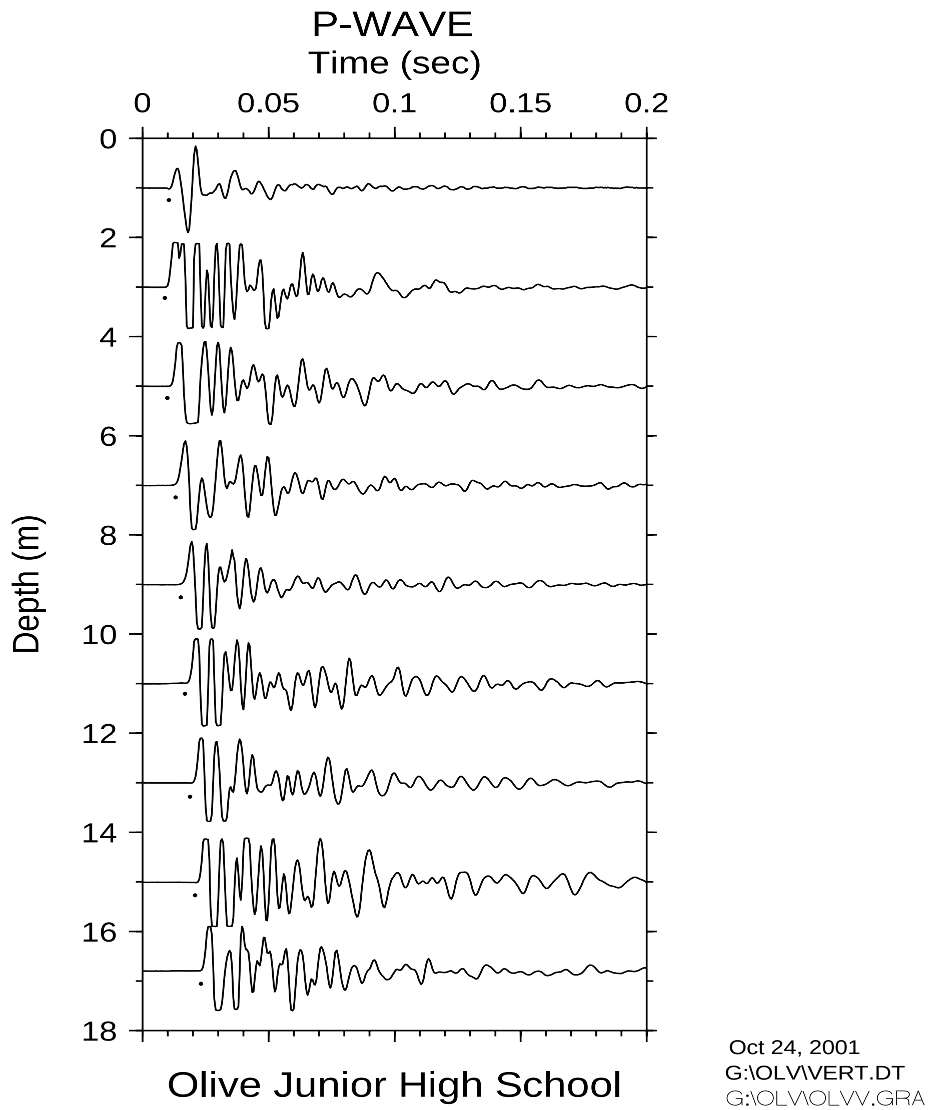

Figure A-43. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

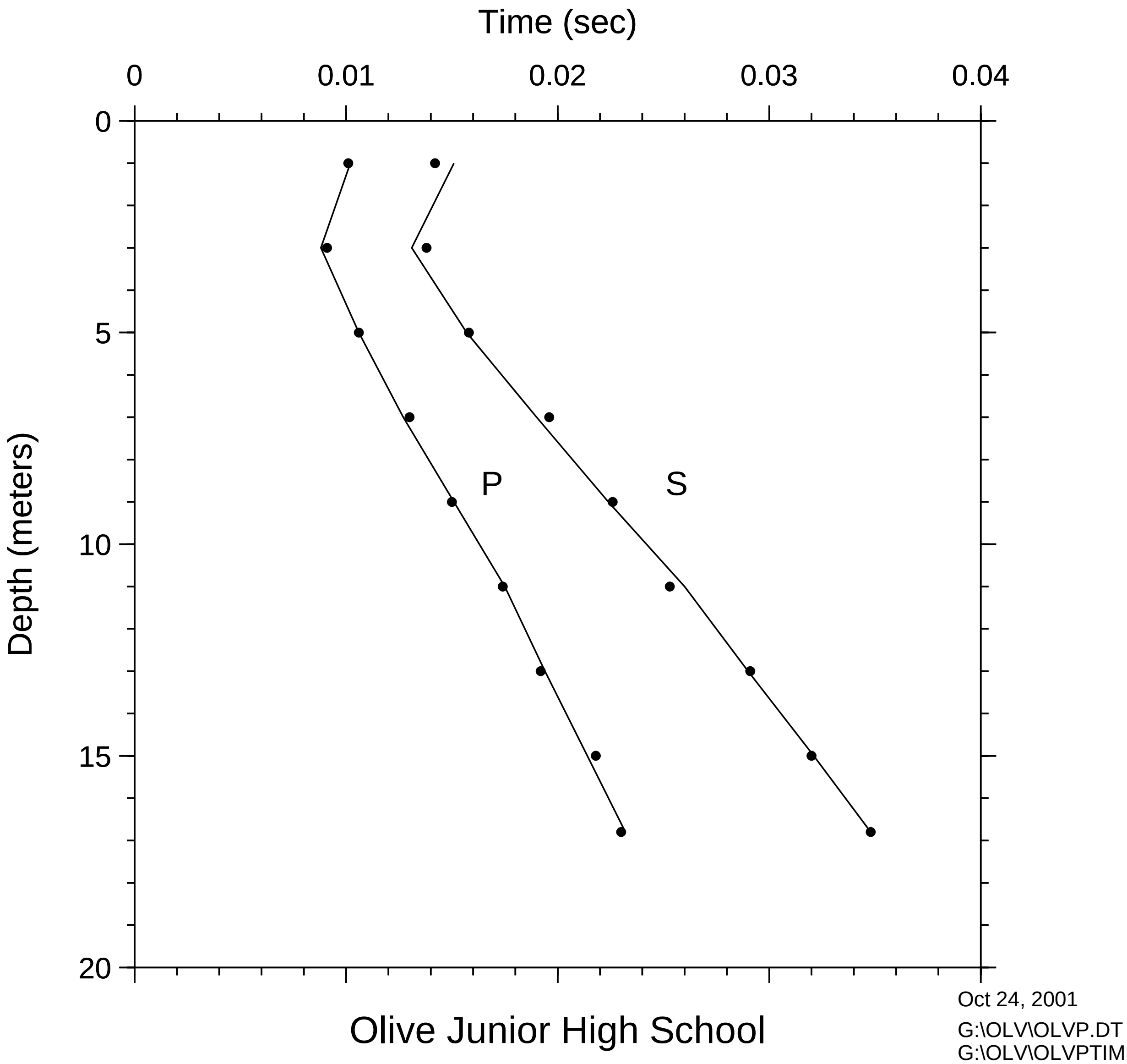

Figure A-44. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

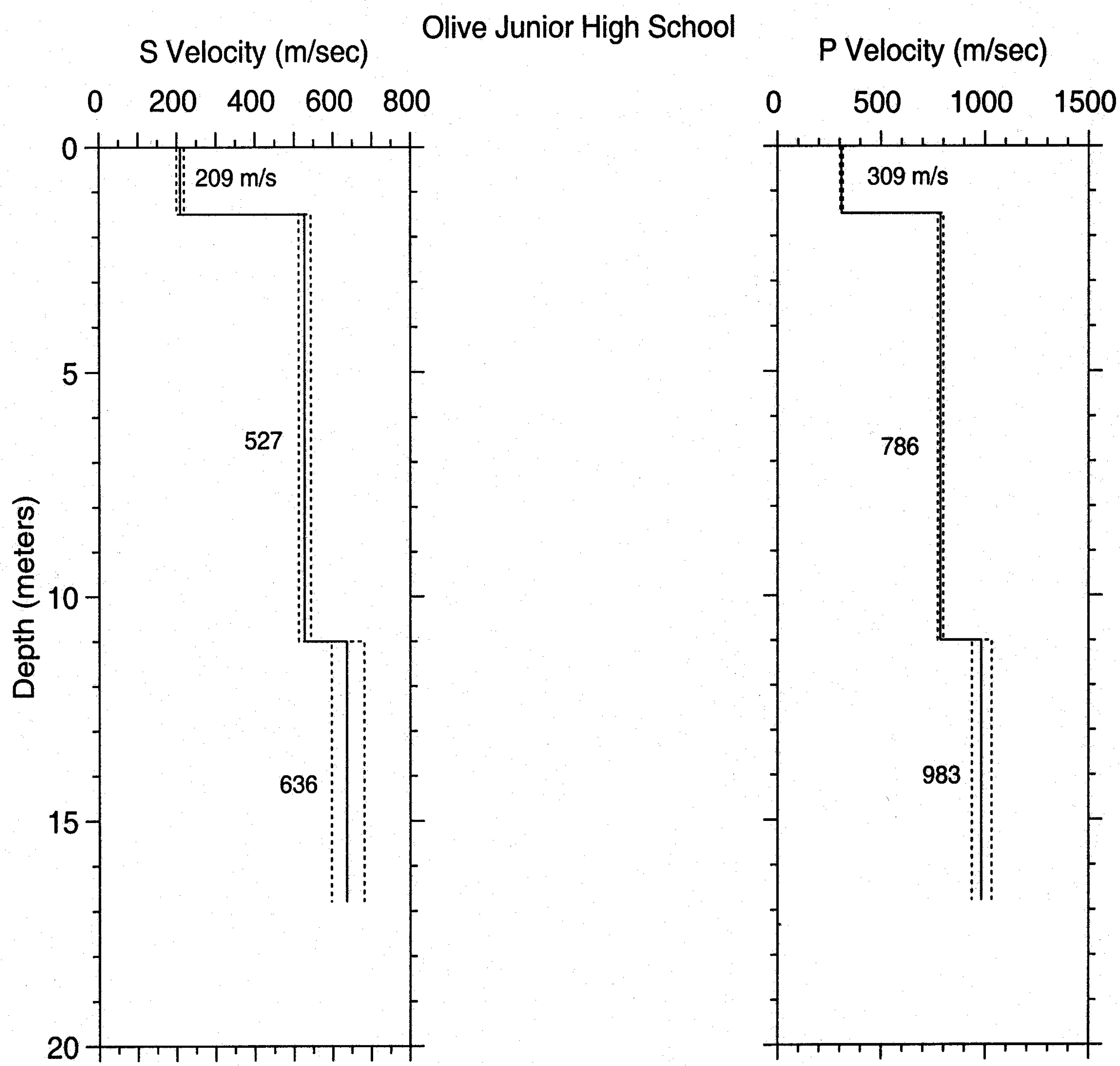

Figure A-45. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

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

Location: Olive Jr. High School: S Coordinates: 34.10073 -117.97409 Hole_Code: 303
hoffset = 3.00 travel-time file: G:\OLV\OLVS.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
1.0	3.3	0.0142	0.0048	209	2	-0.0009
3.0	9.8	0.0138	0.0100	299	1	0.0007
5.0	16.4	0.0158	0.0138	362	1	0.0001
7.0	23.0	0.0196	0.0176	397	1	0.0006
9.0	29.5	0.0226	0.0214	420	1	0.0001
11.0	36.1	0.0253	0.0252	436	1	-0.0008
13.0	42.7	0.0291	0.0283	459	1	0.0001
15.0	49.2	0.0320	0.0315	476	1	0.0000
16.8	55.1	0.0348	0.0343	489	1	0.0000

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)
1.5	1.5	209	200	219	4.9	4.9	685	655	718
11.0	9.5	527	512	543	36.1	31.2	1728	1679	1781
16.8	5.8	636	597	681	55.1	19.0	2087	1957	2235

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

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

Location: Olive Jr. High School: P Coordinates: 34.10073 -117.97409 Hole_Code: 303
hoffset = 3.00 travel-time file: G:\OLV\OLVP.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
1.0	3.3	0.0101	0.0032	309	1	-0.0001
3.0	9.8	0.0091	0.0068	444	1	0.0002
5.0	16.4	0.0106	0.0093	537	1	0.0000
7.0	23.0	0.0130	0.0119	591	1	0.0002
9.0	29.5	0.0150	0.0144	625	1	-0.0001
11.0	36.1	0.0174	0.0169	649	1	-0.0001
13.0	42.7	0.0192	0.0190	685	1	-0.0002
15.0	49.2	0.0218	0.0210	714	1	0.0004
16.8	55.1	0.0230	0.0228	736	1	-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)
1.5	1.5	309	302	316	4.9	4.9	1013	990	1038
11.0	9.5	786	772	800	36.1	31.2	2579	2534	2625
16.8	5.8	983	937	1032	55.1	19.0	3223	3075	3386

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

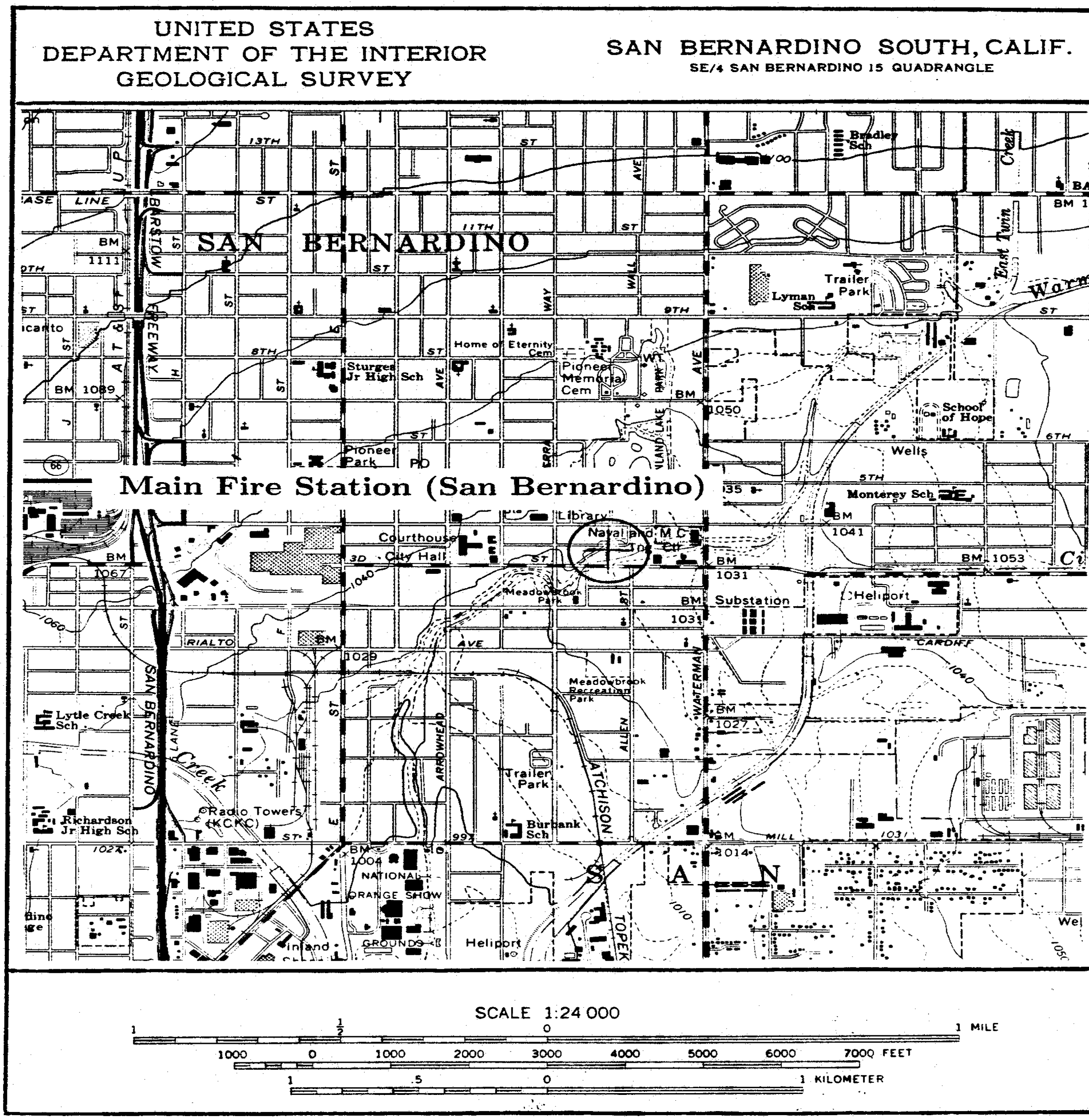

Figure A-46. Site location map for the borehole at San Bernardino Main Fire Station.

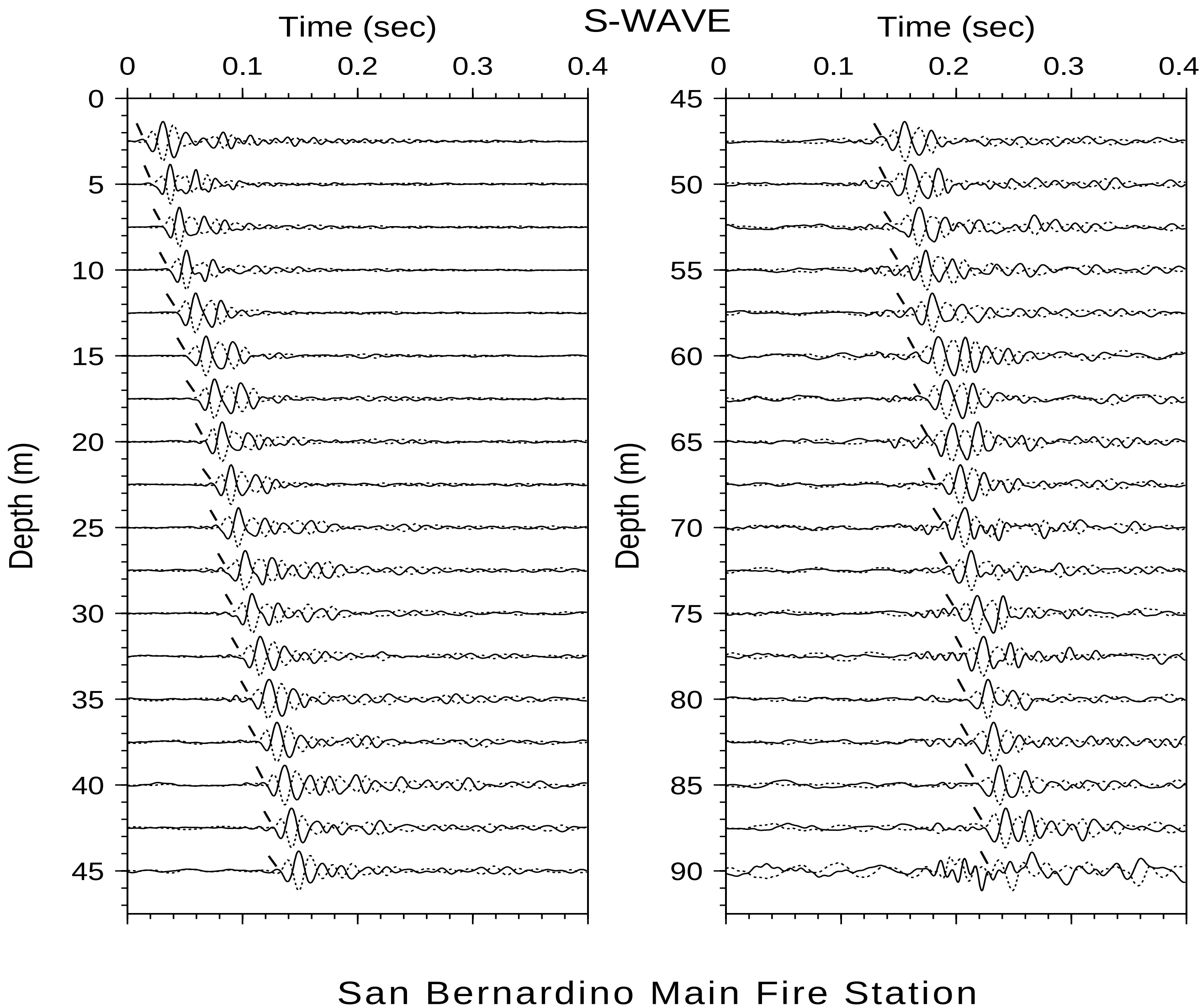

Figure A-47. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

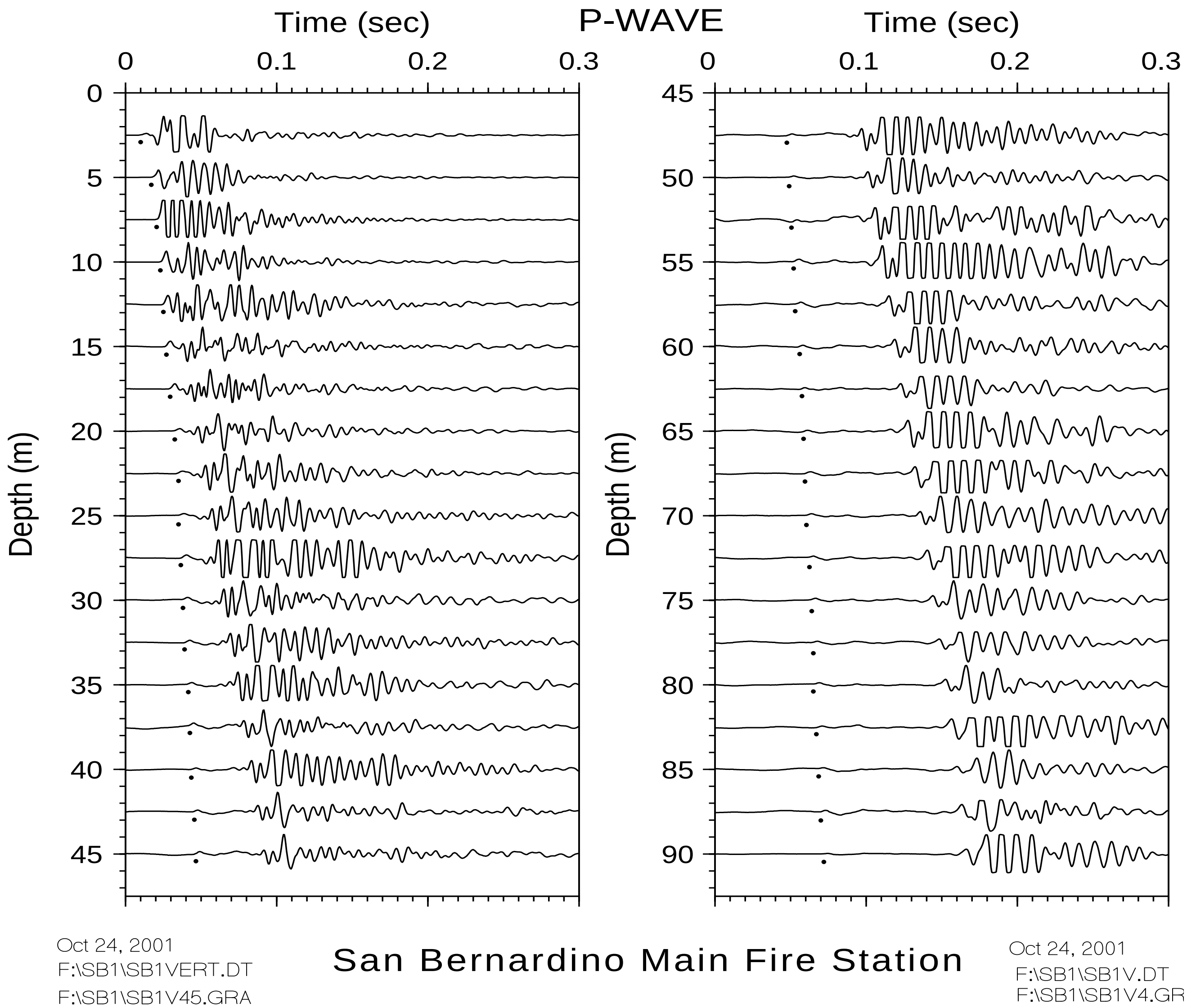

Figure A-48. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

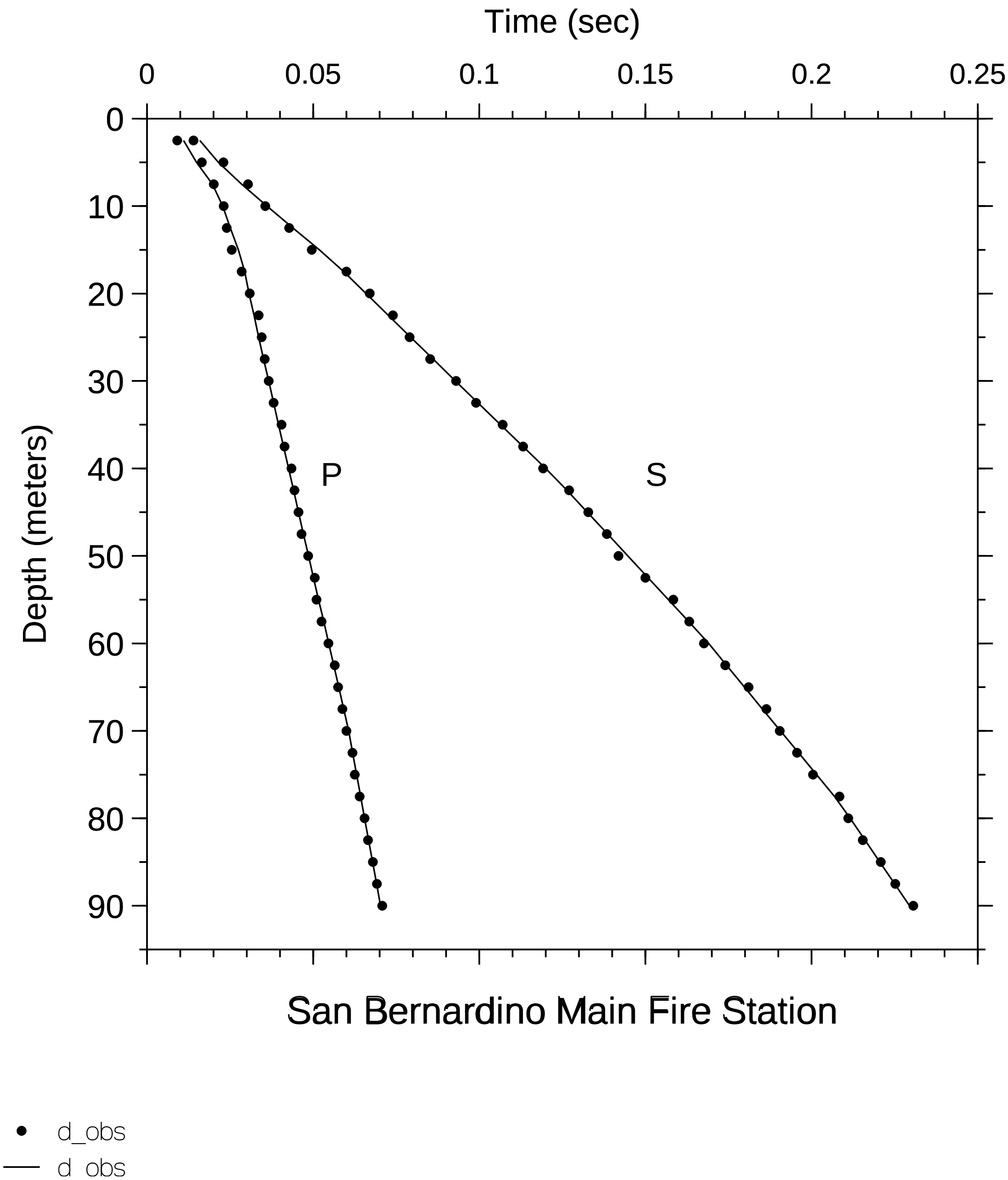

Figure A-49. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

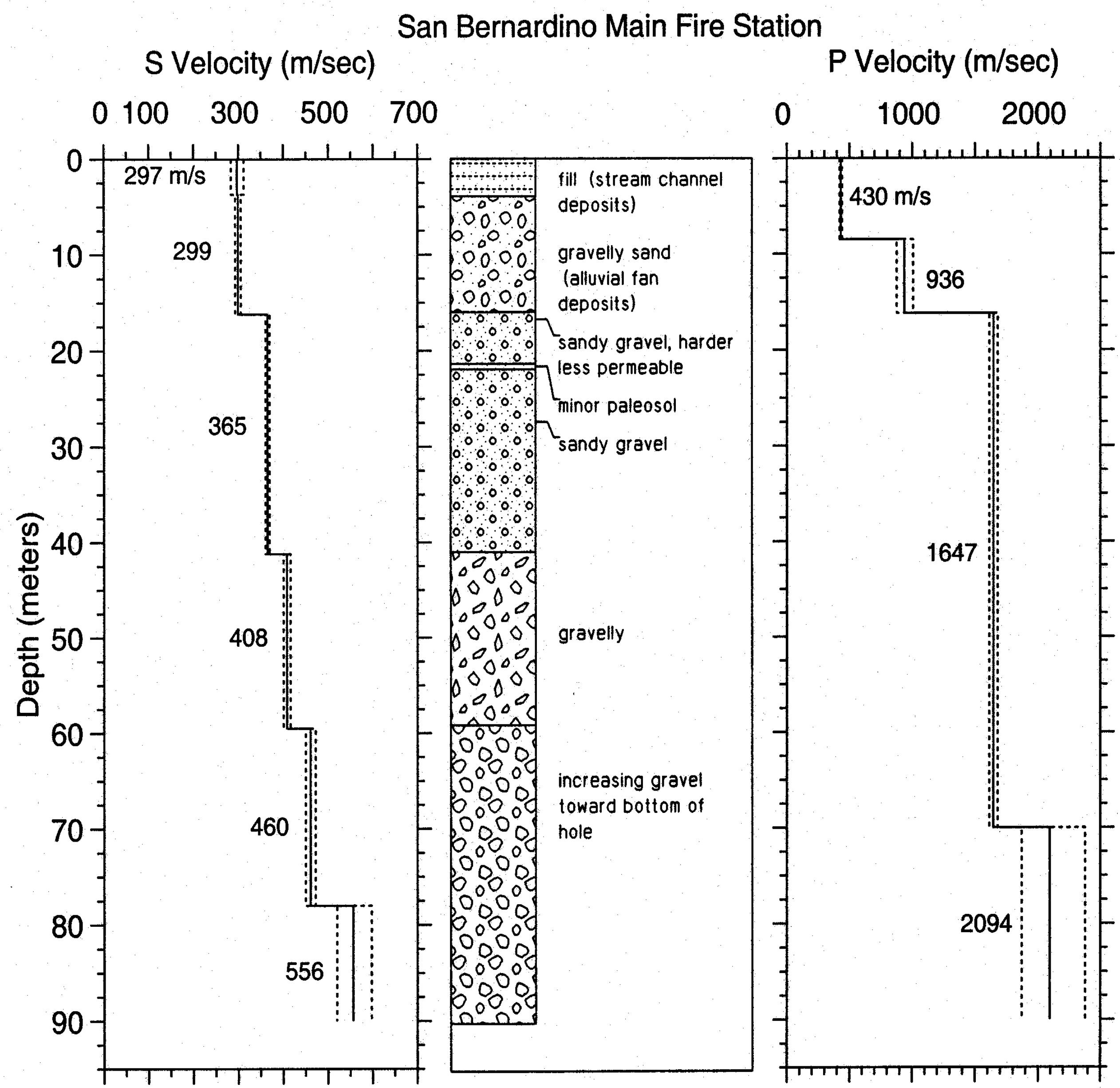

Figure A-50. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is shown for correlation with velocities.

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

Location: San Bernardino Fire Station: S Coordinates: 34.10534 -117.28201 Hole_Code: 305
hoffset = 4.00 travel-time file: F:\SB1\SB1S.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0140	0.0084	297	1	-0.0019
5.0	16.4	0.0230	0.0168	298	1	0.0015
7.5	24.6	0.0304	0.0252	298	1	0.0019
10.0	32.8	0.0356	0.0335	298	1	-0.0005
12.5	41.0	0.0428	0.0419	298	1	-0.0011
15.0	49.2	0.0496	0.0503	299	1	-0.0024
17.5	57.4	0.0600	0.0578	303	1	0.0008
20.0	65.6	0.0670	0.0647	309	1	0.0011
22.5	73.8	0.0740	0.0715	315	1	0.0015
25.0	82.0	0.0790	0.0784	319	1	-0.0003
27.5	90.2	0.0852	0.0852	323	2	-0.0009
30.0	98.4	0.0930	0.0921	326	1	0.0002
32.5	106.6	0.0990	0.0989	329	1	-0.0006
35.0	114.8	0.1070	0.1058	331	1	0.0006
37.5	123.0	0.1132	0.1126	333	1	0.0000
40.0	131.2	0.1192	0.1195	335	1	-0.0008
42.5	139.4	0.1270	0.1259	337	1	0.0005
45.0	147.6	0.1328	0.1321	341	1	0.0003
47.5	155.8	0.1384	0.1382	344	1	-0.0002
50.0	164.0	0.1419	0.1443	346	2	-0.0028
52.5	172.2	0.1500	0.1505	349	2	-0.0008
55.0	180.4	0.1584	0.1566	351	1	0.0015
57.5	188.6	0.1632	0.1627	353	1	0.0002
60.0	196.9	0.1676	0.1687	356	1	-0.0014
62.5	205.1	0.1740	0.1741	359	1	-0.0004
65.0	213.3	0.1810	0.1796	362	1	0.0012
67.5	221.5	0.1864	0.1850	365	1	0.0012
70.0	229.7	0.1904	0.1904	368	1	-0.0002
72.5	237.9	0.1956	0.1959	370	1	-0.0005
75.0	246.1	0.2004	0.2013	373	1	-0.0011
77.5	254.3	0.2084	0.2067	375	1	0.0015
80.0	262.5	0.2110	0.2114	378	1	-0.0006
82.5	270.7	0.2154	0.2159	382	1	-0.0007
85.0	278.9	0.2208	0.2204	386	2	0.0003
87.5	287.1	0.2252	0.2249	389	1	0.0002
90.0	295.3	0.2306	0.2294	392	3	0.0011

nlayers = 6

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)
3.7	3.7	297	284	312	12.1	12.1	976	932	1024
16.2	12.5	299	293	306	53.1	41.0	982	962	1004
41.2	25.0	365	360	370	135.2	82.0	1197	1182	1213
59.5	18.3	408	401	416	195.2	60.0	1339	1314	1365
78.0	18.5	460	450	472	255.9	60.7	1511	1475	1548
90.0	12.0	556	520	597	295.3	39.4	1824	1706	1960

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

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

Location: San Bernardino Fire Station: P Coordinates: 34.10534 -117.28201 Hole_Code: 305
hoffset = 4.00 travel-time file: F:\SB1\SB1P.TT

nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0091	0.0058	430	1	-0.0019
5.0	16.4	0.0165	0.0116	430	1	0.0016
7.5	24.6	0.0201	0.0174	430	1	0.0003
10.0	32.8	0.0231	0.0214	468	1	0.0002
12.5	41.0	0.0240	0.0240	520	1	-0.0010
15.0	49.2	0.0255	0.0267	562	1	-0.0020
17.5	57.4	0.0285	0.0288	608	1	-0.0008
20.0	65.6	0.0309	0.0303	660	1	0.0002
22.5	73.8	0.0336	0.0318	707	1	0.0015
25.0	82.0	0.0345	0.0333	750	1	0.0009
27.5	90.2	0.0354	0.0349	789	1	0.0003
30.0	98.4	0.0366	0.0364	825	1	0.0000
32.5	106.6	0.0381	0.0379	858	1	0.0000
35.0	114.8	0.0405	0.0394	888	1	0.0009
37.5	123.0	0.0414	0.0409	916	1	0.0004
40.0	131.2	0.0435	0.0424	942	3	0.0009
42.5	139.4	0.0444	0.0440	967	1	0.0003
45.0	147.6	0.0456	0.0455	989	1	0.0000
47.5	155.8	0.0465	0.0470	1011	3	-0.0006
50.0	164.0	0.0485	0.0485	1031	4	-0.0001
52.5	172.2	0.0505	0.0500	1049	3	0.0003
55.0	180.4	0.0510	0.0516	1067	1	-0.0006
57.5	188.6	0.0525	0.0531	1083	2	-0.0006
60.0	196.9	0.0546	0.0546	1099	3	0.0000
62.5	205.1	0.0565	0.0561	1114	2	0.0003
65.0	213.3	0.0575	0.0576	1128	2	-0.0002
67.5	221.5	0.0588	0.0591	1141	2	-0.0004
70.0	229.7	0.0600	0.0607	1154	2	-0.0007
72.5	237.9	0.0618	0.0619	1172	2	-0.0001
75.0	246.1	0.0625	0.0630	1190	2	-0.0006
77.5	254.3	0.0640	0.0642	1206	2	-0.0003
80.0	262.5	0.0655	0.0654	1223	2	0.0000
82.5	270.7	0.0665	0.0666	1238	2	-0.0002
85.0	278.9	0.0680	0.0678	1253	2	0.0001
87.5	287.1	0.0692	0.0690	1268	2	0.0001
90.0	295.3	0.0708	0.0702	1282	3	0.0005

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)
8.5	8.5	430	421	441	27.9	27.9	1412	1381	1445
16.2	7.7	936	876	1006	53.1	25.3	3072	2873	3301
70.0	53.8	1647	1614	1680	229.7	176.5	5402	5295	5513
90.0	20.0	2094	1870	2378	295.3	65.6	6870	6136	7803

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

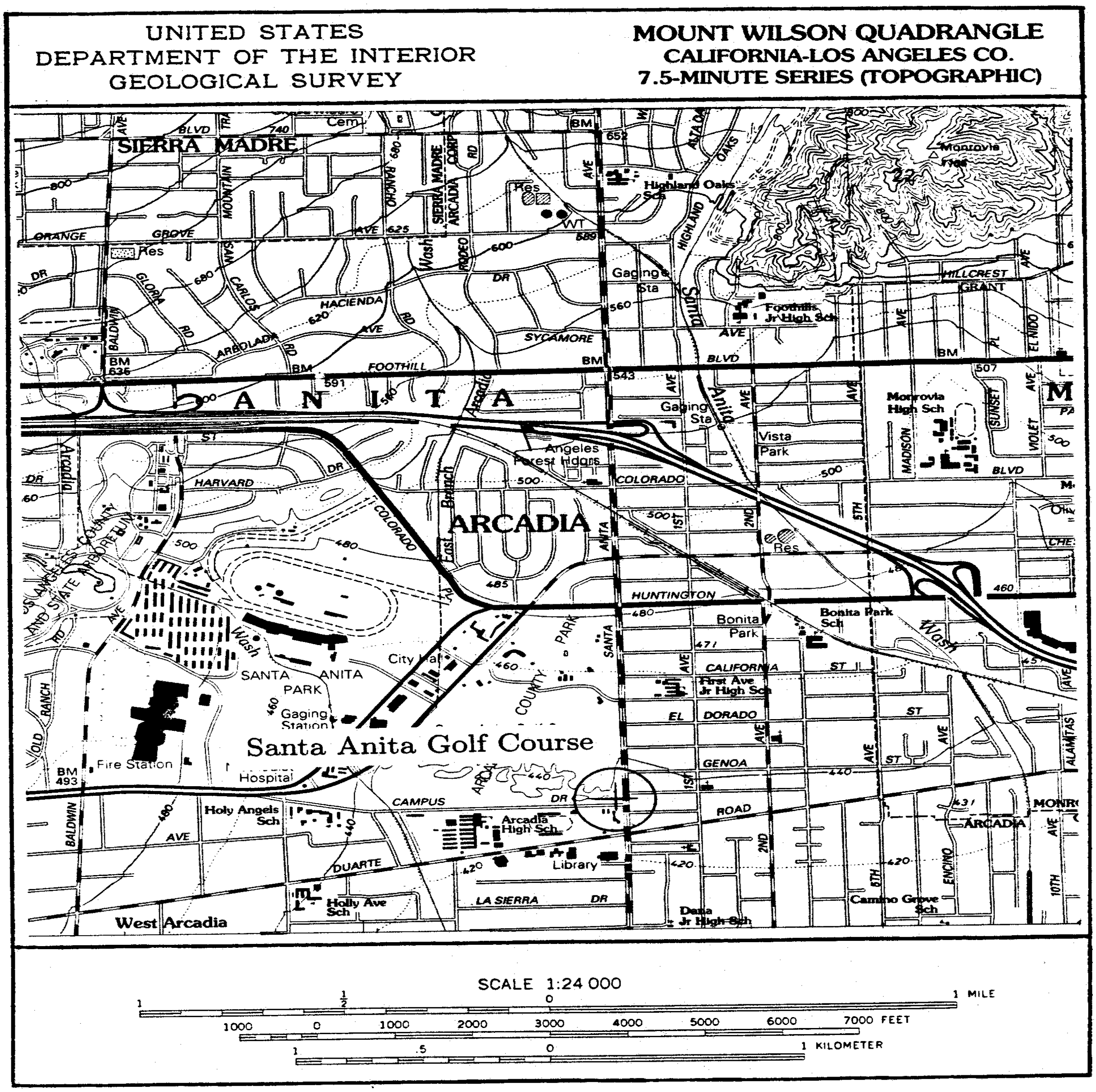

Figure A-51. Site location map for the borehole at Santa Anita Golf Course.

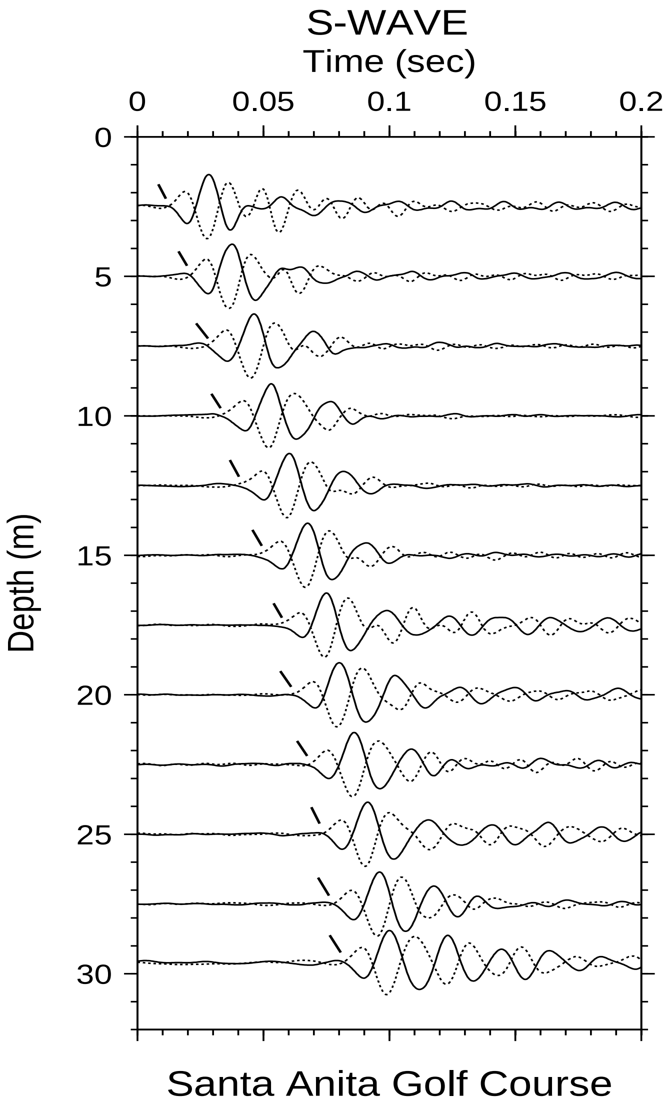

Figure A-52. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

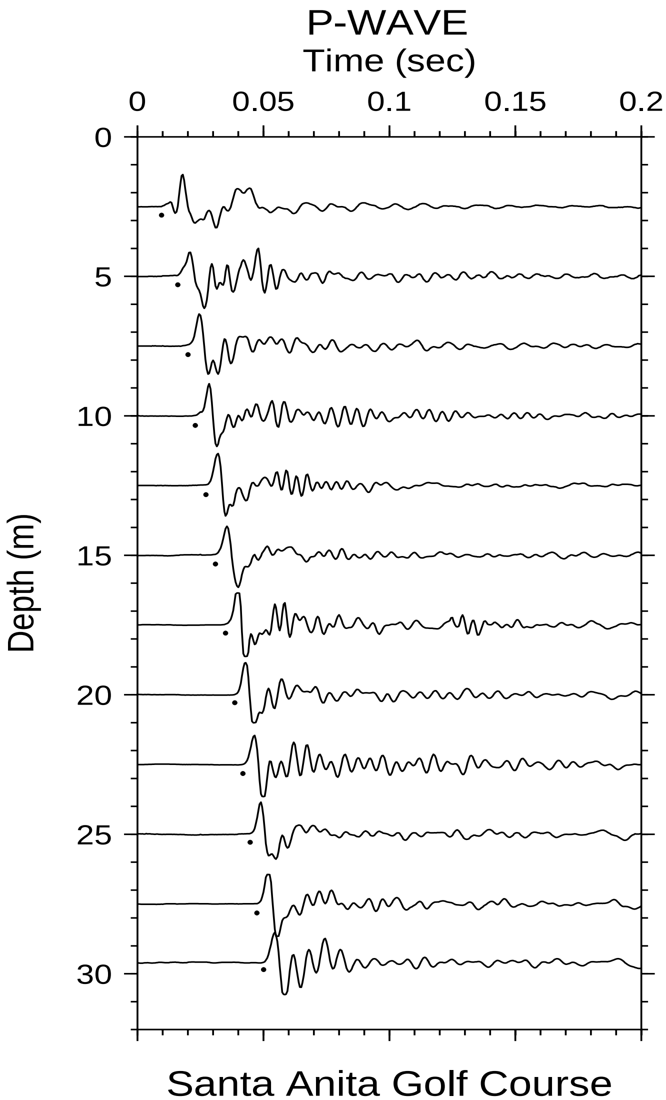

Figure A-53. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

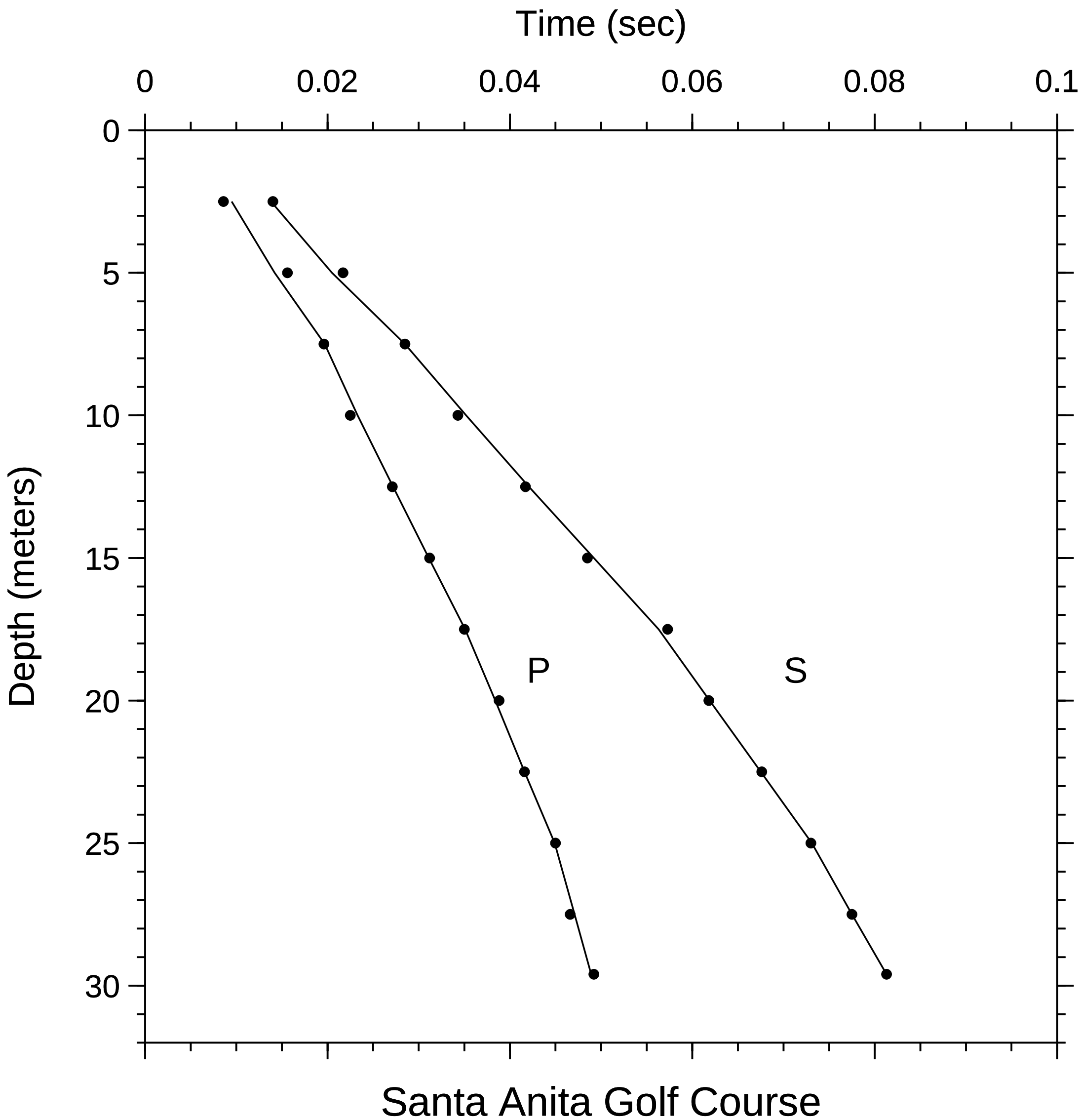

Figure A-54. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

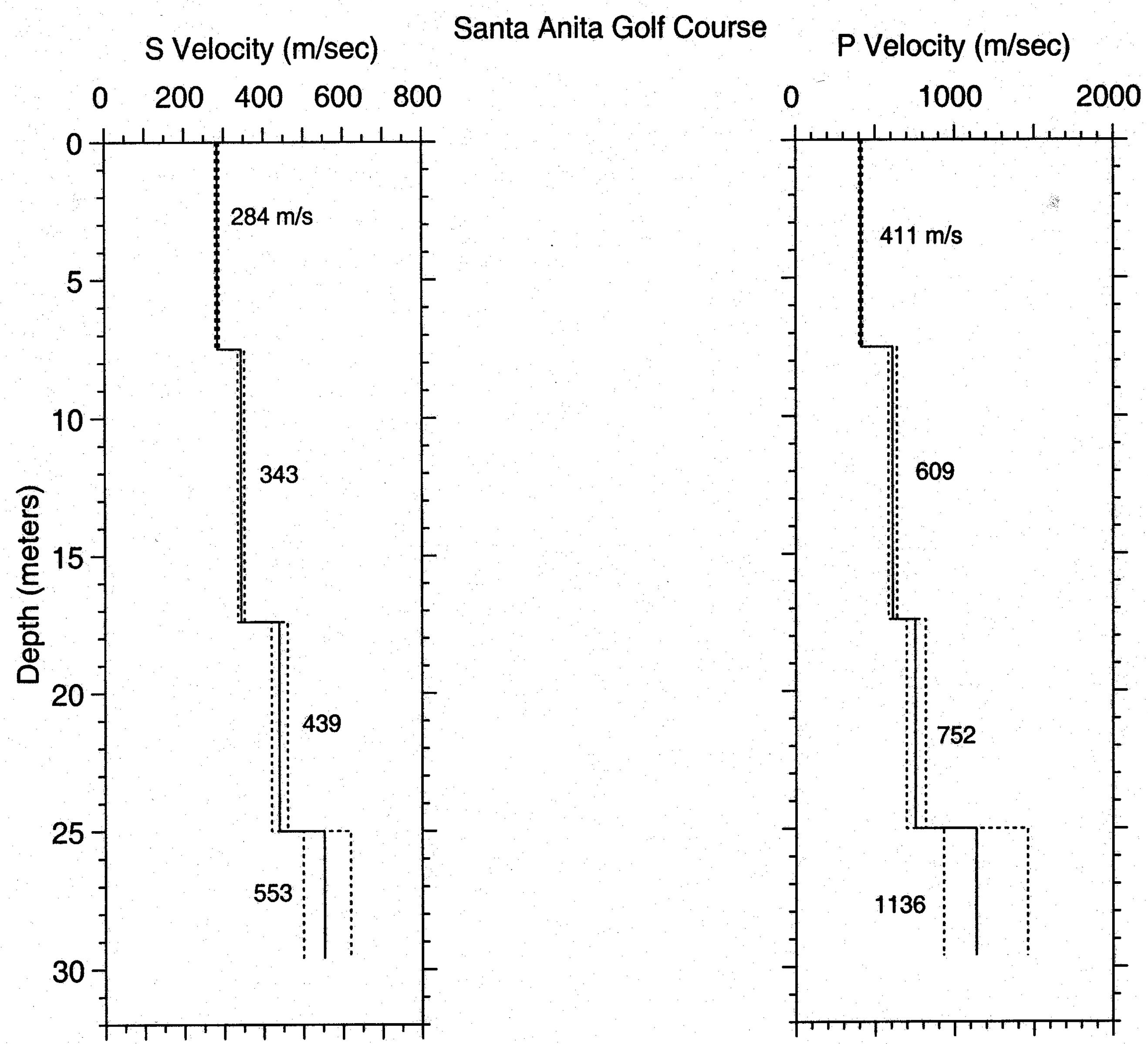

Figure A-55. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

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

Location: Santa Anita Golf Course: S Coordinates: 34.13096 -118.03070 Hole_Code: 304
hoffset = 3.00 travel-time file: F:\SAG\SAGS_RE.TT

nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0140	0.0088	284	1	0.0002
5.0	16.4	0.0217	0.0176	284	1	0.0012
7.5	24.6	0.0285	0.0264	284	1	0.0000
10.0	32.8	0.0343	0.0337	297	1	-0.0009
12.5	41.0	0.0417	0.0410	305	1	-0.0004
15.0	49.2	0.0485	0.0483	311	1	-0.0007
17.5	57.4	0.0573	0.0555	315	1	0.0010
20.0	65.6	0.0618	0.0612	327	1	-0.0001
22.5	73.8	0.0676	0.0669	336	1	0.0001
25.0	82.0	0.0730	0.0726	344	1	-0.0001
27.5	90.2	0.0775	0.0771	357	1	0.0000
29.6	97.1	0.0813	0.0809	366	1	0.0000

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)
7.5	7.5	284	279	288	24.6	24.6	931	917	946
17.4	9.9	343	335	352	57.1	32.5	1126	1099	1154
25.0	7.6	439	420	460	82.0	24.9	1441	1377	1510
29.6	4.6	553	500	619	97.1	15.1	1814	1640	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

ABLE A22. P-wave arrival times and velocity summaries.

Location: Santa Anita Golf Course: P Coordinates: 34.13096 -118.03075 Hole_Code: 304
hoffset = 3.00 travel-time file: F:\SAG\SAGP.TT

nlayers = 4

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0086	0.0061	411	1	-0.0009
5.0	16.4	0.0156	0.0122	411	1	0.0014
7.5	24.6	0.0196	0.0182	411	1	-0.0001
10.0	32.8	0.0225	0.0224	447	1	-0.0008
12.5	41.0	0.0271	0.0265	472	1	0.0000
15.0	49.2	0.0312	0.0306	491	1	0.0001
17.5	57.4	0.0350	0.0346	505	1	-0.0001
20.0	65.6	0.0388	0.0380	527	1	0.0005
22.5	73.8	0.0416	0.0413	545	1	-0.0001
25.0	82.0	0.0450	0.0446	560	1	0.0001
27.5	90.2	0.0466	0.0468	587	1	-0.0005
29.6	97.1	0.0492	0.0487	608	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)
7.5	7.5	411	401	421	24.6	24.6	1348	1317	1381
17.4	9.9	609	584	637	57.1	32.5	1999	1915	2091
25.0	7.6	752	696	817	82.0	24.9	2466	2285	2679
29.6	4.6	1136	930	1459	97.1	15.1	3727	3052	4785

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 South Western Academy. The accelerograph is located approximately 10 meters from the borehole.

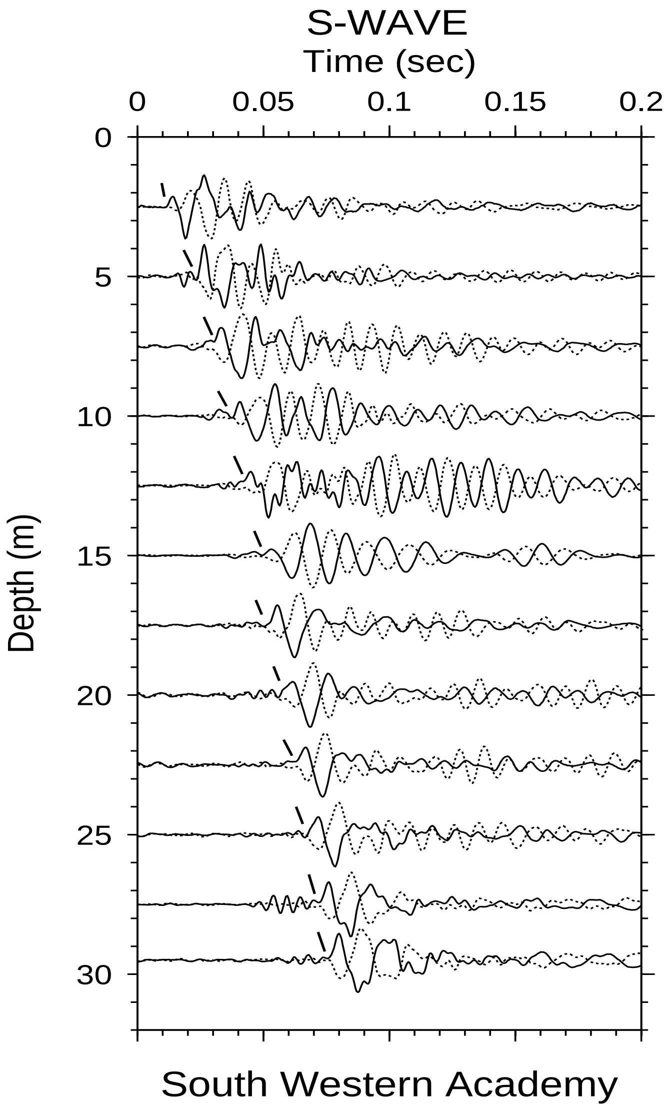

Figure A-57. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

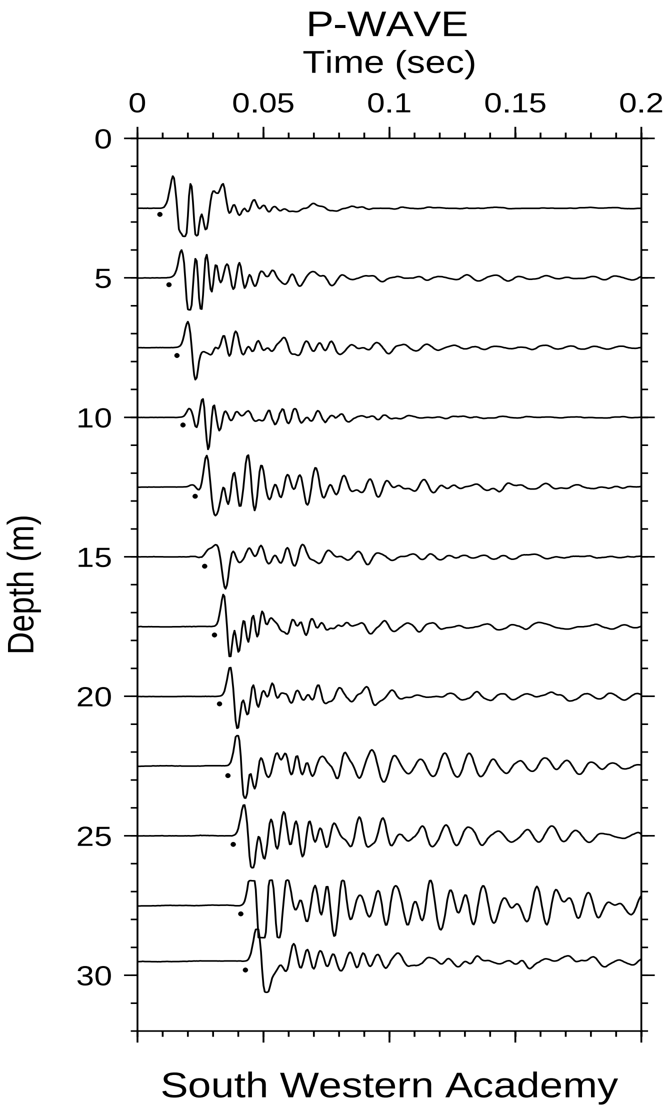

Figure A-58. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

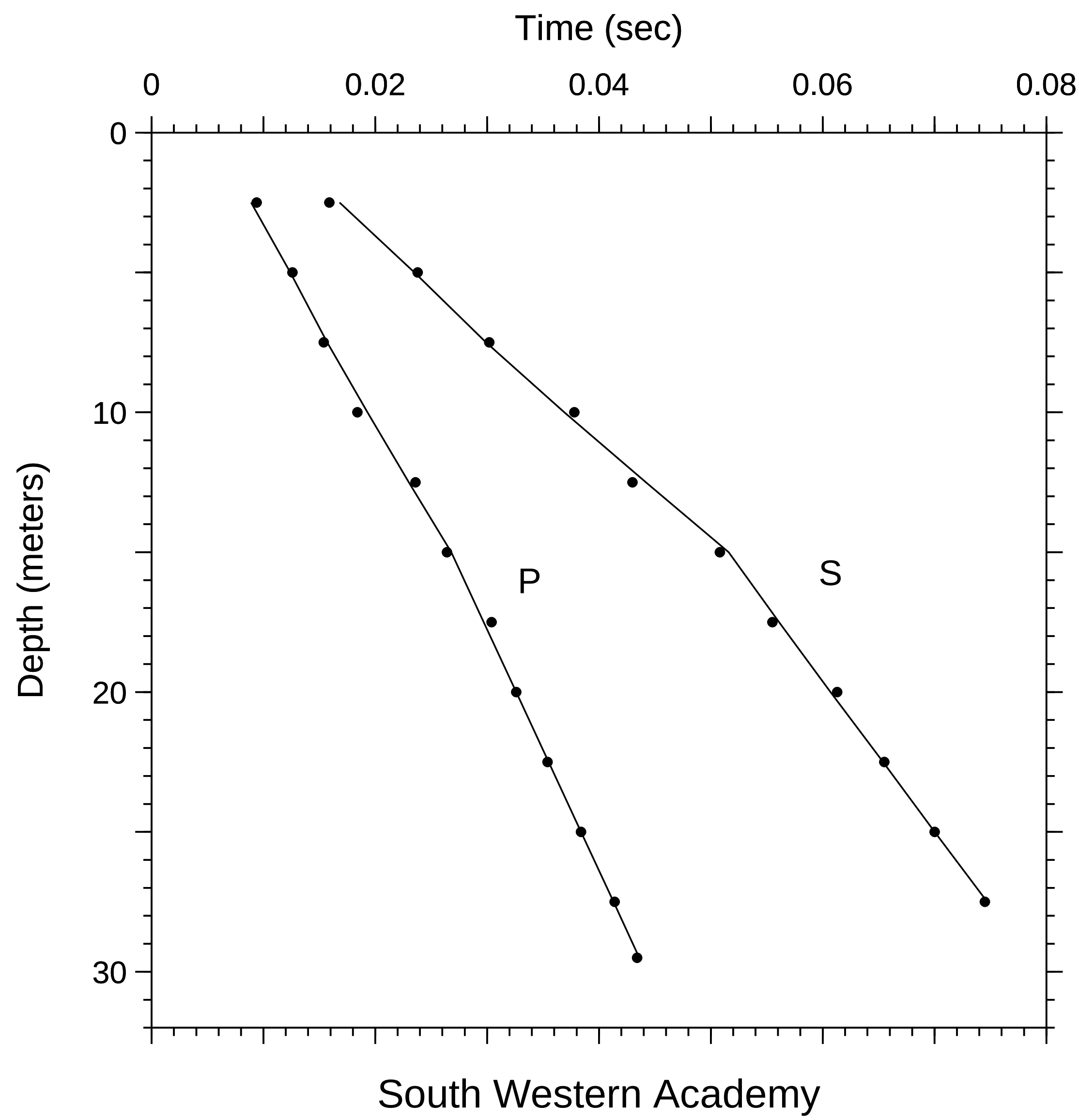

Figure A-59. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

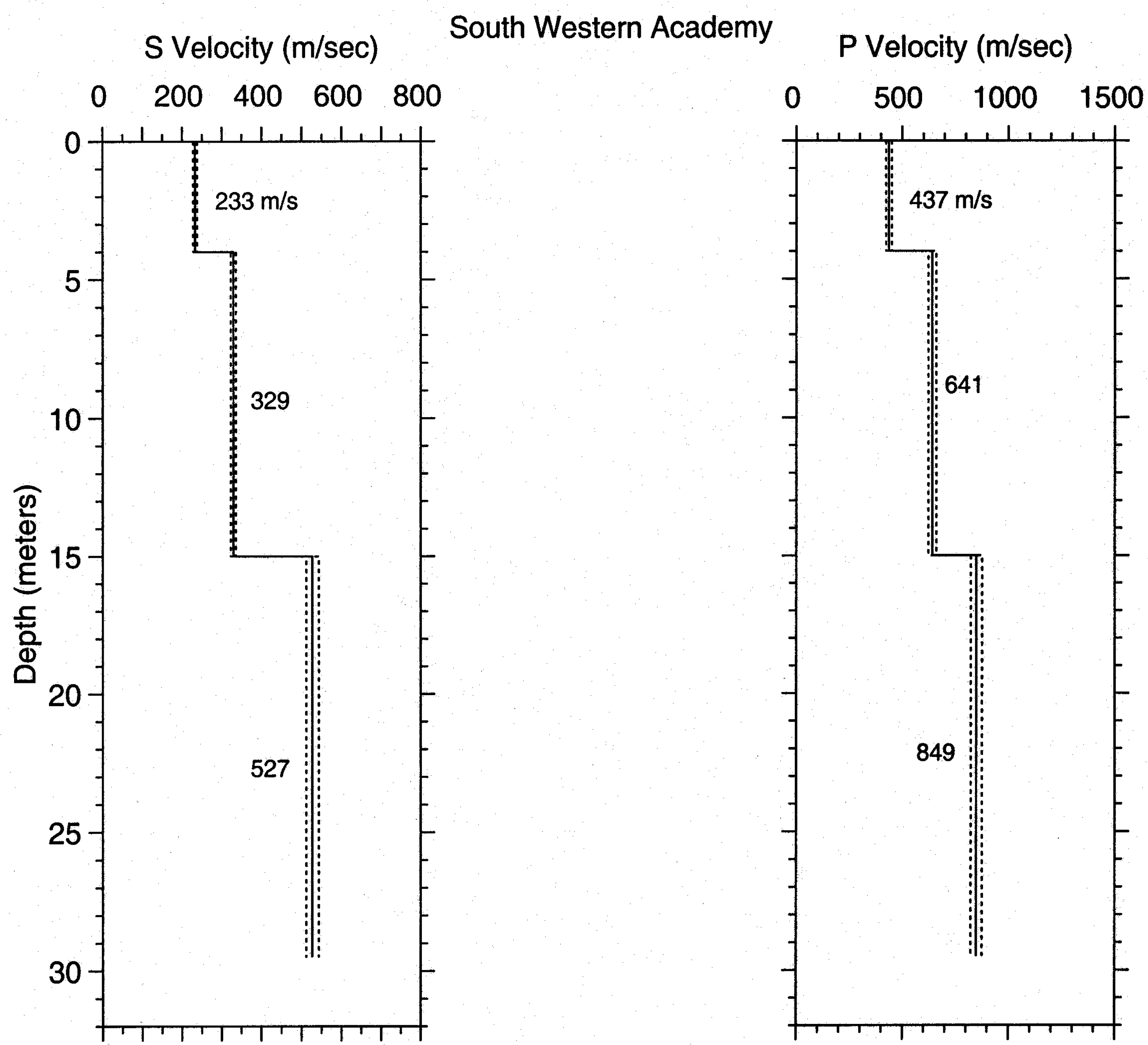

Figure A-60. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is not available from this borehole.

ABLE A23. S-wave arrival times and velocity summaries.

Location: South Western Academy: S Coordinates: 34.11533 -118.13050 Hole_Code: 306
hoffset = 3.00 travel-time file: F:\SWA\SWAS_RE.TT

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0159	0.0107	233	1	-0.0009
5.0	16.4	0.0238	0.0202	247	1	0.0003
7.5	24.6	0.0302	0.0278	270	1	0.0003
10.0	32.8	0.0378	0.0354	282	1	0.0009
12.5	41.0	0.0430	0.0430	291	3	-0.0012
15.0	49.2	0.0508	0.0506	296	1	-0.0008
17.5	57.4	0.0555	0.0553	316	2	-0.0006
20.0	65.6	0.0613	0.0601	333	1	0.0006
22.5	73.8	0.0655	0.0648	347	1	0.0001
25.0	82.0	0.0700	0.0696	359	1	0.0000
27.5	90.2	0.0745	0.0743	370	1	-0.0002

nlayers = 3

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)
4.0	4.0	233	227	238	13.1	13.1	763	746	781
15.0	11.0	329	323	336	49.2	36.1	1080	1059	1102
29.5	14.5	527	511	543	96.8	47.6	1728	1678	1781

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

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

Location: South Western Academy: P Coordinates: 34.11533 -118.13050 Hole_Code: 306
hoffset = 3.00 travel-time file: F:\SWA\SWAP.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0094	0.0057	437	1	0.0005
5.0	16.4	0.0126	0.0107	467	1	0.0002
7.5	24.6	0.0154	0.0146	513	1	-0.0003
10.0	32.8	0.0184	0.0185	540	1	-0.0009
12.5	41.0	0.0236	0.0224	558	2	0.0006
15.0	49.2	0.0264	0.0263	570	2	-0.0004
17.5	57.4	0.0304	0.0293	598	1	0.0007
20.0	65.6	0.0326	0.0322	621	1	0.0000
22.5	73.8	0.0354	0.0351	640	1	-0.0001
25.0	82.0	0.0384	0.0381	656	1	0.0000
27.5	90.2	0.0414	0.0410	670	1	0.0001
29.5	96.8	0.0434	0.0434	680	1	-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)
4.0	4.0	437	423	451	13.1	13.1	1432	1388	1479
15.0	11.0	641	623	660	49.2	36.1	2102	2042	2165
29.5	14.5	849	823	876	96.8	47.6	2785	2701	2874

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

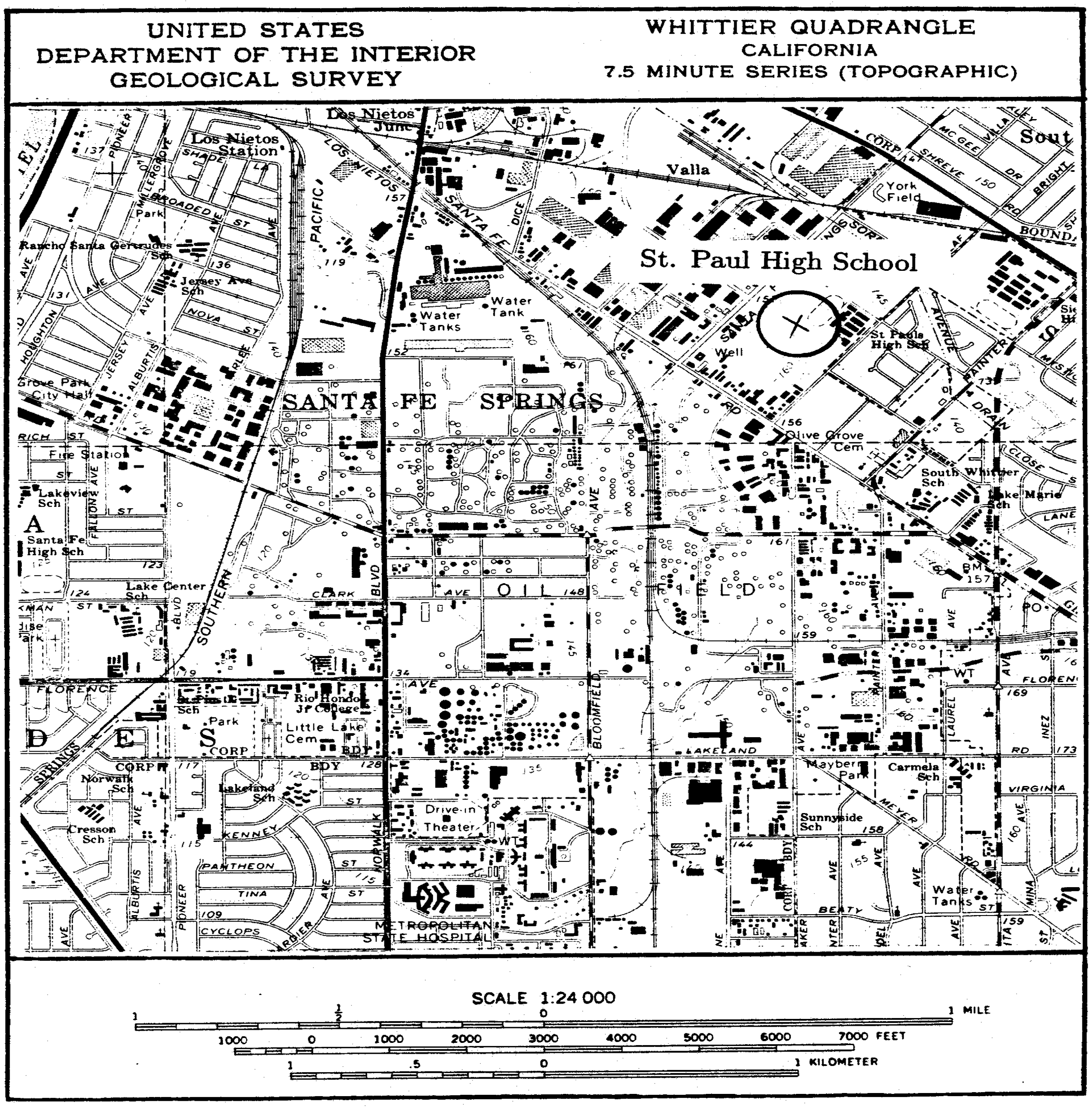

Figure A-61. Site location map for the borehole at St. Paul High School.

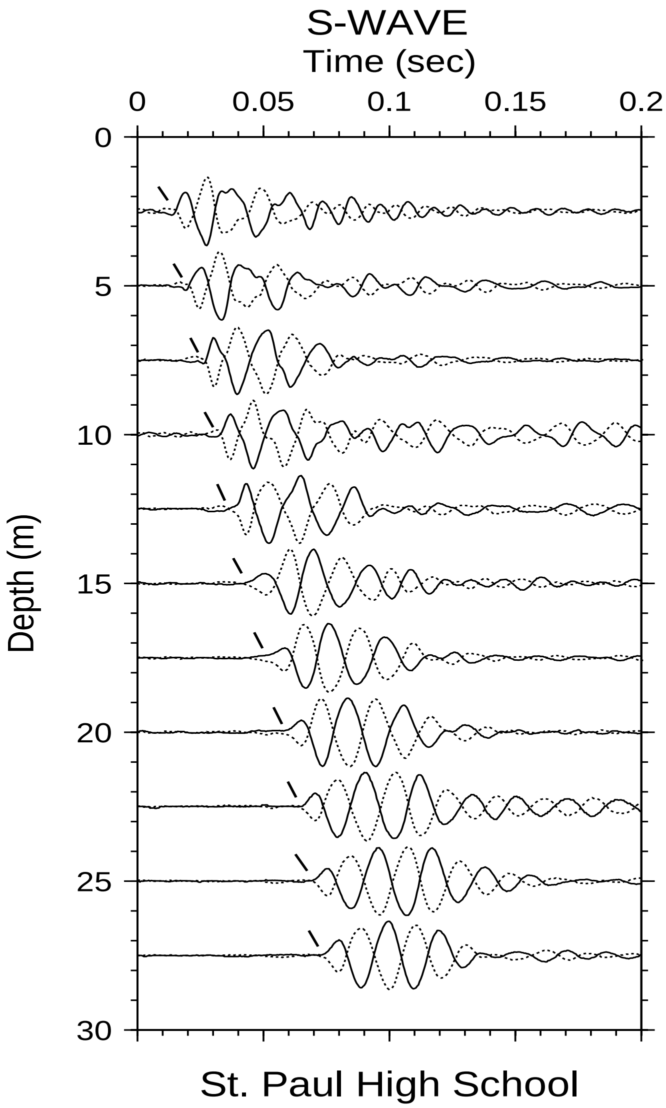

Figure A-62. Horizontal component record section (from impacts in opposite directions) superimposed for identification of S-wave onset. Approximate S-wave time picks are indicated by the hatch marks.

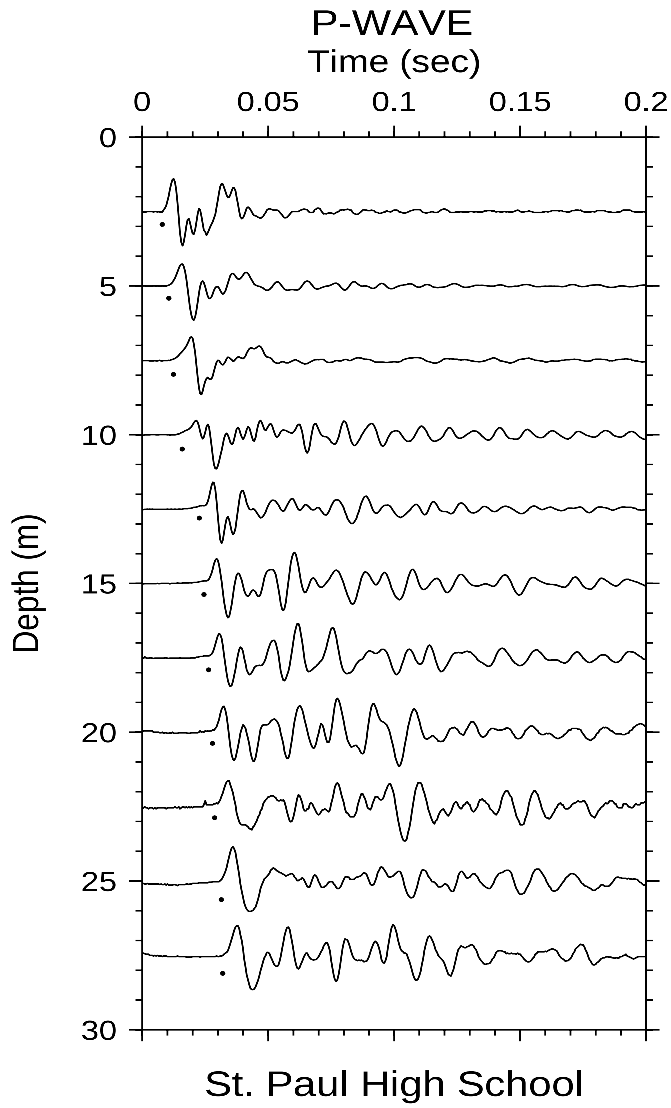

Figure A-63. Vertical component record section. Approximate P-wave arrivals are indicated by the dots.

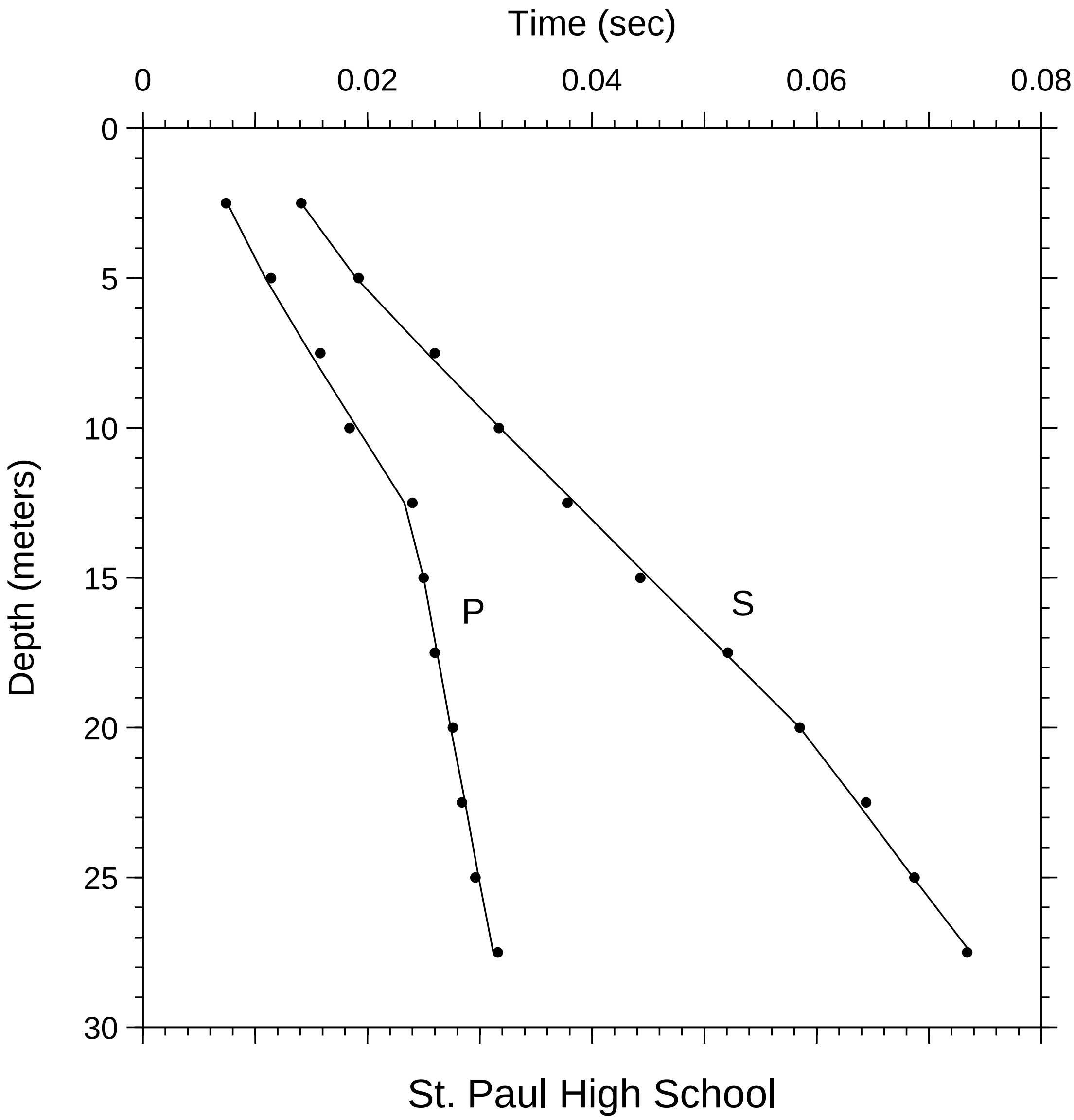

Figure A-64. Time-depth graph of P-wave and S-wave picks. Line segments are straightline interpolations of model predictions at the observation depths. The times for zero depth, not shown, are given by hoffset divided by the velocity in the uppermost layer (see accompanying tables of velocities for specific values).

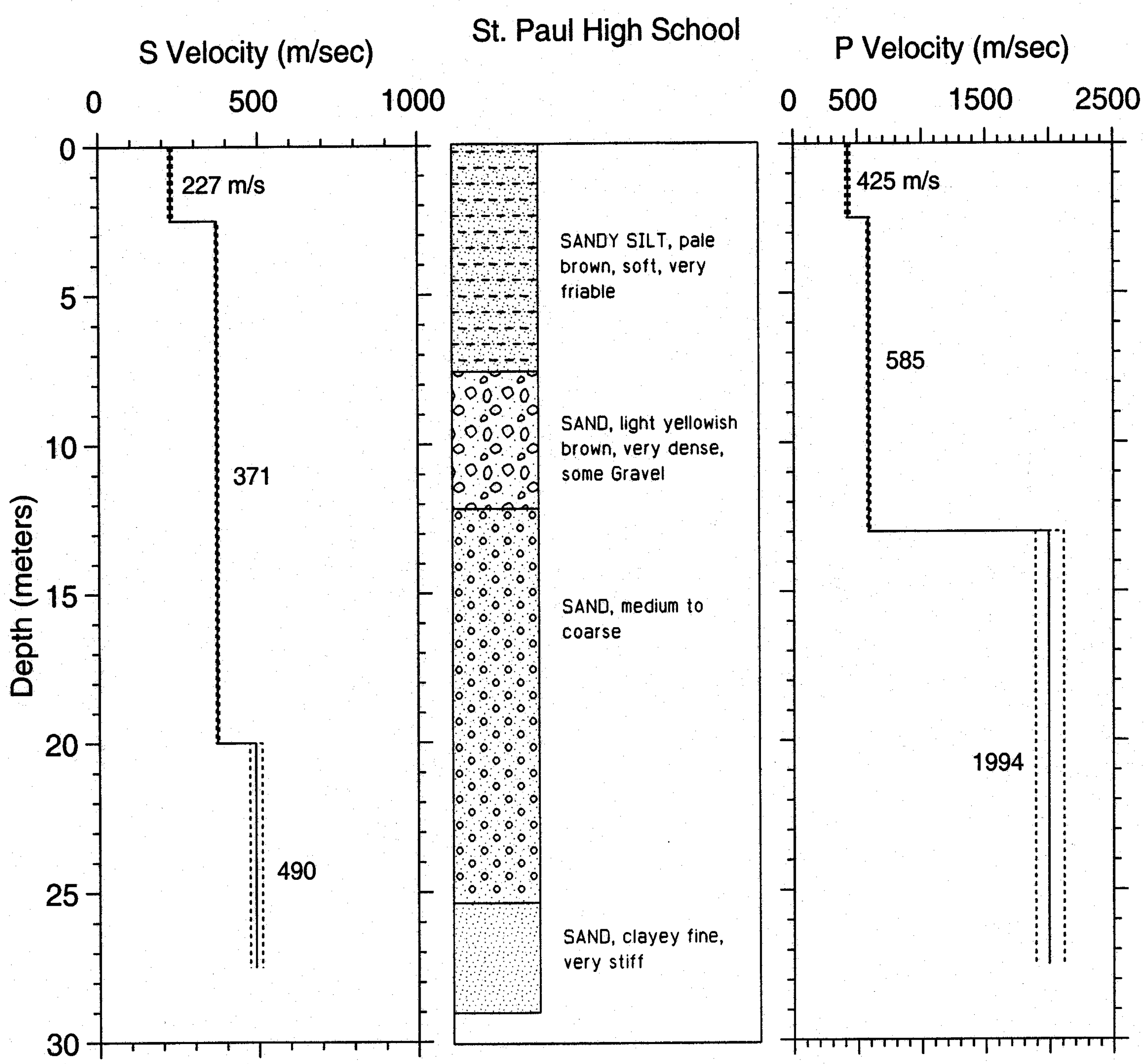

Figure A-65. S- and P-wave velocity profiles with dashed lines representing one standard deviation. Lithology is shown for correlation with velocities.

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

Location: St. Paul High School: S   Coordinates: 33.95158 -118.05369 Hole_Code: 307
hoffset = 2.00 travel-time file: F:\STP\STPS.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0141	0.0110	227	1	0.0000
5.0	16.4	0.0192	0.0178	282	1	0.0001
7.5	24.6	0.0260	0.0245	306	1	0.0007
10.0	32.8	0.0317	0.0312	320	1	-0.0001
12.5	41.0	0.0378	0.0380	329	1	-0.0007
15.0	49.2	0.0443	0.0447	336	1	-0.0008
17.5	57.4	0.0521	0.0514	340	1	0.0003
20.0	65.6	0.0585	0.0582	344	1	0.0000
22.5	73.8	0.0644	0.0633	356	1	0.0008
25.0	82.0	0.0687	0.0684	366	1	0.0001
27.5	90.2	0.0734	0.0735	374	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)
2.5	2.5	227	221	233	8.2	8.2	744	723	766
20.0	17.5	371	367	375	65.6	57.4	1216	1203	1230
27.5	7.5	490	471	510	90.2	24.6	1608	1546	1674

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

ABLE A-26. P-wave arrival times and velocity summaries.

Location: St. Paul High School: P Coordinates: 33.95158 -118.05369 Hole_Code: 307
hoffset = 2.00 travel-time file: F:\STP\STPP.TT

nlayers = 3

d(m)	d(ft)	tsl(s)	tvrt(s)	vavg(m/s)	sig	rsdl(sec)
2.5	8.2	0.0074	0.0059	425	1	-0.0001
5.0	16.4	0.0114	0.0102	492	2	0.0005
7.5	24.6	0.0158	0.0144	520	3	0.0009
10.0	32.8	0.0184	0.0187	535	3	-0.0007
12.5	41.0	0.0240	0.0230	544	2	0.0007
15.0	49.2	0.0250	0.0248	604	1	0.0000
17.5	57.4	0.0260	0.0261	671	1	-0.0002
20.0	65.6	0.0276	0.0273	731	1	0.0002
22.5	73.8	0.0284	0.0286	787	1	-0.0003
25.0	82.0	0.0296	0.0298	838	1	-0.0003
27.5	90.2	0.0316	0.0311	884	1	0.0004

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)
2.5	2.5	425	408	442	8.2	8.2	1394	1340	1452
13.0	10.5	585	574	597	42.7	34.4	1919	1882	1958
27.5	14.5	1994	1890	2111	90.2	47.6	6543	6200	6927

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 fo: the Cerritos College Gymnasium site.

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

6.00000	437.000
10.0000	348.000
29.4000	1563.00

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

2.50000	255.000
5.00000	288.000
12.5000	217.000
25.0000	249.000
29.4000	329.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
6.000E+00	2.500E+00	2.500E+00	2.500E+00	4.370E+02	2.550E+02	0.24
6.000E+00	5.000E+00	5.000E+00	2.500E+00	4.370E+02	2.880E+02	0.12
6.000E+00	1.250E+01	6.000E+00	1.000E+00	4.370E+02	2.170E+02	0.34
1.000E+01	1.250E+01	1.000E+01	4.000E+00	3.480E+02	2.170E+02	0.18
2.940E+01	1.250E+01	1.250E+01	2.500E+00	1.563E+03	2.170E+02	0.49
2.940E+01	2.500E+01	2.500E+01	1.250E+01	1.563E+03	2.490E+02	0.49
2.940E+01	2.940E+01	2.940E+01	4.400E+00	1.563E+03	3.290E+02	0.48

Table B-2. Poisson's ratio calculated from P- and S-wave velocity models for the Cerritos College Physical Sciences Building site.

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

2.50000	353.000
15.0000	517.000
29.0000	1172.00

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

2.50000	185.000
15.0000	218.000
29.0000	253.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.500E+00	2.500E+00	2.500E+00	2.500E+00	3.530E+02	1.850E+02	0.31
1.500E+01	1.500E+01	1.500E+01	1.250E+01	5.170E+02	2.180E+02	0.39
2.900E+01	2.900E+01	2.900E+01	1.400E+01	1.172E+03	2.530E+02	0.48

Table B-3. Poisson's ratio calculated from P- and S-wave velocity models for the Cerritos College Police Building site.

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

9.00000	359.000
12.5000	734.000
89.8000	1739.00

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

3.00000	229.000
9.00000	204.000
23.0000	259.000
32.0000	295.000
46.0000	348.000
78.0000	418.000
89.8000	450.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
9.000E+00	3.000E+00	3.000E+00	3.000E+00	3.590E+02	2.290E+02	0.16
9.000E+00	9.000E+00	9.000E+00	6.000E+00	3.590E+02	2.040E+02	0.26
1.250E+01	2.300E+01	1.250E+01	3.500E+00	7.340E+02	2.590E+02	0.43
8.980E+01	2.300E+01	2.300E+01	1.050E+01	1.739E+03	2.590E+02	0.49
8.980E+01	3.200E+01	3.200E+01	9.000E+00	1.739E+03	2.950E+02	0.49
8.980E+01	4.600E+01	4.600E+01	1.400E+01	1.739E+03	3.480E+02	0.48
8.980E+01	7.800E+01	7.800E+01	3.200E+01	1.739E+03	4.180E+02	0.47
8.980E+01	8.980E+01	8.980E+01	1.180E+01	1.739E+03	4.500E+02	0.46

Table B-4. Poisson's ratio calculated from the P- and S-wave velocity models for the Corps of Engineer's site.

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

6.00000	362.000
12.0000	798.000
22.0000	1409.00

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

6.00000	241.000
12.0000	212.000
22.0000	381.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
6.000E+00	6.000E+00	6.000E+00	6.000E+00	3.620E+02	2.410E+02	0.10
1.200E+01	1.200E+01	1.200E+01	6.000E+00	7.980E+02	2.120E+02	0.46
2.200E+01	2.200E+01	2.200E+01	1.000E+01	1.409E+03	3.810E+02	0.46

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

P wave - d2bot, pvel, for file: HOOP2.VEL

7.50000	680.000
25.0000	1283.00

S wave - d2bot, svel, for file: HOOS2.VEL

7.50000	470.000
25.0000	790.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
7.500E+00	7.500E+00	7.500E+00	7.500E+00	6.800E+02	4.700E+02	0.04
2.500E+01	2.500E+01	2.500E+01	1.750E+01	1.283E+03	7.900E+02	0.19

Table B-6. Poisson's ratio calculated from P- and S-wave velocity models for the Lincoln School site.

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

3.00000	368.000
22.0000	675.000
29.7000	753.000

S wave - d2bot, svel, for file: LINS2.VEL

3.00000	256.000
22.0000	413.000
29.7000	470.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
3.000E+00	3.000E+00	3.000E+00	3.000E+00	3.680E+02	2.560E+02	0.03
2.200E+01	2.200E+01	2.200E+01	1.900E+01	6.750E+02	4.130E+02	0.20
2.970E+01	2.970E+01	2.970E+01	7.700E+00	7.530E+02	4.700E+02	0.18

Table B-7. Poisson's ratio calculated from P- and S-wave velocity models for the Lincoln School Whittier site.

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

1.50000	224.000
7.50000	1382.00
18.5000	517.000

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

1.50000	139.000
18.5000	347.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
1.500E+00	1.500E+00	1.500E+00	1.500E+00	2.240E+02	1.390E+02	0.19
7.500E+00	1.850E+01	7.500E+00	6.000E+00	1.382E+03	3.470E+02	0.47
1.850E+01	1.850E+01	1.850E+01	1.100E+01	5.170E+02	3.470E+02	0.09

Table B-8. Poisson's ratio calculated from P- and S-wave velocity models for the Los Alisos Adult School site.

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

2.50000	361.000
12.5000	509.000
20.0000	1358.00
27.5000	711.000

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

2.50000	194.000
14.0000	242.000
27.5000	262.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.500E+00	2.500E+00	2.500E+00	2.500E+00	3.610E+02	1.940E+02	0.30
1.250E+01	1.400E+01	1.250E+01	1.000E+01	5.090E+02	2.420E+02	0.35
2.000E+01	1.400E+01	1.400E+01	1.500E+00	1.358E+03	2.420E+02	0.48
2.000E+01	2.750E+01	2.000E+01	6.000E+00	1.358E+03	2.620E+02	0.48
2.750E+01	2.750E+01	2.750E+01	7.500E+00	7.110E+02	2.620E+02	0.42

Table B-9. Poisson's ratio calculated from P- and S-wave velocity models for the Olive Junior High School site.

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

1.50000	309.000
11.0000	786.000
16.8000	983.000

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

1.50000	209.000
11.0000	527.000
16.8000	636.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
1.500E+00	1.500E+00	1.500E+00	1.500E+00	3.090E+02	2.090E+02	0.08
1.100E+01	1.100E+01	1.100E+01	9.500E+00	7.860E+02	5.270E+02	0.09
1.680E+01	1.680E+01	1.680E+01	5.800E+00	9.830E+02	6.360E+02	0.14

Table B-10. Poisson's ratio calculated from P- and S-wave velocity models for the San Bernardino Fire Station site.

P wave - d2bot, pvel, for file: SB1P.VEL

8.50000	430.000
16.2000	936.000
70.0000	1647.00
90.0000	2094.00

S wave - d2bot, svel, for file: SB1S.VEL

3.70000	297.000
16.2000	299.000
41.2000	365.000
59.5000	408.000
78.0000	460.000
90.0000	556.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
8.500E+00	3.700E+00	3.700E+00	3.700E+00	4.300E+02	2.970E+02	0.04
8.500E+00	1.620E+01	8.500E+00	4.800E+00	4.300E+02	2.990E+02	0.03
1.620E+01	1.620E+01	1.620E+01	7.700E+00	9.360E+02	2.990E+02	0.44
7.000E+01	4.120E+01	4.120E+01	2.500E+01	1.647E+03	3.650E+02	0.47
7.000E+01	5.950E+01	5.950E+01	1.830E+01	1.647E+03	4.080E+02	0.47
7.000E+01	7.800E+01	7.000E+01	1.050E+01	1.647E+03	4.600E+02	0.46
9.000E+01	7.800E+01	7.800E+01	8.000E+00	2.094E+03	4.600E+02	0.47
9.000E+01	9.000E+01	9.000E+01	1.200E+01	2.094E+03	5.560E+02	0.46

Table B-11. Poisson's ratio calculated from the P- and S-wave velocity model for the Santa Anita Golf Course site.

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

7.50000	411.000
17.4000	609.000
25.0000	752.000
29.6000	1136.00

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

7.50000	284.000
17.4000	343.000
25.0000	439.000
29.6000	553.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
7.500E+00	7.500E+00	7.500E+00	7.500E+00	4.110E+02	2.840E+02	0.04
1.740E+01	1.740E+01	1.740E+01	9.900E+00	6.090E+02	3.430E+02	0.27
2.500E+01	2.500E+01	2.500E+01	7.600E+00	7.520E+02	4.390E+02	0.24
2.960E+01	2.960E+01	2.960E+01	4.600E+00	1.136E+03	5.530E+02	0.34

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

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

4.00000	437.000
15.0000	641.000
29.5000	849.000

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

4.00000	233.000
15.0000	329.000
29.5000	527.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
4.000E+00	4.000E+00	4.000E+00	4.000E+00	4.370E+02	2.330E+02	0.30
1.500E+01	1.500E+01	1.500E+01	1.100E+01	6.410E+02	3.290E+02	0.32
2.950E+01	2.950E+01	2.950E+01	1.450E+01	8.490E+02	5.270E+02	0.19

Table B-13. Poisson's ratio calculated from P- and S-wave velocity models for the St. Paul High School site.

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

2.50000	425.000
13.0000	585.000
27.5000	1994.00

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

2.50000	227.000
20.0000	371.000
27.5000	490.000

d2bot_p	d2bot_s	d2bot	thick	pvel	svel	pssnrat
2.500E+00	2.500E+00	2.500E+00	2.500E+00	4.250E+02	2.270E+02	0.30
1.300E+01	2.000E+01	1.300E+01	1.050E+01	5.850E+02	3.710E+02	0.16
2.750E+01	2.000E+01	2.000E+01	7.000E+00	1.994E+03	3.710E+02	0.48
2.750E+01	2.750E+01	2.750E+01	7.500E+00	1.994E+03	4.900E+02	0.47