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Teleseismic P-wave traveltime residuals across the Cascade Range in Southern Oregon

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Introduction

To investigate the velocity structure of the crust and upper mantle beneath southwest Oregon and the Cascade Range, I have used the teleseismic compressional-wave traveltime residual method, described by Steeples and Iyer (1976), Reasenberg et al. (1980), Iyer et al. (1981), and Stauber (1982a), to name a few. The primary purpose of the study is to characterize the configuration and structure of the subducting Juan de Fuca plate beneath the Cascade Range in Oregon. Segmentation and changes in dip and curvature are thought to characterize the subducting Juan de Fuca plate in Washington and northern Oregon (Weaver and Michaelson, 1985; Michaelson and Weaver, 1985). The dip of the slab also varies laterally between the coastal thrust zone and the Cascade Range volcanic arc (Langston, 1981; Leaver et al., 1984). Since most of Oregon lacks the subcrustal seismicity observed near Puget Sound and in parts of northern California (Taber and Smith, 1985; Bolt and Miller, 1971; Chandra, 1974), and at most convergent plate boundaries, little is known about the plate configuration and structure in southern Oregon (Hill, 1978; McBirney, 1978; Hughes et al., 1980; Rite and Iyer, 1981; Kollmann, 1984).

Teleseisms have steeply plunging rays for stations more than 25° from the event's epicenter. For an array that is small compared to delta (the distance between a station and an event), the paths of the rays to different stations are subparallel and only weakly dependent on structure between the array and the source (e.g. Aki et al., 1977). Traveltime residuals across the array are attributable mainly to crustal and upper mantle velocity anomalies below the array, and thus yield information about the corresponding compressional wave velocity structure.

Twenty of the U.S. Geological Survey's "five-day recorder" seismic instruments (Criley and Eaton, 1978) were deployed in a 366-km-long northwest-southeast profile extending from the Coast Range in southern Oregon across the Cascade Range at Crater Lake to the Modoc Plateau in northern California (see Figure 1 and Table 1). Data collected simultaneously at some of these same stations using the U.S. Geological Survey's intermediate-period seismic system (Stauber, 1982b) is currently being analyzed and will not be discussed here. The stations, with an average spacing of 20 km, recorded continuously for eight weeks in September and October, 1982. In the western United States, most teleseisms arrive from southwest, northwest, or southeast azimuths. Few events from other directions can be recorded in a timespan of several months. In anticipation of this, the array was deployed in the northwest-southeast direction, to function as a reversed profile, even though this direction does not follow regional structural trends.

P arrivals from 40 teleseismic events, PKIKP arrivals from 2 events at distances of about 123°, and P arrivals for 3 regional events about 3-8° from the profile were clearly recorded by our network (Table 2).

Twenty-two of these teleseisms came from the northwest and 16 were from the southeast. Only two southwest events are included in the data set, since information from that direction is not reversed and therefore can not be interpretted.

Methods

The five-day recording instruments each have one vertical and two horizontal 1-Hz seismometers. They record data in FM analog form on 1/2" magnetic tape, along with time signals from an internal clock and from the WWVB radio signal. To facilitate identification of useful teleseismic events, a smoked paper drum recorder with a 1-Hz vertical seismometer was operated near the Crater Lake station ("spal" in Figure 1). The smoke drum record showed clear arrivals from many teleseismic events with magnitude $m_b \geq 5.0$, and from several regional events with $m_b \geq 4.0$. All clear events were played back and digitized using the U.S. Geological Survey's Data General Eclipse S/200 computer system. Hypocentral information used is from the U.S. Geological Survey's Preliminary Determinations of Epicenters bulletins for 1982.

Digitized events were picked using an interactive computer program written by John R. Evans (written communication, 1982). Traveltimes were picked at a large feature, such as a peak or a trough, in the first cycle of motion. Picks were visually correlated for all stations recording an event. Systematic errors due to variations in waveform across the array are expected to be less than 0.1 s using this method (Steeples and Iyer, 1976). Coherency between stations improved when teleseismic traces were filtered with a 0.5- to 2.0-Hz bandpass filter. The reading uncertainty in each pick was noted by assigning a pick quality as follows: "a" quality for $\pm$ 0.05 s uncertainty; "b", $\pm$ 0.125 s; "c", $\pm$ 0.25 s; and "x", $\pm$ 1.0 s. The "x" quality picks were not used in subsequent data analysis. For three teleseismic events, the PcP phase could also be timed. Typical seismograms are plotted in Figures 2a-f.

Residual Computation

Traveltime residuals at each station for each teleseism (P) and for each PKIKP event were calculated by a computer program which subtracts a theoretical traveltime computed using Herrin's standard earth model from the observed traveltime between the source and the seismometer (J.R. Evans, written commun., 1983; Herrin, 1968a&b). The absolute residual for the ith station and jth event is:

$$RA_{ij} = (TA_{ij} - TO_j) - TE_{ij}$$

where TA_{ij} is the observed arrival time, TO_j is the event origin time, and TE_{ij} is the expected traveltime predicted by the Herrin model (Steeples and Iyer, 1976). An early arrival will produce a negative residual, while a late arrival will produce a positive residual.

To correct for source and total-path effects, which do not relate to the crustal and upper mantle structure beneath the profile, a relative residual is calculated for each observed arrival. To avoid introducing dependence on a reference station, the relative residuals were calculated for each event by subtracting the mean of the absolute residuals for all stations from the absolute residual at each station:

$$RR_{ij} = RA_{ij} - \frac{1}{n}\sum_{k} RA_{kj}$$

where RR_{ij} is the relative residual at the ith station and the jth event, n is the number of stations reporting for the particular event, and the summation is over all reporting stations.

Alternatively, relative residuals may be calculated using a pick-quality weighting factor for each station, as follows: for an uncertainty of $\pm$ 0.05 s, the weighting factor W_i is 1.0; for $\pm$ 0.125 s, W_i = 0.5; for $\pm$ 0.25 s, W_i = 0.2 s; and for $\pm$ 1.0 s, W_i = 0.0 s. The weighted relative residuals were calculated by:

$$RW_{ij} = RA_{ij} - \frac{1}{\sum_{k} W_k} \times \sum_{k} RA_{kj}\, W_k$$

where RW_{ij} is the weighted relative residual for the ith station. All relative residuals presented here are this latter, more stable, type.

Residuals for PcP phase events were calculated with respect to a reference station. At each station i, the absolute residual RA_i for that station is:

$$RA_i = (OT_i - OT_{ref}) - S(\Delta_i - \Delta_{ref})$$

where OT_i is the observed traveltime for station i, OT_{ref} is the observed traveltime at the reference station, S is the slowness $dT/d\Delta$, Δ_i is the distance between the event and the station, and Δ_{ref} is the distance between the event and the reference station, for the event in question. By assuming a constant slowness across the array, an error on the order of .2-.3 s is introduced for PcP phase event residuals.

To calculate relative residuals for regional events, a plane wave from the northwest or the southeast was fit to the observed traveltimes, using least squares. At each station, the difference between observed and predicted times is the relative residual. The relative residuals for the Kodiak Island event at delta=22° were also calculated in this manner. The residuals for regional events are more indicative of local crustal anomalies than of deeper structure, and will not be discussed in detail. Table 3 presents the traveltimes and residuals for all events, teleseismic and regional.

To look for effects of station elevations on residuals we plotted relative residuals (s) versus station elevations (km) for all teleseisms from the different azimuth groups (Figures 3a-c). Since there is no

apparent linear relationship between the residuals and the station elevations in these plots, no elevation correction is used for any of the teleseismic residuals.

Residual Plots

This data report does not include a complete analysis of the velocity structure giving rise to the relative residuals reported here. It may, however, help the reader to visualize a causative structure. C.A.Michaelson (oral communication, 1985) is analyzing this structure; the major features she reports are schematically illustrated in Figure 4. The relation between this structure and the relative residuals is considered below, in the "Discussion" section.

Figures 5a-p show the relative residuals (Table 3) for all stations and all events. The vertical axis shows residuals (s), while the horizontal axis is distance in kilometers along the profile, from the northwest on the left to the southeast on the right. Station names are indicated along the bottom of the plots. All plots are scaled the same. The events are plotted in groups by azimuth, delta, and phase. It is evident from these plots that the residual pattern shifts with azimuth, and that the relative residuals depend strongly on delta and the phase. Since the distance to an event and its phase control the raypaths and angles of incidence of the rays at the stations, differences in the residual patterns for events from discrete distances can be used to reconstruct variations in the velocity structure beneath the array.

In the plots for events from discrete delta-azimuth blocks, scatter on the order of .2-.3 s results from uncertainties in timing and errors due to variations in waveforms across the array. The overall pattern of the residual anomaly and its approximate magnitude are apparent, despite this scatter. A detailed analysis of the velocity structure, using three-dimensional inversion techniques, will be presented in a later paper. But a qualitative picture of the velocities can be constructed by examining the general pattern apparent in the residual plots.

Figures 5a-c show how the residual pattern changes with azimuth, regardless of delta. The most obvious feature of Figure 5a (all southeast events) is that stations in or bordering the Western Cascades (sp41, sp51, sp61, sp71, and sp81) are 0.5 to 1.0 s earlier than the stations near the ends of the profile. In the plot of the residuals for all northwest events (Figure 5b), a similar pattern is evident, but is shifted slightly to the southeast. For the northwest events, residuals at stations in or bordering the High Cascades (sp71, sp81, sp91, spa1, and spb1) are about 0.75 s earlier than residuals for the other stations. Figure 5c shows the residuals for two southwest events. Because we did not record any events from the northeast, the southwest direction is unreversed and the residuals from these events will not be discussed further.

Grouping the events by delta as well as by azimuth reduces scatter

in the plots and highlights the shifting anomalous residual patterns. Figures 5d-i plot residuals for the southeast events in groups by delta, and Figures 5j-p plot the northwest event residuals. We will first examine the residuals for the southeast events.

Figure 5d shows the residual pattern for a regional event at delta = 4-7° . Stations sp41-sp81 in the Western Cascades are all early, relative to stations farther to the southeast, by a maximum of 0.6-0.7 s at station sp51. (The method used to calculate the residuals for this regional event did not take local crustal structural variations into account, so this plot can only be used to give a very general idea of the residual pattern for events with nearly horizontal angles of incidence). The plot of southeast events 30-42° from the profile, Figure 5e, similarly shows early arrivals for Western Cascades stations sp41 through sp81. The early-arrival pattern is a symmetric trough with a maximum amplitude of 0.8-1.1 s, at station sp51, relative to stations at the ends of the array. The plot for southeast events 42-60° away, Figure 5f, has to few readings to be interpretted. The plot for the southeast events 60-80° away (Figure 5g) shows a steep trough for early stations in and on the east edge of the Western Cascades, between sp41 and sp91. The trough has an amplitude of about 0.8 to 1.1 s, but centers on station sp71. For more distant events, 80-100° from the profile (Figure 5h), the trough has a noticeably asymetrical shape, a smaller amplitude, and is again centered on station sp51. This station is about 0.5 s earlier than stations sp41 and spal. For these distant events, station sp41 is no longer early and stations sp91, spal, spbl, spcl, and spdl appear to be slightly early. The trough is steep to the northwest and spreads out to the southeast, gradually dying out somewhere southeast of the High Cascades.

PcP arrivals for two Guatemalan events are plotted in Figure 5i. The plot is similar to the plot for southeast events 80-100° from the profile. The earliest station, sp71, is about 0.9 to 1.0 s earlier than surrounding stations outside of the Cascade Range. At the edge of the Western Cascades, the residuals jump abruptly from about -0.1 s at station sp41 down to about -0.8 s at station sp51. The Western Cascades stations sp51, sp61, sp71, and sp81 are all early. The early arrivals gradually die out in the High Cascades and bordering stations, sp91 through spdl.

Now looking at the plots of residuals for the northwest events (Figures 5j-p), we see a pattern similar to the trough seen in the southeast event plots, but shifted southeast by 30 km. The residual pattern for events from the northwest is less sensitive to delta, and is about the same for all northwest events from 22° to 100° away. A few readings from a Kodiak Island event (Figure 5j), 22-25° from the profile, show residuals at stations sp71 and sp91 to be about 0.5-0.6 s earlier than the residual for station sp61. Plots for delta = 25-100° (Figures 5k-n) show a steep asymmetric trough of about 0.6 to 0.8 s amplitude, centered on stations sp71 and sp81.

The PKIKP and PcP-phase residual plots (Figures 5o-p) differ slightly from the other northwest event plots in that stations sp51 and sp61 are early for these events. These plots show a 0.8 to 1.1 s low centered on stations sp71-sp81 and extending from stations sp51 to spb1.

Table 4 summarizes the dependence of the residual on azimuth and delta, as discussed above.

Discussion

Linear inversion and forward modelling using raytracing are required to quantitatively model the velocity structure indicated by the residual patterns discussed above (Figure 4). This modelling is in progress and will be presented in a later paper. The pattern of residuals, however, can be used to qualitatively describe the P-velocity structure of the crust and the upper mantle beneath the profile.

If the negative residuals observed beneath the Cascade Range stations result from rays which pass through the high velocity material of a subducted Juan de Fuca plate, the strong dependence of the observed residuals on delta and azimuth can yield information about the depth, location, and dip of the proposed slab.

The crustal thickening under the Cascade Range (Leaver et al., 1984) would produce positive residuals for the Cascade Range stations, yet the opposite effect is observed. Thus the early arrivals are not produced by any known crustal structure, which may in fact mask part of the observed high velocities.

The proposed subducted plate can be located by noting which stations see negative residuals, and at which delta and azimuth. All plots for all events show a trough-shaped pattern of early arrivals, varying in magnitude and symmetry but generally centered in the Cascades. Events from the southeast azimuth show early arrivals for stations sp41 through sp81 for events at delta = 30-80° , and early arrivals at stations sp51 through sp81 for steeper rays from PcP events and events at delta = 80-100° . The center of the trough is between stations sp71 and sp51 for all southeast events. For northwest events between 25° and 80° distance, stations sp71 through spb1 show early arrivals. In addition, the steeper rays (PcP, PKIKP phases, or delta = 80-100° for P) from northwest events arriving at stations sp51 and sp61 also seem to be slightly early. The early arrivals from northwest events are earliest between stations sp71 and sp81 in the Western Cascades. Keeping in mind that rays from the southeast push the residual pattern to the northwest while rays from the northwest shift the trough to the southeast, and that steep rays (from PKIKP, PcP, or delta = 80-100° events) from either azimuth do not shift the trough very much, we can infer the slab's approximate location. Residual patterns from steep rays, from both northwest and southeast azimuths, show that the anomaly is probably strongest beneath stations sp61 and sp71, and that the slab may plunge steeply beneath station sp51, the abrupt northwest edge of the residual trough in figures 5h-i and 5n-p. The southeast edge of the residual

trough pattern changes less abruptly, which implies the high-velocity anomaly dips to the southeast, as expected if it is associated with the subducting Juan de Fuca plate. Stations as far southeast as spel may be early, but the most significant part of the anomaly seems to extend from beneath station sp51 in the Western Cascades to beneath station spbl in the High Cascades. The plate anomaly ends or substantially weakens below the High Cascades near station spbl.

The change in the residual pattern with delta, i.e. with ray angle, can be used to estimate the slab's dip. Since rays from southeast events travel up the proposed slab, we will look at the residuals from southeast events to see which rays travelled the greatest distance within the slab. The earliest arrivals for southeast events between 30° and 42° away are .75-1.05 s early (see Table 4). For southeast events at delta = $60\text{-}80^{\circ}$, the arrivals are about 0.85-1.1 s early. Arrivals from a regional event are only about 0.6-0.7 s early, and arrivals from the more distant events at delta = $80\text{-}100^{\circ}$ are only 0.5-0.65 s early. This decrease in the magnitude of residuals for closer and further events implies that rays from events $30\text{-}80^{\circ}$ away travelled further within the slab than rays from regional or very distant events. Thus the slab parallels rays from southeast events $30\text{-}80^{\circ}$ away, and dips at about $44\text{-}60^{\circ}$ (Table 4). This dip estimate is the apparent dip in the northwest-southeast direction, rather than true dip, which may be more easterly.

Some of the steeper rays from PcP events have large residuals, but because the PcP anomaly is quite broad, the proposed slab probably does not dip as steeply as these PcP residuals might imply. Again, the inversion is being used to resolve these complications in the structure.

If the top of the slab is placed at the Moho, 44-km deep according to Leaver et al. (1984), and if the slab dips at an angle between 40° and 60° from beneath station sp51 to beneath station spbl, the inferred slab length is 130 $\pm$ 30 km, with a maximum depth of about 130 $\pm$ 30 km. If the slab is allowed to extend further to the southeast so that it ends below station spel, the slab length would be about 180 km and the maximum depth would be 160 km. Then a reasonable estimate for the slab length is 130 $\pm$ 50 km, and for the maximum depth, 130 $\pm$ 30 km. This is consistent with estimates of the slab depth beneath the Cascade Range in Washington (Langston, 1981; Tabor and Smith, 1985; Weaver and Michaelson, 1985) and with estimates of slab depths beneath volcanoes in other regions (Jachens and Griscom, 1983, figure 11).

These estimates of the slab length can be used to estimate the velocity contrast between the slab and the slower surrounding mantle. From Steeples and Iyer (1976), the distance a ray travels through an anomalous body to produce a given residual is the path length L_p :

$$L_p = \frac{\Delta t V_1 V_2}{(V_1 - V_2)}$$

where Δt is the observed residual in seconds, V_1 is the normal velocity of the surrounding rock, and V_2 is the anomalous velocity.

For a normal upper mantle velocity of about 8.25 km/s (Herrin, 1968b), and a residual of $\Delta t = 1$ s, a velocity contrast of 5% requires a path length of 173 km. A velocity contrast of 10% requires a path length of 91 km through the anomaly. For the 130-km-long slab, the velocity contrast would be about 7%. These estimates assume a constant contrast throughout a uniform slab. A better picture of the velocity structure is being developed by raytracing and by three-dimensional inversions.

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TABLE CAPTIONS

Table 1. Station locations for the Oregon South Cascade Range 1982 teleseismic experiment. Also see Figure 1. USGS trace names used in Figures 2a-f and Table 3 are shown along with the corresponding station names.

2. Event origin times and locations for the 1982 Oregon South Cascades teleseismic experiment. Latitude, in degrees and minutes, is positive North, longitude in degrees and minutes is positive West. The Julian day of each event is given along with the calendar day. Origin times in hours, minutes, and seconds refer to Coordinated Universal Time (UTC). Locations are from the U.S. Geological Survey National Earthquake Information Service (NEIS) Preliminary Determinations of Epicenters bulletins for September and October, 1982.

   "*" indicates less reliable hypocenter solution, "?" indicates a poor hypocenter solution, "&" = hypocenter determined by UC Berkeley, "%" = hypocenter determined by dense local network and local crustal model, according to NEIS.

3. The first line for each event shows a six- (or fewer) character abbreviation for the event location, a two-character description of where the seismograms were picked, and the event origin time and location (positive North and West) as shown in Table 2. The two-character descriptions of pick locations are as follows: fb indicates a first-break was picked on an unfiltered trace; pl = first peak, unfiltered; tl = first trough, unfiltered; pa indicates that a first peak was picked after using a 0.5-2.0 Hz bandpass filter; ta = first trough, 0.5-2.0 Hz bandpass filter; and ca = first peak or trough, 0.75-1.25 Hz bandpass filter.

   The next group of lines for each event tells which stations recorded the event (USGS trace names), the distance, delta, between the event and the station, the azimuth from the station to the event, the arrival time picked (in hours, minutes, and seconds, UTC), the observed traveltime (s), the theoretical traveltime (s) (from Herrin, 1968a&b), and the difference between observed and theoretical traveltime, which is the absolute residual. The next two columns show the ray parameter $dT/d\Delta$ and the pick quality, which is related to the uncertainty in the pick time (see text). The phase picked is P unless otherwise indicated.

The last columns for each event show the relative residuals. The "MEAN" column is simply the absolute residual at that station minus the mean of the absolute residuals for all the stations for that event. The "WT. MEAN" column subtracts a weighted average absolute residual from the absolute residual at each station (see text). In the "MEDIAN" column, the median absolute residual of all the station residuals for the event has been subtracted from the absolute residual at each station. These three types of relative residual usually differ by a few hundredths of a second for good quality picks (a,b,c). The plots in Figures 5a-p use the weighted relative residuals because these take into account the quality of the data, and are more stable than the other types of relative residual.

Residuals for each PcP phase event were calculated with respect to a reference station, as indicated (see text). The slowness (s/ ^{o}) used to calculate the residuals is indicated (Herrin, 1968a&b). The relative and weighted relative residuals are calculated as for other events (see text).

For regional events and the Kodiak Island teleseism, the relative residuals were calculated by a least-squares fit to a plane-wave solution for the data. The residual to this fit is the relative residual. The slope (slowness) of the linear fit is shown. Weighted relative residuals were calculated as for other events. See plots in Figures 5a-p.

4. This table summarizes the observations that can be made by comparing the plots in Figures 5a-p. See text for discussion. All residuals are from P phase events, unless otherwise noted. The angles shown were calculated by using the Herrin tables (Herrin, 1968a&b) and Bullen's (1963) formulae:

$$p = \frac{r \sin i}{V} \quad \text{and} \quad p = \frac{dT}{d\Delta} \quad .$$

$\theta = 90 - i$ is given, rather than i, so that comparisons can be made to dip of structure (see text).

TABLE 1

OREGON SOUTH CASCADE RANGE
1982 TELESEISMIC STATION LOCATIONS

station name	USGS trace name	North Latitude deg	min	West Longitude deg	min	elevation m
spl1	spl1	44	02.49	123	38.34	443
sp21	sp21	43	54.75	123	24.44	555
sp31	sp31	43	47.37	123	18.10	341
sp41	sp41	43	37.44	123	02.05	808
sp51	sp66	43	31.00	122	48.81	1222
sp61	sp61	43	25.93	122	43.52	1506
sp71	sp71	43	17.47	122	30.85	914
sp81	sp64	43	10.34	122	26.73	1759
sp91	sp91	43	04.82	122	15.60	1548
spa1	spa1	42	53.86	122	08.05	1975
spb1	spf2	42	53.11	121	58.74	1902
spc1	spf4	42	45.58	121	47.47	1743
spd1	spf6	42	34.24	121	36.53	1487
spe1	spe1	42	28.33	121	24.70	1376
spf1	spf1	42	19.66	121	16.16	2176
spg1	spg1	42	13.52	121	08.71	1512
sph1	sph1	42	03.36	120	57.74	1597
spi1	spi1	41	58.96	120	48.52	1611
spj1	spj1	41	50.00	120	34.45	1577
spk1	spk1	41	42.81	120	27.92	1448

TABLE 2

LOCATIONS OF EVENTS RECORDED DURING THE 1982
OREGON SOUTH CASCADES TELESEISMIC EXPERIMENT

DATE MO/DA	JUL DAY	ORIG TIME HH MM SS.S	LAT +N DEG	LONG +W DEG	DEP KM	MAG	REGION
09/03	246	03:40:11.8	+43.815	-148.420	33	5.8	Kuril Islands
09/03	246	08:28:35.8	+43.766	-148.427	33	5.7	Kuril Islands
09/03	246	20:14:30.3	-23.859	+66.605	183	5.5	Jujuy Argentina
09/04	247	07:56:06.2	+15.559	-147.581	46	5.5	Mariana Islands
09/05	248	02:36:34.9	+14.130	+91.765	62	5.4	Guatemala (PcP and P phases picked)
09/05	248	11:42:54.2	+15.639	-147.596	38	5.3	Mariana Islands
09/05	248	12:07:25.2	+15.633	-147.561	33	5.3	Mariana Islands
09/06	249	01:47:02.7	+29.325	-140.360	176	6.5	Honshu
09/06	249	07:48:54.9	+56.844	+151.588	33	5.7	Kodiak Island
09/06	249	11:13:26.2	-32.138	+71.456	73	5.3	Central Chile
09/08	251	02:37:32.4	+27.060	-140.193	440	5.3	Bonin Islands
09/09	252	15:42:22.1	+15.530	-147.558	33	5.4	Mariana Islands
09/10	253	10:20:37.6	+55.178	-161.698	33	5.0	Kamchatka
09/11	254	14:12:14.5	-24.173	+66.996	150	5.1	Salta Argentina
09/11	254	14:27:29.6	-24.185	+66.985	152	5.0	Salta Argentina
09/12	255	09:22:23.1	+52.640	+166.941	33	5.7	Fox Islands
09/12	255	11:59:52.0	+52.642	+166.848	33	5.2	Fox Islands
09/12	255	16:50:37.7	+52.819	+167.053	33	5.5	Fox Islands
09/13	256	09:19:28.2*	+49.090	+128.648	10	4.5	Vancouver Island (regional)
09/15	258	20:22:55.2	-14.493	+70.785	128	6.0	Peru
09/17	260	05:56:27.2	+1.763	+90.676	10	5.3	Galapagos Islands
09/17	260	06:32:09.2	+1.675	+90.856	10	5.1	Galapagos Islands
09/18	261	07:31:33.5?	+43.57	+127.18	10	4.0	Oregon Coast (regional)
09/20	263	08:23:18.2	-26.631	+70.553	46	5.1	N Chile
09/20	263	13:48:32.4	-26.886	+175.873	33	5.2	South of Tonga Islands
09/24	267	07:40:24.3&	+37.852	+118.123	5	5.0	Cal-Nev Border (regional)
09/25	268	08:48:43.6	+15.744	-147.608	55	5.3	Mariana Islands
09/26	269	01:09:28.5	+50.053	-158.798	44	5.5	Kuril Islands
09/26	269	04:46:37.8	+47.015	-152.289	112	5.6	Kuril Islands
09/29	272	05:50:32.2	+14.487	+89.121	12	5.5	Guatemala
10/01	274	16:53:50.8	+37.718	-139.621	145	5.1	Honshu Japan
10/04	277	07:46:52.8%	+51.435	+176.620	38	5.5	Andreanof Is. (PcP and P phases picked)
10/07	280	11:02:17.3	+32.345	-137.513	386	5.1	Honshu Japan

TABLE 2, CONTINUED

10/14	287	21:40:18.2	+27.300	-139.934	487	5.1	Bonin Islands Region
10/17	290	08:35:25.3	-15.674	+73.042	114	5.2	Southern Peru
10/17	290	18:12:09.0	+49.632	-155.892	47	5.5	Kuril Islands
10/18	291	12:56:58.4	+13.847	+90.847	78	5.3	Guatemala (PcP and P phases picked)
10/20	293	20:01:57.2	+23.825	-121.836	33	5.4	Taiwan
10/26	299	03:24:30.9	-29.683	+71.367	71	5.5	Central Chile
10/26	299	12:44:21.9	-7.403	-108.744	153	5.6	Java (PKIKP phase picked)
10/28	301	12:29:01.5*	+14.155	+91.601	44	5.0	Guatemala
10/28	301	12:45:19.7*	+13.983	+91.825	50	5.0	Guatemala
10/29	302	00:42:16.2	-4.506	-152.453	105	5.4	New Britain Region
10/31	304	02:48:13.6	+2.967	-96.100	62	5.5	Northern Sumatera (PKIKP phase picked)
10/31	304	06:03:04.5	+14.086	+90.274	98	5.3	Guatemala

Kuril ta(9/ 3/82) 3. 40. 11.8   43. 48.90 -148. 25.20   33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	60.219	303.538	3. 50. 19.642	607.842	604.169	3.672	6.840	x	0.247	0.201	0.258
sp41	60.815	304.014	3. 50. 23.859	612.059	608.234	3.825	6.806	a	0.399	0.353	0.410
sp71	61.315	304.404	3. 50. 26.337	614.537	611.626	2.911	6.766	x	-0.515	-0.561	-0.504
spf2	61.868	304.829	3. 50. 30.475	618.675	615.359	3.316	6.740	a	-0.110	-0.156	-0.099
spf4	62.053	304.969	3. 50. 31.910	620.110	616.606	3.504	6.720	c	0.078	0.033	0.090
spf6	62.272	305.133	3. 50. 33.247	621.447	618.075	3.372	6.720	c	-0.053	-0.099	-0.042
spe1	62.448	305.264	3. 50. 34.205	622.405	619.256	3.149	6.720	c	-0.277	-0.323	-0.266
spf1	62.617	305.389	3. 50. 35.646	623.846	620.389	3.457	6.666	a	0.031	-0.015	0.042
spg1	62.752	305.488	3. 50. 36.605	624.805	621.285	3.520	6.666	b	0.094	0.049	0.106
sph1	62.961	305.640	3. 50. 37.991	626.191	622.678	3.513	6.666	a	0.087	0.041	0.098
spi1	63.097	305.739	3. 50. 39.853	628.053	623.581	4.472	6.640	x	1.047	1.001	1.058
spj1	63.326	305.904	3. 50. 40.236	628.436	625.103	3.333	6.640	b	-0.093	-0.139	-0.082
spk1	63.462	306.001	3. 50. 41.077	629.277	626.007	3.270	6.640	b	-0.156	-0.202	-0.145

Kuril ta(9/ 3/82) 8. 28. 35.8 43. 46.00 -148. 25.60 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp41	60.838	303.965	8. 38. 48.649	612.849	608.390	4.459	6.806	a	0.479	0.452	0.450
sp71	61.338	304.356	8. 38. 51.058	615.258	611.780	3.478	6.766	b	-0.502	-0.529	-0.531
spf2	61.891	304.780	8. 38. 55.215	619.415	615.512	3.903	6.740	a	-0.077	-0.104	-0.106
spf4	62.076	304.920	8. 38. 56.632	620.832	616.758	4.074	6.720	a	0.094	0.067	0.065
spf6	62.295	305.084	8. 38. 58.018	622.218	618.226	3.992	6.720	a	0.011	-0.015	-0.018
spe1	62.471	305.215	8. 38. 59.098	623.298	619.408	3.890	6.720	b	-0.090	-0.117	-0.120
spf1	62.640	305.340	8. 39. 0.442	624.642	620.539	4.103	6.666	a	0.123	0.096	0.093
spg1	62.774	305.439	8. 39. 1.262	625.462	621.435	4.027	6.666	a	0.047	0.020	0.018
sph1	62.983	305.591	8. 39. 2.750	626.950	622.828	4.122	6.666	a	0.142	0.115	0.113
spi1	63.119	305.690	8. 39. 3.575	627.775	623.730	4.045	6.640	a	0.065	0.038	0.036
spj1	63.348	305.856	8. 39. 4.904	629.104	625.252	3.852	6.640	a	-0.128	-0.155	-0.157
spk1	63.484	305.953	8. 39. 5.773	629.973	626.156	3.817	6.640	a	-0.163	-0.190	-0.192

JujuyApa(9/ 3/82) 20. 14. 30.3 -23. 51.50 66. 36.30 183.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	85.374	129.587	20. 26. 49.166	738.866	736.215	2.651	4.920	a	-0.060	-0.060	-0.081
sp41	84.770	130.001	20. 26. 46.069	735.769	733.240	2.529	4.947	a	-0.182	-0.182	-0.203
spa1	83.799	130.603	20. 26. 41.169	730.869	728.401	2.468	5.027	a	-0.243	-0.243	-0.263
spf2	83.704	130.715	20. 26. 40.635	730.335	727.925	2.410	5.027	a	-0.301	-0.301	-0.322
spf4	83.518	130.842	20. 26. 39.852	729.552	726.987	2.565	5.027	a	-0.146	-0.146	-0.167
spf6	83.293	130.959	20. 26. 38.875	728.575	725.843	2.732	5.080	a	0.021	0.021	0.
spa1	83.118	131.094	20. 26. 37.776	727.476	724.956	2.520	5.080	a	-0.192	-0.192	-0.212
spf1	82.944	131.185	20. 26. 37.161	726.861	724.069	8.792	5.114	a	0.081	0.081	0.061
spg1	82.807	131.266	20. 26. 36.508	726.208	723.370	8.839	5.114	a	0.127	0.127	0.107
sph1	82.593	131.384	20. 26. 35.459	725.159	722.276	8.883	5.114	a	0.172	0.172	0.151
spi1	82.459	131.489	20. 26. 34.828	724.528	721.587	8.941	5.167	a	0.230	0.230	0.210
spj1	82.229	131.645	20. 26. 33.641	723.341	720.398	8.943	5.167	a	0.231	0.231	0.211
spk1	82.088	131.713	20. 26. 32.946	722.646	719.673	8.973	5.167	a	0.262	0.262	0.241

Marianpa(9/ 4/82) 7. 56. 6.2   15. 33.50 -147. 34.90   46.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp41	79.002	280.949	8. 8. 8.710	722.510	718.645	3.865	5.448	a	0.276	0.253	0.217
sp71	79.438	281.353	8. 8. 10.282	724.082	721.020	3.062	5.448	b	-0.527	-0.549	-0.585
sp91	79.662	281.558	8. 8. 11.919	725.719	722.236	3.483	5.420	a	-0.106	-0.129	-0.165
spa1	79.790	281.673	8. 8. 12.530	726.330	722.925	3.405	5.420	a	-0.184	-0.207	-0.243
spf2	79.904	281.776	8. 8. 13.216	727.016	723.544	3.472	5.420	a	-0.117	-0.140	-0.176
spe1	80.399	282.214	8. 8. 15.978	729.778	726.203	3.575	5.360	a	-0.014	-0.037	-0.073
spf1	80.532	282.330	8. 8. 16.908	730.708	726.919	3.789	5.340	a	0.200	0.177	0.141
spg1	80.644	282.426	8. 8. 17.418	731.218	727.517	3.701	5.340	a	0.112	0.089	0.053
sph1	80.814	282.570	8. 8. 18.327	732.127	728.422	3.705	5.340	a	0.117	0.094	0.058
spi1	80.942	282.680	8. 8. 19.018	732.818	729.104	3.714	5.340	a	0.125	0.102	0.067
spj1	81.145	282.853	8. 8. 20.008	733.808	730.186	3.622	5.300	a	0.033	0.011	-0.025
spk1	81.251	282.941	8. 8. 20.621	734.421	730.748	3.673	5.300	a	0.084	0.061	0.025

Guatemla(9/ 5/82) 2. 36. 34.9 14. 7.80 91. 45.90 62.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	UT. MEAN	MEDIAN
sp11	40.343	127.689	2. 44. 9.811	454.911	450.936	3.975	8.261	a	0.030	0.021	0.
sp41	39.741	128.034	2. 44. 4.211	449.311	445.955	3.356	8.300	a	-0.589	-0.598	-0.619
sp91	38.961	128.470	2. 43. 58.514	443.614	439.469	4.145	8.370	a	0.200	0.191	0.170
spa1	38.775	128.449	2. 43. 56.660	441.760	437.913	3.847	8.370	a	-0.099	-0.107	-0.128
spf2	38.678	128.631	2. 43. 55.729	440.829	437.101	3.728	8.370	b	-0.218	-0.226	-0.247
spf4	38.492	128.743	2. 43. 54.070	439.170	435.542	3.628	8.390	a	-0.317	-0.326	-0.347
spf6	38.269	128.787	2. 43. 52.342	437.442	433.669	3.773	8.390	a	-0.173	-0.182	-0.203
spf1	37.921	128.975	2. 43. 49.632	434.732	430.745	3.987	8.440	a	0.041	0.032	0.011
spg1	37.785	129.031	2. 43. 48.428	433.528	429.598	3.930	8.440	a	-0.015	-0.024	-0.045
sph1	37.573	129.094	2. 43. 46.869	431.969	427.807	4.162	8.440	a	0.217	0.208	0.187
spi1	37.438	129.216	2. 43. 45.848	430.948	426.665	4.283	8.460	a	0.337	0.328	0.307
spj1	37.208	129.366	2. 43. 43.901	429.001	424.720	4.281	8.460	a	0.335	0.327	0.306
spk1	37.069	129.385	2. 43. 42.643	427.743	423.545	4.198	8.460	a	0.252	0.244	0.223

Mariana(9/ 5/82) 11. 42. 54.2 15. 38.30 -147. 35.80 38.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	78.430	280.516	11. 54. 55.270	721.070	716.462	4.608	5.540	b	0.188	0.168	0.191
sp66	79.116	281.165	11. 54. 58.873	724.673	720.224	4.449	5.460	b	0.029	0.003	0.032
sp61	79.196	281.239	11. 54. 59.226	725.026	720.657	4.369	5.460	c	-0.051	-0.077	-0.048
sp91	79.599	281.608	11. 55. 1.282	727.082	722.853	4.229	5.420	c	-0.191	-0.217	-0.188
spf6	80.172	282.121	11. 55. 4.569	730.369	725.952	4.417	5.362	c	-0.003	-0.029	0.
spe1	80.335	282.265	11. 55. 5.360	731.160	726.827	4.333	5.362	b	-0.087	-0.113	-0.084
spf1	80.469	282.381	11. 55. 6.235	732.035	727.545	4.490	5.362	a	0.070	0.044	0.073
spg1	80.581	282.477	11. 55. 6.771	732.571	728.144	4.427	5.342	a	0.007	-0.019	0.010
sph1	80.751	282.622	11. 55. 7.827	733.627	729.049	4.578	5.342	a	0.158	0.132	0.161
spi1	80.878	282.732	11. 55. 8.048	733.848	729.732	4.116	5.342	x	-0.303	-0.330	-0.301
spj1	81.082	282.905	11. 55. 9.351	735.151	730.817	4.334	5.300	b	-0.086	-0.112	-0.083
spk1	81.188	282.992	11. 55. 9.964	735.764	731.380	4.384	5.300	a	-0.035	-0.062	-0.033

Mariana(9/ 5/82) 12. 7. 25.8 15. 38.00 -147. 33.70 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	78.458	280.535	12. 19. 26.422	721.222	717.314	3.908	5.540	x	-0.199	-0.199	-0.185
sp41	78.967	281.018	12. 19. 29.531	724.331	720.104	4.227	5.486	a	0.121	0.121	0.134
sp66	79.145	281.184	12. 19. 30.373	725.173	721.077	4.096	5.460	a	-0.010	-0.010	0.003
sp61	79.224	281.258	12. 19. 30.727	725.527	721.510	4.017	5.460	a	-0.090	-0.090	-0.076
sp91	79.627	281.628	12. 19. 32.792	727.592	723.705	3.887	5.420	a	-0.220	-0.220	-0.206
spf2	79.869	281.845	12. 19. 34.342	729.142	725.015	4.127	5.420	a	0.021	0.021	0.034
spe1	80.364	282.284	12. 19. 37.058	731.858	727.680	4.178	5.366	a	0.071	0.071	0.085
spf1	80.498	282.399	12. 19. 38.020	732.820	728.398	4.422	5.366	a	0.315	0.315	0.329
spg1	80.610	282.496	12. 19. 38.346	733.146	728.997	4.149	5.346	a	0.042	0.042	0.056
sph1	80.779	282.640	12. 19. 39.193	733.993	729.903	4.090	5.346	a	-0.017	-0.017	-0.003
spi1	80.907	282.750	12. 19. 39.875	734.675	730.587	4.088	5.346	a	-0.018	-0.018	-0.005
spj1	81.111	282.923	12. 19. 40.838	735.638	731.671	3.967	5.300	a	-0.140	-0.140	-0.126
spk1	81.217	283.011	12. 19. 41.465	736.265	732.234	4.031	5.300	a	-0.076	-0.076	-0.062

Honshuta(9/ 6/82) 1. 47. 2.7 29. 19.50 -140. 21.60 176.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	74.234	295.521	1. 58. 23.706	681.006	677.287	3.719	5.790	a	0.234	0.217	0.234
sp21	74.441	295.694	1. 58. 24.916	682.216	678.483	3.733	5.790	a	0.248	0.231	0.248
sp41	74.810	295.990	1. 58. 27.183	684.483	680.608	3.875	5.750	a	0.391	0.374	0.391
sp66	75.001	296.149	1. 58. 28.091	685.391	681.707	3.684	5.730	a	0.200	0.183	0.199
sp61	75.096	296.222	1. 58. 28.552	685.852	682.251	3.601	5.730	a	0.117	0.100	0.117
sp71	75.296	296.382	1. 58. 29.018	686.318	683.399	2.919	5.730	b	-0.566	-0.583	-0.566
sp91	75.557	296.583	1. 58. 30.931	688.231	684.889	3.342	5.689	a	-0.142	-0.159	-0.143
spf2	75.829	296.794	1. 58. 32.558	689.858	686.436	3.422	5.689	a	-0.062	-0.079	-0.062
spf4	76.009	296.934	1. 58. 33.706	691.006	687.459	3.547	5.640	b	0.062	0.046	0.062
spf6	76.214	297.084	1. 58. 34.920	692.220	688.619	3.601	5.640	a	0.117	0.100	0.117
spf1	76.549	297.336	1. 58. 36.795	694.095	690.504	3.591	5.610	a	0.107	0.090	0.107
spg1	76.678	297.431	1. 58. 37.330	694.630	691.227	3.403	5.610	a	-0.081	-0.098	-0.081
sph1	76.876	297.574	1. 58. 38.451	695.751	692.342	3.409	5.610	a	-0.075	-0.092	-0.075
spi1	77.012	297.679	1. 58. 39.182	696.482	693.101	3.381	5.570	a	-0.103	-0.120	-0.104
spj1	77.236	297.847	1. 58. 40.296	697.596	694.351	3.245	5.570	a	-0.239	-0.256	-0.239
spk1	77.364	297.934	1. 58. 41.042	698.342	695.064	3.278	5.570	a	-0.206	-0.223	-0.206

Kodiakt1(9/ 6/82) 7. 48. 54.9   56. 50.60   151. 35.30   33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	
sp11	21.743	315.951	7. 53. 45.353	290.453	288.130	2.323	10.368	a	-0.408	-0.408	
sp21	21.952	316.035	7. 53. 47.647	292.747	290.297	2.450	10.368	a	-0.246	-0.246	
sp31	22.093	316.183	7. 53. 49.147	294.247	291.747	2.500	10.177	a	-0.192	-0.192	
sp41	22.347	316.304	7. 53. 51.999	297.099	294.329	2.770	10.177	a	0.061	0.061	
sp66	22.535	316.354	7. 53. 54.143	299.243	296.239	3.004	9.982	a	0.326	0.326	
sp61	22.641	316.443	7. 53. 55.429	300.529	297.291	3.238	9.982	a	0.513	0.513	SLOWNESS = 10.3 seconds/degree
sp71	22.849	316.552	7. 53. 57.012	302.112	299.370	2.742	9.982	a	-0.043	-0.043	
sp91	23.130	316.748	7. 54. 0.071	305.171	302.152	3.019	9.811	a	0.146	0.146	
spg1	24.316	317.453	7. 54. 12.508	317.608	313.598	4.010	9.491	a	0.364	0.364	
sp11	24.663	317.632	7. 54. 15.742	320.842	316.880	3.962	9.371	a	0.064	0.064	
spj1	24.892	317.725	7. 54. 17.961	323.061	319.019	4.042	9.371	a	-0.091	-0.091	
spk1	25.035	317.840	7. 54. 19.010	324.110	320.358	3.752	9.251	a	-0.495	-0.495	

Chile pa(9/ 6/82) 11. 13. 26.2 -32. 8.30 71. 27.40 73.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	89.518	137.917	11. 26. 17.163	770.963	768.649	2.314	4.700	x	-0.369	-0.483	-0.523
sp21	89.311	138.077	11. 26. 16.499	770.299	767.673	2.626	4.702	c	-0.056	-0.170	-0.211
sp41	88.915	138.335	11. 26. 14.625	768.425	765.811	2.614	4.740	x	-0.069	-0.183	-0.223
sp66	88.729	138.487	11. 26. 13.071	766.871	764.926	1.945	4.740	c	-0.738	-0.852	-0.892
sp61	88.623	138.547	11. 26. 12.586	766.386	764.425	1.961	4.740	x	-0.721	-0.835	-0.876
sp71	88.415	138.692	11. 26. 11.400	765.200	763.439	1.761	4.762	x	-0.922	-1.035	-1.076
sp91	88.134	138.866	11. 26. 10.729	764.529	762.101	2.428	4.762	a	-0.255	-0.368	-0.409
spg1	86.950	139.621	11. 26. 5.457	759.257	756.420	2.837	4.840	b	0.154	0.041	0.
spi1	86.603	139.848	11. 26. 3.936	757.736	754.741	2.995	4.840	a	0.312	0.199	0.158
spj1	86.376	140.006	11. 26. 2.831	756.631	753.638	2.993	4.880	a	0.310	0.196	0.156
spk1	86.232	140.078	11. 26. 2.089	755.889	752.935	2.954	4.880	a	0.271	0.157	0.117

Bonin ta(9/ 8/82) 2. 37. 32.4 27. 3.60 -140. 11.60 440.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	75.855	293.890	2. 48. 35.028	662.628	659.801	2.827	5.584	a	0.207	0.178	0.181
sp21	76.061	294.063	2. 48. 36.243	663.843	660.944	2.899	5.544	a	0.279	0.250	0.193
sp31	76.181	294.155	2. 48. 36.852	664.452	661.610	2.842	5.544	a	0.222	0.193	0.137
sp41	76.425	294.357	2. 48. 38.348	665.948	662.967	2.981	5.544	a	0.361	0.332	0.275
sp66	76.616	294.516	2. 48. 39.179	666.779	664.018	2.761	5.504	a	0.141	0.112	0.055
sp61	76.709	294.588	2. 48. 39.583	667.183	664.532	2.651	5.504	a	0.030	0.001	-0.055
sp71	76.908	294.748	2. 48. 40.014	667.614	665.627	1.987	5.504	a	-0.633	-0.662	-0.718
sp91	77.165	294.947	2. 48. 41.897	669.497	667.036	2.461	5.464	a	-0.159	-0.188	-0.245
spa1	77.326	295.061	2. 48. 42.600	670.200	667.915	2.285	5.464	c	-0.335	-0.364	-0.421
spk1	78.955	296.292	2. 48. 51.614	679.214	676.708	2.506	5.344	a	-0.114	-0.143	-0.200

Marianpa(9/ 9/82) 15. 42. 22.1 15. 31.80 -147. 33.50 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp66	79.216	281.109	15. 54. 27.314	725.214	721.467	3.747	5.460	a	0.076	0.065	0.058
sp61	79.295	281.183	15. 54. 27.658	725.558	721.900	3.658	5.460	x	-0.013	-0.024	-0.037
spf2	79.939	281.770	15. 54. 31.013	728.913	725.398	3.515	5.420	b	-0.157	-0.168	-0.180
spf6	80.271	282.064	15. 54. 32.977	730.877	727.182	3.695	5.366	b	0.024	0.013	0.
spe1	80.434	282.208	15. 54. 33.685	731.585	728.057	3.528	5.366	x	-0.144	-0.155	-0.168
spf1	80.568	282.323	15. 54. 34.630	732.530	728.773	3.757	5.346	a	0.085	0.074	0.061
spg1	80.680	282.420	15. 54. 35.180	733.080	729.372	3.708	5.346	a	0.037	0.026	0.013
spj1	81.181	282.847	15. 54. 37.747	735.647	732.040	3.607	5.300	a	-0.065	-0.076	-0.089
spk1	81.287	282.934	15. 54. 38.375	736.275	732.603	3.672	5.300	a	0.001	-0.010	-0.023

Kamchapa(9/10/82) 10. 20. 37.6 55. 10.70 -161. 41.90 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	47.401	311.279	10. 29. 12.571	514.971	510.630	4.341	7.780	b	-0.194	-0.224	-0.191
sp21	47.611	311.426	10. 29. 14.235	516.635	512.264	4.371	7.726	b	-0.164	-0.194	-0.161
sp31	47.750	311.537	10. 29. 15.287	517.687	513.335	4.352	7.726	b	-0.184	-0.214	-0.181
sp41	48.005	311.717	10. 29. 17.748	520.148	515.305	4.844	7.700	a	0.308	0.278	0.311
sp66	48.196	311.844	10. 29. 19.122	521.522	516.776	4.746	7.700	a	0.211	0.181	0.214
sp61	48.300	311.922	10. 29. 19.830	522.230	517.578	4.652	7.700	a	0.117	0.087	0.119
sp91	48.788	312.269	10. 29. 23.218	525.618	521.326	4.292	7.666	a	-0.243	-0.273	-0.240
spa1	48.980	312.418	10. 29. 24.569	526.969	522.792	4.177	7.666	b	-0.358	-0.388	-0.355
spf2	49.072	312.465	10. 29. 25.546	527.946	523.498	4.448	7.620	a	-0.088	-0.118	-0.085
spf6	49.486	312.755	10. 29. 28.770	531.170	526.650	4.520	7.620	a	-0.015	-0.045	-0.012
spe1	49.660	312.865	10. 29. 30.031	532.431	527.969	4.462	7.586	a	-0.073	-0.103	-0.070
spf1	49.835	312.989	10. 29. 31.512	533.912	529.300	4.612	7.586	a	0.076	0.046	0.079
spg1	49.972	313.083	10. 29. 32.473	534.873	530.341	4.532	7.586	a	-0.003	-0.033	0.
sph1	50.187	313.230	10. 29. 34.299	536.699	531.966	4.733	7.560	a	0.197	0.167	0.200
spi1	50.321	313.312	10. 29. 35.302	537.702	532.976	4.726	7.560	a	0.190	0.160	0.193
spj1	50.550	313.458	10. 29. 36.949	539.349	534.710	4.639	7.506	a	0.104	0.074	0.106
spk1	50.692	313.556	10. 29. 38.026	540.426	535.772	4.654	7.506	a	0.119	0.089	0.122

Argentca(9/11/82) 14. 12. 14.5 -24. 10.40 66. 59.80 150.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	85.406	130.064	14. 24. 38.131	743.631	740.078	3.553	4.920	b	0.066	0.071	0.
sp21	85.195	130.225	14. 24. 37.146	742.646	739.040	3.606	4.920	a	0.119	0.124	0.053
sp31	85.057	130.294	14. 24. 36.422	741.922	738.362	3.560	4.920	b	0.073	0.078	0.007
sp41	84.802	130.478	14. 24. 34.960	740.460	737.100	3.360	4.960	a	-0.126	-0.122	-0.193
sp66	84.611	130.632	14. 24. 33.320	738.820	736.149	2.671	4.960	a	-0.816	-0.811	-0.882
sp61	84.507	130.690	14. 24. 32.891	738.391	735.635	2.756	4.960	a	-0.730	-0.726	-0.797
sp91	84.020	131.004	14. 24. 30.982	736.482	733.199	3.283	5.000	a	-0.204	-0.199	-0.270
spa1	83.830	131.081	14. 24. 30.075	735.575	732.245	3.330	5.040	a	-0.156	-0.152	-0.223
spf2	83.736	131.193	14. 24. 29.581	735.081	731.771	3.310	5.040	a	-0.176	-0.172	-0.242
spf6	83.324	131.437	14. 24. 27.735	733.235	729.685	3.550	5.080	a	0.063	0.068	-0.003
spe1	83.149	131.573	14. 24. 26.732	732.232	728.799	3.433	5.080	a	-0.054	-0.049	-0.120
spf1	82.975	131.664	14. 24. 26.119	731.619	727.910	3.709	5.140	a	0.223	0.227	0.156
spg1	82.838	131.745	14. 24. 25.466	730.966	727.207	3.759	5.140	a	0.273	0.277	0.207
sph1	82.624	131.863	14. 24. 24.402	729.902	726.106	3.796	5.140	a	0.310	0.314	0.243
spi1	82.490	131.968	14. 24. 23.790	729.290	725.416	3.874	5.180	a	0.388	0.392	0.321
spj1	82.260	132.125	14. 24. 22.582	728.082	724.225	3.857	5.180	a	0.371	0.375	0.305
spk1	82.119	132.192	14. 24. 21.858	727.358	723.496	3.862	5.180	a	0.376	0.380	0.309

SaltaApa(9/11/82) 14. 27. 29.6 -24. 11.10 66. 59.10 152.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	85.422	130.062	14. 39. 52.488	742.888	739.931	2.957	4.920	x	0.069	0.037	-0.019
sp21	85.211	130.223	14. 39. 51.469	741.869	738.893	2.976	4.920	c	0.088	0.056	0.
sp31	85.073	130.293	14. 39. 50.236	740.636	738.215	2.421	4.920	x	-0.467	-0.499	-0.555
sp41	84.818	130.477	14. 39. 49.282	739.682	736.953	2.729	4.959	x	-0.159	-0.192	-0.247
sp66	84.626	130.630	14. 39. 47.574	737.974	736.003	1.971	4.959	x	-0.917	-0.949	-1.005
sp61	84.523	130.689	14. 39. 47.175	737.575	735.489	2.086	4.959	b	-0.802	-0.834	-0.890
sp91	84.036	131.002	14. 39. 45.207	735.607	733.054	2.553	4.999	b	-0.335	-0.367	-0.423
spa1	83.846	131.079	14. 39. 44.414	734.814	732.100	2.714	5.039	a	-0.174	-0.207	-0.263
spf2	83.752	131.192	14. 39. 43.907	734.307	731.626	2.681	5.039	a	-0.207	-0.239	-0.295
spf6	83.340	131.436	14. 39. 42.092	732.492	729.542	2.950	5.080	a	0.062	0.030	-0.026
spe1	83.165	131.571	14. 39. 40.988	731.388	728.656	2.732	5.080	c	-0.156	-0.188	-0.244
spf1	82.990	131.662	14. 39. 40.395	730.795	727.768	3.027	5.138	a	0.140	0.107	0.051
spg1	82.854	131.744	14. 39. 39.728	730.128	727.064	3.064	5.138	a	0.176	0.143	0.088
sph1	82.639	131.861	14. 39. 38.715	729.115	725.964	3.151	5.138	a	0.263	0.231	0.175
spi1	82.505	131.967	14. 39. 38.095	728.495	725.275	3.220	5.138	b	0.333	0.300	0.244
spj1	82.275	132.123	14. 39. 36.878	727.278	724.084	3.194	5.179	b	0.306	0.274	0.218
spk1	82.135	132.191	14. 39. 36.149	726.549	723.355	3.194	5.179	a	0.306	0.274	0.218

FoxIslta(9/12/82) 9. 22. 23.1 52. 38.40 166. 56.50 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp21	29.857	302.527	9. 28. 33.119	370.019	363.807	6.212	8.886	c	-0.235	-0.255	-0.212
sp41	30.241	302.951	9. 28. 36.934	373.834	367.211	6.623	8.874	b	0.176	0.156	0.199
sp66	30.434	303.106	9. 28. 38.715	375.615	368.923	6.692	8.874	a	0.244	0.225	0.267
sp61	30.534	303.227	9. 28. 39.746	376.646	369.809	6.837	8.846	a	0.390	0.370	0.413
sp91	31.011	303.723	9. 28. 43.357	380.257	374.033	6.224	8.820	a	-0.223	-0.243	-0.200
spa1	31.190	303.974	9. 28. 44.836	381.736	375.606	6.130	8.820	b	-0.318	-0.337	-0.295
spf2	31.291	303.992	9. 28. 45.914	382.814	376.502	6.312	8.820	a	-0.135	-0.155	-0.112
spf6	31.693	304.416	9. 28. 49.593	386.493	380.043	6.450	8.786	a	0.002	-0.017	0.025
spe1	31.869	304.547	9. 28. 51.113	388.013	381.589	6.424	8.786	a	-0.023	-0.043	0.
spf1	32.038	304.737	9. 28. 52.751	389.651	383.072	6.579	8.780	a	0.132	0.112	0.155
spg1	32.172	304.870	9. 28. 53.744	390.644	384.249	6.395	8.780	a	-0.052	-0.072	-0.029
sph1	32.381	305.088	9. 28. 55.784	392.684	386.079	6.605	8.780	a	0.158	0.138	0.181
spi1	32.516	305.181	9. 28. 56.933	393.833	387.270	6.563	8.746	a	0.115	0.096	0.138
spj1	32.746	305.370	9. 28. 58.777	395.677	389.274	6.403	8.746	a	-0.044	-0.064	-0.021
spk1	32.881	305.520	9. 28. 59.822	396.722	390.461	6.261	8.746	a	-0.187	-0.206	-0.164

Foxis ta(9/12/82) 11. 59. 52.0 52. 38.50 166. 50.90 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp21	29.801	302.529	12. 6. 0.254	368.254	363.301	4.953	8.886	b	-0.239	-0.269	-0.224
sp31	29.931	302.710	12. 6. 1.484	369.484	364.463	5.021	8.886	c	-0.170	-0.201	-0.155
sp41	30.184	302.953	12. 6. 4.101	372.101	366.706	5.395	8.874	a	0.203	0.173	0.218
sp66	30.377	303.109	12. 6. 5.876	373.876	368.418	5.458	8.874	a	0.266	0.236	0.281
sp61	30.477	303.230	12. 6. 6.910	374.910	369.305	5.605	8.874	a	0.413	0.383	0.428
sp91	30.954	303.726	12. 6. 10.475	378.475	373.530	4.945	8.846	a	-0.247	-0.277	-0.232
spa1	31.133	303.978	12. 6. 11.898	379.898	375.105	4.793	8.820	b	-0.398	-0.429	-0.383
spf2	31.234	303.995	12. 6. 13.045	381.045	376.000	5.045	8.820	a	-0.147	-0.177	-0.132
spf6	31.637	304.419	12. 6. 16.728	384.728	379.544	5.184	8.786	a	-0.007	-0.038	0.008
spe1	31.812	304.550	12. 6. 18.215	386.215	381.089	5.126	8.786	a	-0.066	-0.096	-0.051
spf1	31.981	304.740	12. 6. 19.869	387.869	382.572	5.297	8.786	a	0.105	0.075	0.120
spg1	32.115	304.873	12. 6. 21.018	389.018	383.749	5.269	8.780	b	0.077	0.047	0.092
sph1	32.324	305.092	12. 6. 22.920	390.920	385.579	5.341	8.780	a	0.149	0.119	0.164
spi1	32.460	305.185	12. 6. 24.082	392.082	386.772	5.310	8.780	a	0.119	0.088	0.134
spj1	32.689	305.374	12. 6. 25.933	393.933	388.777	5.156	8.746	a	-0.035	-0.066	-0.020
spk1	32.824	305.524	12. 6. 27.133	395.133	389.964	5.169	8.746	a	-0.023	-0.053	-0.008

Fox Isla(9/12/82) 16. 50. 37.7 52. 49.10 167. 3.20 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp66	30.501	303.460	16. 56. 53.114	375.414	369.516	5.898	8.846	c	0.265	0.310	0.310
sp61	30.601	303.579	16. 56. 54.147	376.447	370.402	6.045	8.846	c	0.412	0.457	0.457
sp91	31.079	304.069	16. 56. 57.941	380.241	374.630	5.611	8.820	c	-0.022	0.023	0.024
spf2	31.359	304.335	16. 57. 0.165	382.465	377.101	5.364	8.820	b	-0.269	-0.224	-0.224
spf6	31.762	304.755	16. 57. 3.844	386.144	380.646	5.498	8.786	c	-0.135	-0.090	-0.090
spe1	31.938	304.884	16. 57. 5.315	387.615	382.191	5.424	8.786	b	-0.209	-0.164	-0.164
spg1	32.241	305.204	16. 57. 8.402	390.702	384.855	5.847	8.780	b	0.214	0.259	0.259
sph1	32.450	305.420	16. 57. 10.046	392.346	386.688	5.658	8.780	a	0.025	0.070	0.070
spi1	32.586	305.512	16. 57. 11.165	393.465	387.877	5.588	8.746	c	-0.045	-0.000	0.
spj1	32.815	305.698	16. 57. 13.088	395.388	389.882	5.506	8.746	a	-0.127	-0.082	-0.081
snk1	32.951	305.847	16. 57. 14.296	396.596	391.072	5.525	8.746	a	-0.109	-0.064	-0.063

Peru fb(9/15/82) 20. 22. 55.2 -14. 29.60 70. 47.10 128.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	75.551	127.129	20. 34. 28.034	692.834	690.119	2.715	5.700	b	0.126	0.092	0.034
sp21	75.340	127.289	20. 34. 26.970	691.770	688.909	2.861	5.740	a	0.272	0.238	0.181
sp31	75.204	127.349	20. 34. 25.978	690.778	688.132	2.646	5.740	b	0.057	0.023	-0.034
sp41	74.950	127.529	20. 34. 24.316	689.116	686.669	2.447	5.760	b	-0.142	-0.177	-0.234
sp66	74.757	127.684	20. 34. 22.649	687.449	685.560	1.888	5.760	c	-0.700	-0.735	-0.792
sp61	74.655	127.737	20. 34. 22.074	686.874	684.970	1.904	5.760	a	-0.685	-0.720	-0.777
sp71	74.447	127.877	20. 34. 20.679	685.479	683.769	1.710	5.818	b	-0.879	-0.913	-0.970
sp91	74.171	128.036	20. 34. 19.749	684.549	682.162	2.387	5.818	a	-0.202	-0.236	-0.293
spa1	73.985	128.096	20. 34. 18.886	683.686	681.084	2.602	5.838	b	0.013	-0.021	-0.078
spf2	73.888	128.219	20. 34. 18.302	683.102	680.515	2.587	5.838	a	-0.002	-0.037	-0.094
spf4	73.702	128.343	20. 34. 17.408	682.208	679.428	2.780	5.838	a	0.191	0.156	0.099
spf6	73.479	128.447	20. 34. 16.165	680.965	678.127	2.838	5.880	x	0.249	0.214	0.157
spa1	73.304	128.584	20. 34. 15.087	679.887	677.096	2.791	5.880	c	0.202	0.167	0.110
spf1	73.131	128.665	20. 34. 14.250	679.050	676.082	2.968	5.880	a	0.379	0.345	0.287
spg1	72.995	128.742	20. 34. 13.433	678.233	675.283	2.950	5.900	a	0.361	0.327	0.269
sp11	72.648	128.956	20. 34. 11.559	676.359	673.235	3.124	5.900	c	0.535	0.501	0.444
spj1	72.418	129.111	20. 34. 10.136	674.936	671.874	3.062	5.958	a	0.474	0.439	0.382

GALAPIt1(9/17/82) 5. 56. 27.2 1. 45.80 90. 40.60 10.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp41	50.642	136.222	6. 5. 27.494	540.294	538.526	1.768	7.520	x	-0.711	-0.659	-0.729
sp61	50.348	136.459	6. 5. 25.870	538.670	536.310	2.360	7.560	b	-0.119	-0.068	-0.138
sp91	49.859	136.781	6. 5. 22.029	534.829	532.607	2.222	7.600	b	-0.257	-0.206	-0.276
spf4	49.389	137.127	6. 5. 18.458	531.258	529.037	2.221	7.627	c	-0.258	-0.207	-0.277
spe1	48.988	137.392	6. 5. 15.279	528.079	525.977	2.102	7.673	x	-0.377	-0.326	-0.396
spf1	48.811	137.470	6. 5. 14.306	527.106	524.614	2.492	7.673	c	0.013	0.064	-0.006
spg1	48.673	137.553	6. 5. 13.261	526.061	523.558	2.503	7.673	c	0.024	0.076	0.006
sph1	48.456	137.663	6. 5. 11.656	524.456	521.894	2.562	7.707	c	0.083	0.135	0.065
spi1	48.325	137.797	6. 5. 10.846	523.646	520.882	2.764	7.707	c	0.285	0.336	0.266
spj1	48.097	137.979	6. 5. 9.032	521.832	519.124	2.708	7.707	c	0.229	0.280	0.210
spk1	47.954	138.034	6. 5. 7.575	520.375	518.017	2.358	7.740	x	-0.121	-0.070	-0.140

Galapata(9/17/82) 6. 32. 9.2 1. 40.50 90. 51.40 10.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	51.232	136.040	6. 41. 15.867	546.667	542.954	3.713	7.487	x	-0.548	-0.549	-0.610
sp31	50.881	136.274	6. 41. 13.521	544.321	540.325	3.996	7.520	x	-0.266	-0.266	-0.328
sp71	50.126	136.875	6. 41. 6.946	537.746	534.629	3.117	7.560	x	-1.145	-1.146	-1.207
sp91	49.845	137.042	6. 41. 5.659	536.459	532.499	3.960	7.600	a	-0.302	-0.303	-0.364
spf2	49.561	137.249	6. 41. 3.437	534.237	530.347	3.890	7.600	a	-0.371	-0.372	-0.433
spf4	49.375	137.390	6. 41. 2.182	532.982	528.930	4.052	7.627	a	-0.210	-0.211	-0.272
spf6	49.145	137.488	6. 41. 0.472	531.272	527.176	4.096	7.627	a	-0.165	-0.166	-0.227
spe1	48.974	137.657	6. 40. 59.071	529.871	525.870	4.001	7.673	b	-0.261	-0.262	-0.323
spf1	48.797	137.736	6. 40. 58.030	528.830	524.506	4.324	7.673	a	0.062	0.061	0.
spg1	48.659	137.819	6. 40. 57.092	527.892	523.450	4.442	7.673	a	0.181	0.180	0.118
sph1	48.442	137.930	6. 40. 55.508	526.308	521.785	4.523	7.707	a	0.261	0.261	0.199
spi1	48.311	138.064	6. 40. 54.501	525.301	520.775	4.526	7.707	a	0.265	0.264	0.202
spj1	48.083	138.248	6. 40. 52.775	523.575	519.018	4.557	7.707	a	0.295	0.294	0.233
spk1	47.940	138.303	6. 40. 51.615	522.415	517.910	4.505	7.740	b	0.244	0.243	0.181

NChileta(9/20/82) 8. 23. 18.2 -26. 37.90 70. 33.20 46.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	85.477	134.118	8. 35. 53.662	755.462	752.349	3.113	4.940	x	0.062	0.043	0.019
sp21	85.267	134.280	8. 35. 52.694	754.494	751.313	3.181	4.940	c	0.130	0.111	0.088
sp41	84.872	134.536	8. 35. 50.594	752.394	749.355	3.039	4.988	b	-0.012	-0.032	-0.055
sp66	84.682	134.691	8. 35. 48.979	750.779	748.410	2.369	4.988	a	-0.682	-0.701	-0.725
sp61	84.577	134.750	8. 35. 48.457	750.257	747.886	2.371	4.988	a	-0.680	-0.699	-0.723
sp91	84.088	135.067	8. 35. 46.416	748.216	745.429	2.787	5.032	c	-0.264	-0.283	-0.306
spa1	83.894	135.145	8. 35. 45.591	747.391	744.446	2.945	5.068	b	-0.106	-0.125	-0.149
spf2	83.805	135.258	8. 35. 45.077	746.877	743.994	2.883	5.068	b	-0.168	-0.187	-0.210
spf4	83.618	135.387	8. 35. 44.276	746.076	743.049	3.027	5.068	a	-0.024	-0.044	-0.067
spf6	83.389	135.506	8. 35. 43.232	745.032	741.883	3.149	5.120	a	0.098	0.078	0.055
spe1	83.217	135.643	8. 35. 42.191	743.991	741.001	2.990	5.120	a	-0.061	-0.080	-0.103
spf1	83.040	135.735	8. 35. 41.510	743.310	740.095	3.215	5.120	a	0.164	0.145	0.122
spg1	82.902	135.818	8. 35. 40.797	742.597	739.385	3.212	5.180	a	0.161	0.142	0.119
sph1	82.686	135.937	8. 35. 39.817	741.617	738.265	3.352	5.180	a	0.301	0.282	0.258
spi1	82.554	136.044	8. 35. 39.214	741.014	737.580	3.434	5.180	a	0.383	0.364	0.340
spj1	82.325	136.203	8. 35. 38.027	739.827	736.387	3.440	5.220	a	0.389	0.369	0.346
spk1	82.182	136.272	8. 35. 37.263	739.063	735.642	3.421	5.220	a	0.370	0.351	0.327

Tonga ta(9/20/82) 13. 48. 32.4 -26. 52.30 175. 52.40 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)			TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	UT. MEAN	MEDIAN
sp11	85.234	225.119	14.	1.	8.784	756.384	752.836	3.548	4.940	x	-0.217	-0.224	-0.169
sp21	85.262	225.297	14.	1.	9.050	756.650	752.974	3.676	4.940	c	-0.088	-0.096	-0.040
sp31	85.230	225.382	14.	1.	8.881	756.481	752.815	3.666	4.940	c	-0.099	-0.107	-0.051
sp41	85.252	225.587	14.	1.	9.326	756.926	752.926	4.000	4.940	a	0.236	0.228	0.284
sp66	85.292	225.754	14.	1.	9.379	756.979	753.122	3.857	4.940	a	0.093	0.085	0.141
sp61	85.279	225.823	14.	1.	9.217	756.817	753.058	3.759	4.940	b	-0.006	-0.014	0.042
sp91	85.280	226.182	14.	1.	9.148	756.748	753.060	3.688	4.940	a	-0.076	-0.084	-0.028
spa1	85.220	226.283	14.	1.	8.879	756.479	752.765	3.714	4.940	b	-0.051	-0.058	-0.003
spf2	85.294	226.396	14.	1.	9.225	756.825	753.130	3.695	4.940	a	-0.070	-0.077	-0.022
spf4	85.308	226.538	14.	1.	9.269	756.869	753.198	3.671	4.940	a	-0.094	-0.102	-0.046
spf6	85.276	226.680	14.	1.	9.101	756.701	753.040	3.661	4.940	c	-0.104	-0.111	-0.055
spe1	85.314	226.827	14.	1.	9.129	756.729	753.231	3.498	4.940	x	-0.267	-0.275	-0.219
spf1	85.293	226.938	14.	1.	9.306	756.906	753.124	3.782	4.940	b	0.018	0.010	0.066
spg1	85.290	227.032	14.	1.	9.310	756.910	753.112	3.798	4.940	a	0.033	0.025	0.081
sph1	85.275	227.172	14.	1.	9.241	756.841	753.035	3.806	4.940	a	0.041	0.033	0.089
spi1	85.309	227.285	14.	1.	9.583	757.183	753.205	3.978	4.940	c	0.214	0.206	0.262
spk1	85.316	227.544	14.	1.	9.355	756.955	753.239	3.716	4.940	a	-0.048	-0.056	0.

Mariana(9/25/82) 8. 48. 43.6 15. 44.60 -147. 36.50 55.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	78.351	280.586	9. 0. 41.851	718.251	714.044	4.207	5.520	c	0.089	0.070	0.045
sp21	78.540	280.766	9. 0. 42.865	719.265	715.082	4.183	5.496	x	0.065	0.046	0.021
sp31	78.638	280.861	9. 0. 43.362	719.762	715.621	4.141	5.496	c	0.022	0.003	-0.022
sp41	78.860	281.070	9. 0. 44.675	721.075	716.841	4.234	5.496	c	0.116	0.096	0.071
sp66	79.038	281.236	9. 0. 45.525	721.925	717.818	4.107	5.440	b	-0.011	-0.030	-0.055
sp61	79.117	281.310	9. 0. 45.848	722.248	718.250	3.998	5.440	x	-0.120	-0.140	-0.165
sp71	79.296	281.475	9. 0. 46.345	722.745	719.223	3.522	5.440	x	-0.596	-0.615	-0.640
sp91	79.521	281.680	9. 0. 47.859	724.259	720.443	3.816	5.416	c	-0.302	-0.322	-0.347
spf2	79.762	281.898	9. 0. 49.276	725.676	721.752	3.924	5.416	c	-0.195	-0.214	-0.239
spf4	79.923	282.042	9. 0. 50.466	726.866	722.625	4.241	5.416	c	0.122	0.103	0.078
spf6	80.095	282.193	9. 0. 51.230	727.630	723.547	4.083	5.360	x	-0.035	-0.055	-0.080
spe1	80.258	282.337	9. 0. 51.923	728.323	724.422	3.901	5.360	x	-0.218	-0.237	-0.262
spf1	80.392	282.453	9. 0. 52.924	729.324	725.141	4.183	5.360	a	0.065	0.046	0.021
spg1	80.504	282.549	9. 0. 53.554	729.954	725.741	4.213	5.340	a	0.094	0.075	0.050
sph1	80.674	282.694	9. 0. 54.410	730.810	726.647	4.163	5.340	a	0.044	0.025	0.
spi1	80.802	282.804	9. 0. 55.174	731.574	727.330	4.244	5.340	b	0.126	0.106	0.081
spj1	81.005	282.977	9. 0. 56.001	732.401	728.419	3.982	5.296	b	-0.136	-0.155	-0.180
spk1	81.112	283.065	9. 0. 56.666	733.066	728.982	4.084	5.296	a	-0.034	-0.053	-0.078

Kuril pa(9/26/82) 1. 9. 28.5 50. 3.20 -158. 47.90 44.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	50.969	305.870	1. 18. 29.345	540.845	536.518	4.327	7.508	x	-0.291	-0.316	-0.340
sp21	51.181	306.035	1. 18. 30.971	542.471	538.097	4.374	7.472	x	-0.244	-0.269	-0.292
sp31	51.315	306.151	1. 18. 31.994	543.494	539.100	4.394	7.472	x	-0.224	-0.249	-0.272
sp41	51.569	306.351	1. 18. 34.388	545.888	540.998	4.890	7.452	b	0.272	0.247	0.224
sp66	51.762	306.495	1. 18. 35.601	547.101	542.435	4.666	7.452	c	0.048	0.023	0.
sp61	51.864	306.579	1. 18. 36.357	547.857	543.194	4.663	7.452	b	0.045	0.020	-0.003
sp71	52.071	306.740	1. 18. 37.233	548.733	544.738	3.995	7.400	x	-0.623	-0.648	-0.671
sp64	52.183	306.837	1. 18. 38.028	549.528	545.562	3.966	7.400	b	-0.652	-0.677	-0.700
sp91	52.346	306.957	1. 18. 39.599	551.099	546.774	4.325	7.400	a	-0.293	-0.318	-0.341
spa1	52.530	307.112	1. 18. 40.922	552.422	548.133	4.289	7.380	b	-0.328	-0.353	-0.377
spf2	52.629	307.172	1. 18. 41.871	553.371	548.859	4.512	7.380	a	-0.106	-0.131	-0.154
spf4	52.815	307.312	1. 18. 43.433	554.933	550.231	4.702	7.380	a	0.084	0.059	0.036
spf6	53.036	307.487	1. 18. 44.983	556.483	551.865	4.618	7.328	b	0.001	-0.024	-0.048
spf1	53.383	307.744	1. 18. 47.619	559.119	554.409	4.710	7.328	a	0.092	0.067	0.044
spg1	53.519	307.845	1. 18. 48.523	560.023	555.402	4.621	7.304	a	0.003	-0.022	-0.045
sph1	53.730	308.004	1. 18. 50.316	561.816	556.945	4.871	7.304	a	0.253	0.228	0.205
spi1	53.865	308.098	1. 18. 51.328	562.828	557.933	4.895	7.304	a	0.277	0.252	0.229
spj1	54.095	308.260	1. 18. 52.887	564.387	559.608	4.779	7.260	a	0.161	0.136	0.113
spk1	54.233	308.364	1. 18. 53.871	565.371	560.611	4.760	7.260	a	0.143	0.118	0.094

Kuril pa(9/26/82) 4. 46. 37.8 47. 0.90 -152. 17.30 112.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp21	56.422	305.188	4. 56. 11.247	573.447	569.178	4.269	7.090	x	0.078	0.075	0.120
sp41	56.809	305.498	4. 56. 14.416	576.616	571.916	4.700	7.060	b	0.510	0.507	0.552
sp66	57.002	305.645	4. 56. 15.542	577.742	573.277	4.465	7.010	c	0.274	0.271	0.316
sp61	57.104	305.726	4. 56. 16.144	578.344	573.988	4.356	7.010	c	0.165	0.163	0.207
sp71	57.311	305.886	4. 56. 16.984	579.184	575.442	3.742	7.010	c	-0.449	-0.451	-0.406
sp91	57.585	306.098	4. 56. 19.115	581.315	577.362	3.953	6.980	b	-0.238	-0.240	-0.195
spa1	57.767	306.243	4. 56. 20.194	582.394	578.634	3.760	6.980	x	-0.431	-0.434	-0.389
spf2	57.867	306.312	4. 56. 21.276	583.476	579.328	4.148	6.980	b	-0.042	-0.045	0.
spf4	58.052	306.451	4. 56. 22.681	584.881	580.622	4.259	6.950	b	0.068	0.066	0.111
spf6	58.273	306.619	4. 56. 24.048	586.248	582.155	4.093	6.950	b	-0.097	-0.100	-0.055
spe1	58.449	306.746	4. 56. 25.217	587.417	583.376	4.041	6.950	c	-0.149	-0.152	-0.107
spf1	58.620	306.874	4. 56. 26.556	588.756	584.558	4.198	6.900	a	0.008	0.005	0.050
spg1	58.755	306.973	4. 56. 27.416	589.616	585.490	4.126	6.900	b	-0.065	-0.067	-0.022
sph1	58.965	307.128	4. 56. 29.083	591.283	586.942	4.341	6.900	a	0.150	0.147	0.192
spi1	59.101	307.224	4. 56. 29.940	592.140	587.875	4.265	6.880	b	0.074	0.071	0.116
spj1	59.330	307.387	4. 56. 31.310	593.510	589.456	4.055	6.880	a	-0.136	-0.139	-0.094
spk1	59.468	307.486	4. 56. 32.319	594.519	590.401	4.118	6.880	a	-0.073	-0.075	-0.031

Guatemp1(9/29/82) 5. 50. 32.2 14. 29.20 89. 7.30 12.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	41.603	124.243	5. 58. 23.346	471.146	467.128	4.018	8.180	c	0.363	0.341	0.129
sp21	41.392	124.389	5. 58. 21.503	469.303	465.399	3.904	8.220	a	0.249	0.227	0.015
sp31	41.259	124.396	5. 58. 20.090	467.890	464.309	3.581	8.220	b	-0.074	-0.096	-0.308
sp41	41.006	124.550	5. 58. 17.615	465.415	462.225	3.190	8.220	c	-0.465	-0.487	-0.699
sp66	40.813	124.705	5. 58. 15.764	463.564	460.634	2.930	8.244	a	-0.725	-0.747	-0.959
sp61	40.712	124.727	5. 58. 15.018	462.818	459.803	3.015	8.244	b	-0.640	-0.662	-0.874
sp71	40.505	124.839	5. 58. 13.588	461.388	458.097	3.291	8.244	a	-0.364	-0.386	-0.598
sp91	40.232	124.934	5. 58. 12.095	459.895	455.837	4.058	8.280	b	0.403	0.381	0.169
spa1	40.052	124.905	5. 58. 10.825	458.625	454.344	4.281	8.280	x	0.626	0.604	0.391
spf2	39.951	125.076	5. 58. 10.023	457.823	453.510	4.313	8.320	x	0.658	0.636	0.424
spf1	39.202	125.369	5. 58. 3.181	450.981	447.269	3.712	8.340	b	0.057	0.035	-0.177
spg1	39.067	125.415	5. 58. 2.142	449.942	446.148	3.794	8.340	x	0.139	0.117	-0.095
sph1	38.859	125.465	5. 58. 0.489	448.289	444.400	3.889	8.384	a	0.234	0.212	0.
spi1	38.723	125.576	5. 57. 59.404	447.204	443.262	3.942	8.384	a	0.287	0.265	0.053
spj1	38.494	125.708	5. 57. 57.564	445.364	441.340	4.024	8.420	a	0.369	0.347	0.135
spk1	38.358	125.717	5. 57. 56.353	444.153	440.195	3.958	8.420	a	0.303	0.281	0.069

Honshupa(10/ 1/82) 16. 53. 50.8 37. 43.10 -139. 37.30 145.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	69.212	302.608	17. 4. 45.982	655.182	650.572	4.610	6.184	a	0.102	0.097	0.097
sp21	69.423	302.775	17. 4. 47.323	656.523	651.873	4.650	6.184	a	0.142	0.137	0.136
sp31	69.554	302.871	17. 4. 48.152	657.352	652.682	4.670	6.160	a	0.163	0.158	0.157
sp66	69.999	303.220	17. 4. 51.024	660.224	655.427	4.797	6.160	a	0.289	0.284	0.283
sp61	70.099	303.293	17. 4. 51.429	660.629	656.038	4.591	6.104	a	0.083	0.079	0.078
sp91	70.577	303.649	17. 4. 54.089	663.289	658.950	4.339	6.064	a	-0.168	-0.173	-0.174
spf2	70.857	303.857	17. 4. 55.827	665.027	660.647	4.380	6.064	a	-0.127	-0.132	-0.133
spf4	71.041	303.993	17. 4. 57.150	666.350	661.765	4.585	6.036	a	0.077	0.072	0.071
spf6	71.259	304.144	17. 4. 58.392	667.592	663.077	4.515	6.036	b	0.008	0.003	0.002
spe1	71.434	304.276	17. 4. 59.308	668.508	664.138	4.370	6.036	b	-0.138	-0.143	-0.143
spf1	71.603	304.392	17. 5. 0.463	669.663	665.150	4.513	5.984	a	0.005	0.001	0.
spg1	71.737	304.486	17. 5. 1.204	670.404	665.951	4.453	5.984	a	-0.055	-0.059	-0.060
sph1	71.945	304.629	17. 5. 2.482	671.682	667.195	4.487	5.984	a	-0.021	-0.026	-0.026
spi1	72.081	304.729	17. 5. 3.352	672.552	668.005	4.547	5.944	x	0.039	0.034	0.034
spj1	72.310	304.893	17. 5. 4.387	673.587	669.366	4.881	5.944	a	-0.286	-0.291	-0.292
spk1	72.445	304.981	17. 5. 5.405	674.605	670.170	4.435	5.944	a	-0.073	-0.077	-0.078

AndreIpa(10/ 4/82) 7. 46. 52.8 51. 26.10 176. 37.20 38.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	35.704	301.085	7. 53. 49.487	416.687	414.291	2.396	8.562	b	-0.124	-0.143	-0.136
sp21	35.914	301.278	7. 53. 51.256	418.456	416.087	2.369	8.562	c	-0.152	-0.171	-0.164
sp41	36.295	301.679	7. 53. 54.881	422.081	419.350	2.731	8.560	b	0.210	0.191	0.198
sp61	36.587	301.951	7. 53. 57.422	424.622	421.845	2.777	8.502	b	0.257	0.238	0.245
sp71	36.793	302.146	7. 53. 58.475	425.675	423.590	2.085	8.502	a	-0.436	-0.455	-0.447
sp91	37.062	302.425	7. 54. 0.968	428.168	425.882	2.286	8.480	b	-0.234	-0.253	-0.246
spa1	37.238	302.648	7. 54. 2.377	429.577	427.375	2.202	8.480	b	-0.318	-0.337	-0.330
spf2	37.341	302.686	7. 54. 3.557	430.757	428.246	2.511	8.480	a	-0.010	-0.028	-0.021
spf4	37.525	302.853	7. 54. 5.353	432.553	429.806	2.747	8.442	a	0.226	0.208	0.215
spe1	37.917	303.223	7. 54. 8.537	435.737	433.111	2.626	8.442	a	0.106	0.087	0.094
spf1	38.084	303.399	7. 54. 10.013	437.213	434.521	2.692	8.402	a	0.172	0.153	0.160
spg1	38.217	303.526	7. 54. 10.993	438.193	435.641	2.552	8.402	a	0.032	0.013	0.020
sph1	38.424	303.731	7. 54. 12.896	440.096	437.379	2.717	8.402	a	0.196	0.177	0.185
spi1	38.560	303.831	7. 54. 13.932	441.132	438.520	2.612	8.380	a	0.092	0.073	0.080
spj1	38.789	304.019	7. 54. 15.747	442.947	440.435	2.512	8.380	b	-0.008	-0.027	-0.020
spk1	38.923	304.158	7. 54. 16.874	444.074	441.562	2.518	8.380	a	-0.009	-0.028	-0.021

Honshuta(10/ 7/82) 11. 2. 17.3 32. 20.70 -137. 30.80 386.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	74.041	299.550	11. 13. 15.200	657.900	654.624	3.276	5.726	c	0.195	0.247	0.217
sp21	74.250	299.719	11. 13. 16.493	659.193	655.822	3.371	5.726	c	0.291	0.342	0.313
sp31	74.377	299.811	11. 13. 17.231	659.931	656.551	3.380	5.726	c	0.299	0.351	0.321
sp41	74.628	300.008	11. 13. 18.799	661.499	657.981	3.518	5.686	b	0.437	0.489	0.459
sp61	74.918	300.235	11. 13. 20.143	662.843	659.633	3.210	5.686	b	0.129	0.181	0.151
sp71	75.122	300.391	11. 13. 20.624	663.324	660.789	2.535	5.646	a	-0.545	-0.493	-0.523
sp64	75.226	300.458	11. 13. 21.212	663.912	661.373	2.539	5.646	b	-0.541	-0.489	-0.519
sp91	75.389	300.587	11. 13. 22.519	665.219	662.297	2.922	5.646	a	-0.158	-0.106	-0.136
spf2	75.666	300.794	11. 13. 24.147	666.847	663.853	2.994	5.606	b	-0.087	-0.035	-0.065
spf4	75.849	300.931	11. 13. 25.402	668.102	664.879	3.223	5.606	a	0.142	0.194	0.165
spf6	76.062	301.077	11. 13. 26.590	669.290	666.068	3.222	5.566	b	0.141	0.193	0.163
spe1	76.238	301.212	11. 13. 27.396	670.096	667.046	3.050	5.566	b	-0.030	0.021	-0.008
spf1	76.403	301.324	11. 13. 28.416	671.116	667.964	3.152	5.566	a	0.071	0.123	0.093
spg1	76.535	301.417	11. 13. 29.047	671.747	668.697	3.050	5.526	a	-0.031	0.021	-0.009
sph1	76.739	301.557	11. 13. 30.193	672.893	669.826	3.067	5.526	a	-0.014	0.038	0.008
spi1	76.875	301.660	11. 13. 30.911	673.611	670.578	3.034	5.526	a	-0.047	0.005	-0.025
spj1	77.102	301.824	11. 13. 32.070	674.770	671.830	2.940	5.486	a	-0.140	-0.088	-0.118
spk1	77.235	301.909	11. 13. 32.824	675.524	672.556	2.968	5.486	a	-0.112	-0.061	-0.090

Bonin ta(10/14/82) 21. 40. 18.2 27. 18.00 -139. 56.00 487.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	75.866	294.233	21. 51. 16.719	658.519	655.578	2.941	5.565	c	0.317	0.322	0.259
sp21	76.071	294.405	21. 51. 17.908	659.708	656.718	2.990	5.525	b	0.365	0.370	0.307
sp41	76.437	294.699	21. 51. 20.004	661.804	658.739	3.065	5.525	b	0.441	0.445	0.383
sp66	76.628	294.858	21. 51. 20.860	662.660	659.787	2.873	5.485	b	0.249	0.253	0.190
sp61	76.721	294.930	21. 51. 21.245	663.045	660.302	2.743	5.485	b	0.119	0.124	0.061
sp71	76.920	295.089	21. 51. 21.651	663.451	661.394	2.057	5.485	c	-0.567	-0.563	-0.625
sp64	77.016	295.156	21. 51. 22.185	663.985	661.919	2.066	5.445	b	-0.558	-0.554	-0.617
sp91	77.178	295.288	21. 51. 23.222	665.022	662.802	2.220	5.445	b	-0.404	-0.400	-0.462
spf2	77.448	295.499	21. 51. 24.987	666.787	664.272	2.515	5.445	a	-0.109	-0.104	-0.167
spf4	77.627	295.638	21. 51. 26.207	668.007	665.240	2.767	5.405	a	0.143	0.147	0.085
spf6	77.830	295.785	21. 51. 27.314	669.114	666.338	2.776	5.405	b	0.152	0.156	0.094
spe1	78.004	295.924	21. 51. 28.053	669.853	667.279	2.574	5.385	x	-0.050	-0.046	-0.108
spf1	78.162	296.037	21. 51. 29.080	670.880	668.130	2.750	5.385	b	0.126	0.130	0.068
spg1	78.290	296.131	21. 51. 29.639	671.439	668.818	2.621	5.385	a	-0.003	0.001	-0.061
sph1	78.487	296.272	21. 51. 30.684	672.484	669.877	2.607	5.385	a	-0.017	-0.013	-0.076
spi1	78.622	296.377	21. 51. 31.311	673.111	670.598	2.513	5.325	x	-0.111	-0.106	-0.169
spj1	78.845	296.544	21. 51. 32.447	674.247	671.786	2.461	5.325	a	-0.163	-0.159	-0.221
spk1	78.972	296.630	21. 51. 33.193	674.993	672.459	2.534	5.325	a	-0.090	-0.086	-0.148

S Perut1(10/17/82) 8. 35. 25.3 -15. 40.40 73. 2.50 114.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	75.227	129.666	8. 46. 58.734	693.434	689.816	3.618	5.740	x	0.241	0.256	-0.063
sp21	75.016	129.828	8. 46. 57.586	692.286	688.604	3.682	5.740	c	0.304	0.320	0.
sp31	74.878	129.889	8. 46. 56.668	691.368	687.812	3.556	5.769	x	0.179	0.195	-0.125
sp41	74.623	130.072	8. 46. 54.744	689.444	686.341	3.103	5.769	x	-0.274	-0.259	-0.578
sp66	74.432	130.230	8. 46. 53.201	687.901	685.231	2.670	5.820	x	-0.707	-0.692	-1.012
sp61	74.328	130.284	8. 46. 52.629	687.329	684.628	2.701	5.820	b	-0.677	-0.661	-0.981
sp71	74.119	130.426	8. 46. 51.268	685.968	683.414	2.554	5.820	b	-0.823	-0.808	-1.128
sp64	74.004	130.456	8. 46. 50.715	685.415	682.743	2.672	5.820	b	-0.706	-0.690	-1.010
spf2	73.558	130.775	8. 46. 48.761	683.461	680.136	3.325	5.840	c	-0.052	-0.037	-0.356
spf1	72.797	131.230	8. 46. 44.609	679.309	675.653	3.656	5.909	b	0.278	0.294	-0.026
spg1	72.660	131.309	8. 46. 43.859	678.559	674.846	3.714	5.909	b	0.336	0.352	0.032
sph1	72.446	131.419	8. 46. 42.597	677.297	673.579	3.718	5.960	b	0.341	0.356	0.036
spi1	72.312	131.528	8. 46. 41.789	676.489	672.778	3.711	5.960	b	0.333	0.349	0.029
spj1	72.082	131.686	8. 46. 40.435	675.135	671.408	3.727	5.960	b	0.350	0.365	0.046
spk1	71.941	131.747	8. 46. 39.560	674.260	670.568	3.692	6.000	b	0.314	0.330	0.010

Kuril ta(10/17/82) 18. 12. 9.0 49. 37.90 -155. 53.50 47.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	52.847	306.431	18. 21. 23.199	554.199	550.153	4.046	7.380	x	-0.388	-0.395	-0.415
sp21	53.058	306.595	18. 21. 24.856	555.856	551.708	4.148	7.334	x	-0.286	-0.294	-0.314
sp31	53.192	306.708	18. 21. 25.898	556.898	552.696	4.202	7.334	x	-0.232	-0.240	-0.260
sp41	53.447	306.904	18. 21. 28.265	559.265	554.563	4.702	7.334	c	0.269	0.261	0.241
sp66	53.640	307.047	18. 21. 29.443	560.443	555.970	4.473	7.292	c	0.039	0.032	0.012
sp61	53.742	307.129	18. 21. 30.164	561.164	556.715	4.449	7.292	b	0.016	0.008	-0.012
sp71	53.950	307.287	18. 21. 31.003	562.003	558.230	3.773	7.292	x	-0.661	-0.669	-0.689
sp64	54.062	307.381	18. 21. 31.826	562.826	559.045	3.781	7.260	b	-0.653	-0.660	-0.680
spf2	54.508	307.712	18. 21. 35.593	566.593	562.284	4.310	7.234	a	-0.124	-0.132	-0.152
spf4	54.694	307.849	18. 21. 37.159	568.159	563.630	4.529	7.234	a	0.096	0.088	0.068
spf1	55.264	308.272	18. 21. 41.237	572.237	567.739	4.498	7.186	a	0.064	0.057	0.037
spg1	55.399	308.371	18. 21. 42.118	573.118	568.714	4.404	7.186	a	-0.030	-0.038	-0.058
sph1	55.611	308.527	18. 21. 43.859	574.859	570.233	4.626	7.160	a	0.192	0.185	0.165
spi1	55.746	308.620	18. 21. 44.793	575.793	571.201	4.592	7.160	a	0.158	0.151	0.131
spj1	55.976	308.780	18. 21. 46.290	577.290	572.847	4.443	7.160	a	0.009	0.001	-0.018
spk1	56.115	308.881	18. 21. 47.232	578.232	573.834	4.398	7.120	a	-0.036	-0.044	-0.063

Guatempl(10/18/82) 12. 56. 58.4 13. 50.80 90. 50.80 78.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	41.097	126.842	13. 4. 36.922	458.522	455.561	2.961	8.198	x	0.246	0.280	0.246
sp21	40.886	127.000	13. 4. 35.610	457.210	453.827	3.383	8.220	x	0.668	0.702	0.668
sp31	40.751	127.012	13. 4. 33.884	455.484	452.717	2.767	8.220	c	0.052	0.086	0.052
sp41	40.496	127.179	13. 4. 31.441	453.041	450.625	2.416	8.240	x	-0.299	-0.264	-0.299
sp66	40.304	127.344	13. 4. 29.494	451.094	449.038	2.056	8.240	x	-0.659	-0.624	-0.659
sp61	40.201	127.371	13. 4. 28.848	450.448	448.195	2.253	8.240	x	-0.462	-0.427	-0.462
sp71	39.993	127.494	13. 4. 27.313	448.913	446.481	2.432	8.298	x	-0.283	-0.248	-0.283
sp64	39.881	127.465	13. 4. 26.614	448.214	445.551	2.663	8.298	a	-0.052	-0.017	-0.052
spf2	39.435	127.760	13. 4. 23.474	445.074	441.847	3.227	8.318	x	0.512	0.546	0.512
spf6	39.027	127.911	13. 4. 20.416	442.016	438.452	3.564	8.318	x	0.849	0.884	0.849
spf1	38.679	128.093	13. 4. 17.712	439.312	435.549	3.763	8.358	x	1.048	1.083	1.048
sph1	38.332	128.208	13. 4. 14.062	435.662	432.644	3.018	8.380	x	0.303	0.338	0.303
spi1	38.197	128.327	13. 4. 13.164	434.764	431.510	3.254	8.380	x	0.539	0.573	0.539
spj1	37.967	128.473	13. 4. 11.276	432.876	429.582	3.294	8.438	x	0.579	0.614	0.579
spk1	37.829	128.490	13. 4. 9.993	431.593	428.416	3.177	8.438	x	0.462	0.497	0.462

Taiwanp1(10/20/82) 20. 1. 57.2 23. 49.50 -121. 50.20 33.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	89.764	303.574	20. 14. 55.551	778.351	774.638	3.713	4.714	c	0.369	0.387	0.379
sp31	90.107	303.807	20. 14. 56.869	779.669	776.250	3.419	4.686	c	0.075	0.093	0.085
sp66	90.553	304.143	20. 14. 59.051	781.851	778.341	3.510	4.680	c	0.166	0.184	0.176
sp61	90.653	304.203	20. 14. 59.415	782.215	778.812	3.404	4.680	x	0.059	0.077	0.070
sp64	90.968	304.393	20. 15. 0.359	783.159	780.286	2.873	4.680	c	-0.471	-0.454	-0.461
sp91	91.132	304.519	20. 15. 1.250	784.050	781.049	3.001	4.646	x	-0.343	-0.326	-0.333
spf2	91.413	304.709	20. 15. 2.833	785.633	782.353	3.280	4.646	b	-0.064	-0.046	-0.053
spf4	91.598	304.835	20. 15. 3.852	786.652	783.213	3.439	4.654	c	0.095	0.113	0.105
spf1	92.162	305.183	20. 15. 6.338	789.138	785.831	3.307	4.626	c	-0.038	-0.020	-0.027
spg1	92.296	305.265	20. 15. 6.905	789.705	786.453	3.253	4.626	b	-0.092	-0.074	-0.081
sph1	92.505	305.384	20. 15. 7.979	790.779	787.418	3.361	4.620	c	0.017	0.035	0.027
spi1	92.640	305.487	20. 15. 8.553	791.353	788.046	3.307	4.620	x	-0.037	-0.019	-0.026
spj1	92.870	305.642	20. 15. 9.592	792.392	789.104	3.288	4.620	c	-0.056	-0.039	-0.046

CChilepa(10/26/82) 3. 24. 30.9 -29. 41.00 71. 22.00 71.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	87.552	136.457	3. 37. 13.896	762.996	759.545	3.451	4.797	x	0.174	0.171	-0.043
sp31	87.202	136.690	3. 37. 12.243	761.343	757.862	3.482	4.803	x	0.204	0.202	-0.012
sp41	86.948	136.876	3. 37. 11.036	760.136	756.642	3.494	4.840	a	0.217	0.214	0.
sp66	86.760	137.030	3. 37. 9.437	758.537	755.733	2.804	4.840	a	-0.473	-0.476	-0.690
sp61	86.655	137.090	3. 37. 8.915	758.015	755.222	2.793	4.840	b	-0.484	-0.487	-0.701
sp71	86.447	137.235	3. 37. 7.770	756.870	754.213	2.657	4.880	a	-0.620	-0.623	-0.837
sp64	86.326	137.279	3. 37. 7.299	756.399	753.621	2.778	4.880	a	-0.499	-0.502	-0.716
sp91	86.166	137.408	3. 37. 6.974	756.074	752.842	3.232	4.880	a	-0.045	-0.048	-0.262
spg1	84.980	138.163	3. 37. 1.477	750.577	747.013	3.564	4.980	a	0.287	0.284	0.070
sph1	84.764	138.285	3. 37. 0.475	749.575	745.934	3.641	4.980	a	0.364	0.362	0.148
spi1	84.633	138.391	3. 36. 59.891	748.991	745.282	3.709	4.980	b	0.432	0.429	0.216
spj1	84.405	138.550	3. 36. 58.751	747.851	744.143	3.708	5.023	a	0.430	0.428	0.214
spk1	84.261	138.620	3. 36. 57.990	747.090	743.422	3.668	5.023	a	0.391	0.388	0.174

Java ta(10/26/82) 12. 44. 21.9 -7. 24.20 -108. 44.60 153.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN	PHASE
sp11	121.685	292.603	13. 3. 1.403	1119.503	1115.343	4.160	1.898	x	0.135	0.144	0.005	PKIKP
sp31	122.007	292.750	13. 3. 1.955	1120.055	1115.953	4.102	1.906	b	0.076	0.085	-0.054	PKIKP
sp41	122.250	292.886	13. 3. 2.511	1120.611	1116.416	4.195	1.903	c	0.169	0.178	0.040	PKIKP
sp66	122.440	293.015	13. 3. 2.528	1120.628	1116.777	3.851	1.901	b	-0.174	-0.165	-0.304	PKIKP
sp61	122.532	293.042	13. 3. 2.503	1120.603	1116.952	3.651	1.900	x	-0.374	-0.365	-0.504	PKIKP
sp71	122.729	293.142	13. 3. 2.680	1120.780	1117.326	3.454	1.897	a	-0.571	-0.562	-0.701	PKIKP
sp64	122.822	293.131	13. 3. 2.814	1120.914	1117.502	3.412	1.896	a	-0.613	-0.604	-0.743	PKIKP
sp91	122.983	293.237	13. 3. 3.415	1121.515	1117.807	3.708	1.894	a	-0.317	-0.309	-0.447	PKIKP
spf4	123.426	293.452	13. 3. 4.760	1122.860	1118.693	4.167	2.001	a	0.142	0.150	0.012	PKIKP
spf6	123.624	293.496	13. 3. 5.033	1123.133	1119.090	4.043	1.999	b	0.018	0.026	-0.112	PKIKP
spf1	123.952	293.642	13. 3. 5.799	1123.899	1119.744	4.155	1.995	a	0.130	0.139	0.	PKIKP
spg1	124.077	293.687	13. 3. 6.059	1124.159	1119.987	4.172	1.905	a	0.146	0.155	0.017	PKIKP
sph1	124.270	293.742	13. 3. 6.497	1124.597	1120.354	4.243	1.903	a	0.218	0.227	0.088	PKIKP
spi1	124.404	293.830	13. 3. 6.958	1125.058	1120.609	4.449	1.901	a	0.423	0.432	0.293	PKIKP
spj1	124.625	293.941	13. 3. 7.308	1125.408	1121.028	4.380	1.898	a	0.354	0.363	0.225	PKIKP

Guatemt1(10/28/82) 12. 29. 1.5 14. 9.30 91. 36.10 44.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	40.416	127.469	12. 36. 38.710	457.210	453.319	3.891	8.280	c	0.383	0.425	0.298
sp66	39.622	127.980	12. 36. 31.029	449.529	446.737	2.792	8.300	c	-0.717	-0.674	-0.802
sp61	39.520	128.007	12. 36. 30.333	448.833	445.886	2.947	8.300	c	-0.561	-0.518	-0.646
sp71	39.311	128.132	12. 36. 28.720	447.220	444.152	3.068	8.332	b	-0.440	-0.398	-0.526
sp64	39.199	128.103	12. 36. 28.008	446.508	443.212	3.296	8.332	a	-0.213	-0.170	-0.298
sp91	39.035	128.243	12. 36. 27.352	445.852	441.849	4.003	8.332	c	0.495	0.537	0.409
sph1	37.647	128.861	12. 36. 15.897	434.397	430.191	4.206	8.440	x	0.698	0.741	0.613
spi1	37.512	128.983	12. 36. 14.587	433.087	429.050	4.037	8.440	x	0.528	0.571	0.443
spj1	37.282	129.132	12. 36. 12.691	431.191	427.103	4.088	8.472	b	0.580	0.623	0.495
spk1	37.143	129.149	12. 36. 11.409	429.909	425.927	3.982	8.472	c	0.473	0.516	0.388

Guatemp1(10/28/82) 12. 45. 19.7 13. 59.00 91. 49.50 50.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp11	40.427	127.894	12. 52. 56.353	456.653	452.812	3.841	8.280	x	0.668	0.590	0.723
sp66	39.632	128.412	12. 52. 48.642	448.942	446.228	2.714	8.300	x	-0.459	-0.537	-0.403
sp61	39.529	128.440	12. 52. 48.070	448.370	445.375	2.995	8.300	c	-0.178	-0.256	-0.122
sp71	39.321	128.567	12. 52. 46.460	446.760	443.643	3.117	8.320	c	-0.056	-0.134	0.
sp64	39.208	128.539	12. 52. 45.807	446.107	442.700	3.407	8.320	b	0.234	0.156	0.289
sp91	39.044	128.681	12. 52. 45.162	445.462	441.340	4.122	8.320	x	0.949	0.871	1.005
spj1	37.290	129.587	12. 52. 30.439	430.739	426.585	4.154	8.460	x	0.980	0.903	1.036
spk1	37.151	129.606	12. 52. 29.131	429.431	425.409	4.022	8.460	x	0.849	0.771	0.905

NewBrip1(10/29/82) 0. 42. 16.2 -4. 30.40 -152. 27.20 105.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN
sp66	89.254	263.132	0. 55. 3.157	766.957	763.703	3.254	4.716	x	0.138	0.138	0.138
sp71	89.444	263.340	0. 55. 3.563	767.363	764.599	2.764	4.716	x	-0.353	-0.353	-0.353
sp64	89.480	263.388	0. 55. 3.803	767.603	764.770	2.833	4.716	c	-0.283	-0.283	-0.283
sph1	90.450	264.389	0. 55. 8.919	772.719	769.320	3.399	4.680	c	0.283	0.283	0.283
spi1	90.557	264.491	0. 55. 9.505	773.305	769.819	3.486	4.660	x	0.370	0.370	0.370
spj1	90.717	264.645	0. 55. 10.183	773.983	770.565	3.418	4.660	x	0.302	0.302	0.302
spk1	90.787	264.716	0. 55. 10.503	774.303	770.891	3.412	4.660	x	0.296	0.296	0.296

Sumatrp1(10/31/82) 2. 48. 13.6 2. 58.00 -96. 6.00 62.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)			TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	MEDIAN	PHASE
sp91	122.600	312.635	3.	7.	4.943	1131.343	1128.178	3.165	1.899	x	-0.718	-0.751	-0.738	PKIKP
sph1	124.000	313.448	3.	7.	8.318	1134.718	1130.935	3.783	1.994	c	-0.101	-0.134	-0.120	PKIKP
sp11	124.133	313.567	3.	7.	8.718	1135.118	1131.190	3.928	1.905	b	0.045	0.012	0.026	PKIKP
sp11	124.363	313.732	3.	7.	9.104	1135.504	1131.627	3.877	1.902	c	-0.006	-0.039	-0.026	PKIKP
spk1	124.504	313.784	3.	7.	9.441	1135.841	1131.896	3.945	1.900	a	0.062	0.029	0.042	PKIKP

Guatemala(9/ 5/82) 2. 36. 34.9 14. 7.80 91. 45.90 62.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	MEAN	WT. MEAN	QTY	
sp11	40.343	127.689	2. 46. 12.730	577.830	-0.205	-0.034	c	
sp41	39.741	128.034	2. 46. 10.790	575.890	-0.261	-0.090	b	
sp91	38.961	128.470	2. 46. 8.200	573.300	-0.409	-0.239	b	
spa1	38.775	128.449	2. 46. 7.650	572.750	-0.377	-0.206	x	PCP PHASE
spf2	38.678	128.631	2. 46. 7.310	572.410	-0.413	-0.243	b	
spf4	38.492	128.743	2. 46. 6.980	572.080	-0.161	0.009	x	
spf6	38.269	128.787	2. 46. 6.390	571.490	-0.053	0.117	x	
spf1	37.921	128.975	2. 46. 5.550	570.650	0.196	0.367	b	SLOWNESS = 3.13 seconds/degree
spg1	37.785	129.031	2. 46. 5.130	570.230	0.202	0.372	x	
sph1	37.573	129.094	2. 46. 4.646	569.746	0.381	0.552	x	
spi1	37.438	129.216	2. 46. 4.216	569.316	0.374	0.544	c	REFERENCE STATION = sp41
spj1	37.208	129.366	2. 46. 3.461	568.561	0.339	0.509	x	
spk1	37.069	129.385	2. 46. 3.076	568.176	0.389	0.559	x	

Andrelta(10/ 4/82) 7. 46. 52.8 51. 26.10 176. 37.20 38.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	MEAN	WT. MEAN	QTY	
sp11	35.704	301.085	7. 56. 15.859	563.059	0.224	0.279	b	
sp21	35.914	301.278	7. 56. 16.355	563.555	0.083	0.139	c	
sp41	36.295	301.679	7. 56. 17.801	565.001	0.375	0.430	a	
sp61	36.587	301.951	7. 56. 18.030	565.230	-0.281	-0.226	b	PCP PHASE
sp71	36.793	302.146	7. 56. 18.214	565.414	-0.721	-0.666	a	
sp91	37.062	302.425	7. 56. 19.392	566.592	-0.358	-0.303	b	
spa1	37.238	302.648	7. 56. 20.005	567.205	-0.278	-0.223	b	
spf2	37.341	302.686	7. 56. 20.440	567.640	-0.155	-0.100	b	SLOWNESS = 3.03 seconds/degree
spf4	37.525	302.853	7. 56. 21.290	568.490	0.137	0.192	a	
spe1	37.917	303.223	7. 56. 22.262	569.462	-0.079	-0.023	x	
spf1	38.084	303.399	7. 56. 22.945	570.145	0.098	0.154	c	REFERENCE STATION = sp11
spg1	38.217	303.526	7. 56. 23.376	570.576	0.126	0.182	b	
sph1	38.424	303.731	7. 56. 24.039	571.239	0.162	0.217	x	
sp11	38.560	303.831	7. 56. 24.652	571.852	0.363	0.418	x	
sp11	38.789	304.019	7. 56. 25.286	572.486	0.303	0.358	b	

Guatemala(10/18/82) 12. 56. 58.4 13. 50.80 90. 50.80 78.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	MEAN	WT. MEAN	Q-V	
sp11	41.097	126.842	13. 6. 36.220	577.820	0.014	-0.121	x	
sp21	40.886	127.000	13. 6. 35.405	577.005	-0.136	-0.271	x	
sp31	40.751	127.012	13. 6. 35.044	576.644	-0.072	-0.207	x	
sp41	40.496	127.179	13. 6. 34.269	575.869	-0.044	-0.179	c	PCP PHASE
sp66	40.304	127.344	13. 6. 33.068	574.668	-0.640	-0.775	b	
sp61	40.201	127.371	13. 6. 32.692	574.292	-0.691	-0.827	c	
sp71	39.993	127.494	13. 6. 31.756	573.356	-0.972	-1.107	c	
sp64	39.881	127.465	13. 6. 31.754	573.354	-0.621	-0.757	c	
spf2	39.435	127.760	13. 6. 30.777	572.377	-0.194	-0.329	b	SLOWNESS = 3.15 seconds/degree
spf6	39.027	127.911	13. 6. 29.857	571.457	0.172	0.036	b	
spf1	38.679	128.093	13. 6. 28.992	570.592	0.403	0.268	b	
spg1	38.544	128.147	13. 6. 28.569	570.169	0.405	0.270	c	REFERENCE STATION = sp66
spk1	38.332	128.208	13. 6. 28.027	569.627	0.531	0.396	b	
spl1	38.197	128.327	13. 6. 27.751	569.351	0.680	0.545	b	
spj1	37.967	128.473	13. 6. 26.957	568.557	0.611	0.476	b	
spk1	37.829	128.490	13. 6. 26.466	568.066	0.554	0.419	b	

Vancoup1(9/13/82) 9. 19. 28.2 49. 5.40 128. 38.90 10.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	
sp21	6.316	326.915	9. 21. 2.548	94.348	92.860	1.488	13.673	x	-0.356	-0.559	
sp31	6.460	327.015	9. 21. 4.594	96.394	94.839	1.555	13.673	x	-0.422	-0.625	
sp66	6.883	326.107	9. 21. 10.792	102.592	100.616	1.976	13.660	c	-0.451	-0.654	REGIONAL
sp61	6.989	326.117	9. 21. 13.234	105.034	102.063	2.971	13.660	x	0.533	0.330	
sp71	7.192	325.869	9. 21. 16.830	108.630	104.833	3.797	13.647	c	1.152	0.949	
sp91	7.471	325.767	9. 21. 19.899	111.699	108.637	3.062	13.647	b	0.085	-0.118	SLOWNESS = 14.6
spf2	7.748	325.508	9. 21. 24.181	115.981	112.422	3.559	13.640	x	0.366	0.163	seconds/degree
spf6	8.162	325.425	9. 21. 28.775	120.575	118.059	2.516	13.620	x	-0.906	-1.109	

Oregonpa(9/18/82) 7. 31. 33.5 43. 34.20 127. 10.80 10.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	
sp11	2.607	259.582	7. 32. 16.283	42.783	42.072	0.711	13.720	a	-0.203	-0.252	
sp21	2.756	262.863	7. 32. 18.651	45.151	44.117	1.034	13.720	a	0.082	0.033	
sp31	2.823	265.541	7. 32. 19.479	45.979	45.032	0.947	13.720	a	-0.027	-0.076	
sp41	3.013	268.973	7. 32. 21.795	48.295	47.641	0.654	13.720	b	-0.369	-0.418	
sp66	3.176	270.962	7. 32. 24.013	50.513	49.878	0.635	13.720	a	-0.430	-0.479	
sp61	3.245	272.434	7. 32. 25.032	51.532	50.823	0.709	13.720	b	-0.376	-0.425	
sp71	3.411	274.688	7. 32. 27.827	54.327	53.102	1.225	13.720	b	0.097	0.048	REGIONAL
sp64	3.476	276.568	7. 32. 28.781	55.281	53.991	1.290	13.720	b	0.142	0.093	
sp91	3.624	277.763	7. 32. 31.739	58.239	56.024	2.215	13.700	a	1.030	0.981	
spf2	3.862	281.976	7. 32. 34.824	61.324	59.281	2.043	13.700	a	0.787	0.738	SLOWNESS = 14.0
spf6	4.202	285.634	7. 32. 38.969	65.469	63.939	1.530	13.700	a	0.176	0.127	seconds/degree
spe1	4.369	286.491	7. 32. 40.981	67.481	66.231	1.250	13.700	b	-0.147	-0.196	
spf1	4.513	287.960	7. 32. 43.004	69.504	68.197	1.307	13.700	b	-0.138	-0.187	
spg1	4.633	288.892	7. 32. 44.289	70.789	69.837	0.952	13.700	a	-0.531	-0.580	
sph1	4.818	290.390	7. 32. 47.278	73.778	72.371	1.407	13.700	c	-0.130	-0.179	
spi1	4.951	290.823	7. 32. 49.732	76.232	74.193	2.039	13.700	c	0.464	0.415	
spj1	5.168	291.830	7. 32. 51.876	78.376	77.167	1.209	13.680	x	-0.427	-0.476	

CalNevta(9/24/82) 7. 40. 24.3 37. 51.10 118. 7.40 5.0

STATION	DELTA	AZIMUTH	ARRIVAL TIME (H.M.S)	TT-OBS	TT-THEOR	RESIDUAL	DT/DDEL	QTY	MEAN	WT. MEAN	
sp21	7.257	144.751	7. 42. 15.909	111.609	106.275	5.334	13.653	x	0.152	0.209	
sp31	7.112	144.756	7. 42. 14.446	110.146	104.302	5.844	13.653	x	0.794	0.851	
sp41	6.865	145.467	7. 42. 9.832	105.532	100.933	4.599	13.660	a	-0.233	-0.176	
sp66	6.687	146.228	7. 42. 7.070	102.770	98.490	4.280	13.660	a	-0.410	-0.353	
sp61	6.581	146.345	7. 42. 5.679	101.379	97.044	4.335	13.660	a	-0.262	-0.205	
sp71	6.378	146.940	7. 42. 2.816	98.516	94.278	4.238	13.667	a	-0.178	-0.121	
sp64	6.251	146.779	7. 42. 0.958	96.658	92.543	4.115	13.667	a	-0.192	-0.135	
sp91	6.101	147.498	7. 41. 59.224	94.924	90.481	4.443	13.667	a	0.252	0.309	REGIONAL
spa1	5.897	147.390	7. 41. 56.002	91.702	87.698	4.004	13.673	b	-0.008	0.049	
spf2	5.826	148.371	7. 41. 54.889	90.589	86.724	3.865	13.673	a	-0.090	-0.033	
spf4	5.651	150.223	7. 41. 52.062	87.762	84.329	3.433	13.673	a	-0.376	-0.319	SLOWNESS = 14.5
spf6	5.419	150.477	7. 41. 49.184	84.884	81.165	3.719	13.680	a	0.115	0.172	seconds/degree
spe1	5.261	151.363	7. 41. 46.735	82.435	78.996	3.439	13.680	a	-0.040	0.017	
spf1	5.083	151.637	7. 41. 44.424	80.124	76.564	3.560	13.680	a	0.234	0.291	
spg1	4.949	152.028	7. 41. 42.392	78.092	74.725	3.367	13.700	a	0.148	0.205	
sph1	4.735	152.539	7. 41. 39.205	74.905	71.795	3.110	13.700	a	0.068	0.125	
spi1	4.616	153.409	7. 41. 37.508	73.208	70.172	3.036	13.700	a	0.099	0.156	
spj1	4.404	154.615	7. 41. 34.355	70.055	67.263	2.792	13.700	a	0.024	0.081	
spk1	4.260	154.924	7. 41. 32.141	67.841	65.298	2.543	13.700	a	-0.099	-0.042	

TABLE 4

AZ	DELTA	EARLIEST RESIDUAL	EARLY STATIONS	RESIDUAL ANOMALY	ANGLE
SE	4 - 7 deg	-0.35 s (sp51)	sp41 - sp81	.6 - .7 s?	---
	30 - 42	-0.75 (sp51)	sp31 - sp81	.75 -1.05	44 deg
	42 - 60		sp61 - spe1		49
	60 - 80	-0.85 (sp71)	sp41 - sp91, spa1 - spe1?	.85 -1.1	60
	80 - 100	-0.85 (sp51)	sp51 - sp81, sp91 - spe1	.5 - .65	64
	PcP 37 - 40	-1.1 (sp71)	sp51 - sp81, sp91 - spd1	.85 - .95	74
NW	22 - 25 deg	-0.05 s (sp71)	sp71,sp91,?	.55 s?	32 deg
	25 - 40	-0.45 (sp71)	sp71 - spb1	.6 - .8	41
	40 - 60	-0.65 (sp81)	sp71 - spb1	.8	51
	60 - 80	-0.65 (sp71)	sp71 - spb1, sp51 - sp61?	.7	61
	80 - 100	-0.45 (sp81)	sp81 - spb1	.65	66
	PkikP 123	-0.6 (sp81)	sp51 - sp91	.8	80
	PcP 36 - 39	-0.65 (sp71)	sp61 - spb1	.9 -1.1	75

FIGURE CAPTIONS

Figure 1. Map of Oregon South Cascade Range teleseismic stations. Geology is from the U.S. Geological Survey and the California Division of Mines and Geology (1966), Walker and King (1969), and Walker (1977).

2a-f. Seismograms for events from various azimuths and distances as annotated. See Table 2 for event locations and Table 3 for traveltimes and residuals. Seismograms are aligned at the pick times to show coherence. Pick qualities are shown in parenthesis next to station names. Second ticks are displayed along the bottom of each figure; 0.1 and 0.25 s ticks bracket the longer second mark used to align traces.

3a-c. Weighted relative residuals (s) vs. station elevations (km) for all events, grouped by azimuth. See text for explanation of weighting.

4. Schematic diagram of proposed velocity structure beneath southwestern Oregon and the Cascade Range, in a northwest-southeast cross-section beneath the profile of teleseismic stations shown in Figure 1. Schematic is from C.A. Michaelson (oral communication, 1985). Zero depth is at sea level, and the horizontal and vertical scales are the same. The shading indicates anomalously high and low velocity regions. Arrows indicate incident rays from teleseisms.

5a-p. Weighted relative residuals (s) vs. distance (km) along the profile for all events, grouped by azimuth and distance to the event, for P and PKIKP phases. PcP phases are plotted separately. Northwest events are defined as those events with a station-to-origin azimuth of 270-360° . Southeast events have a station-to-origin azimuth of 90-180° . In the plots, northwest is to the left, and southeast is to the right. Station names are at the bottom of each plot. All plots are scaled the same.

Figure 1 OREGON SOUTH CASCADES TELESEISMIC STATIONS

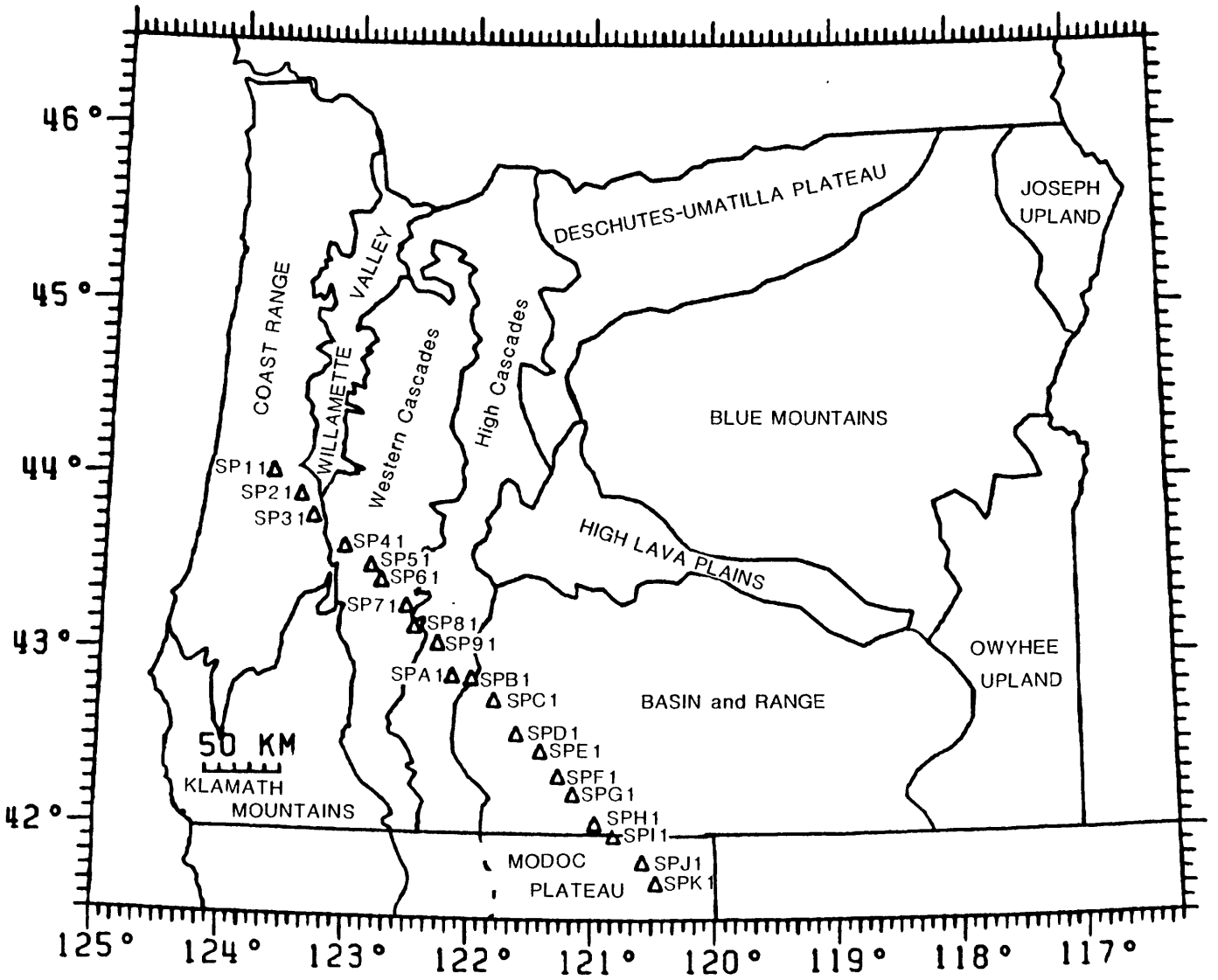


Figure 2.a.

NW az, Delta=79°

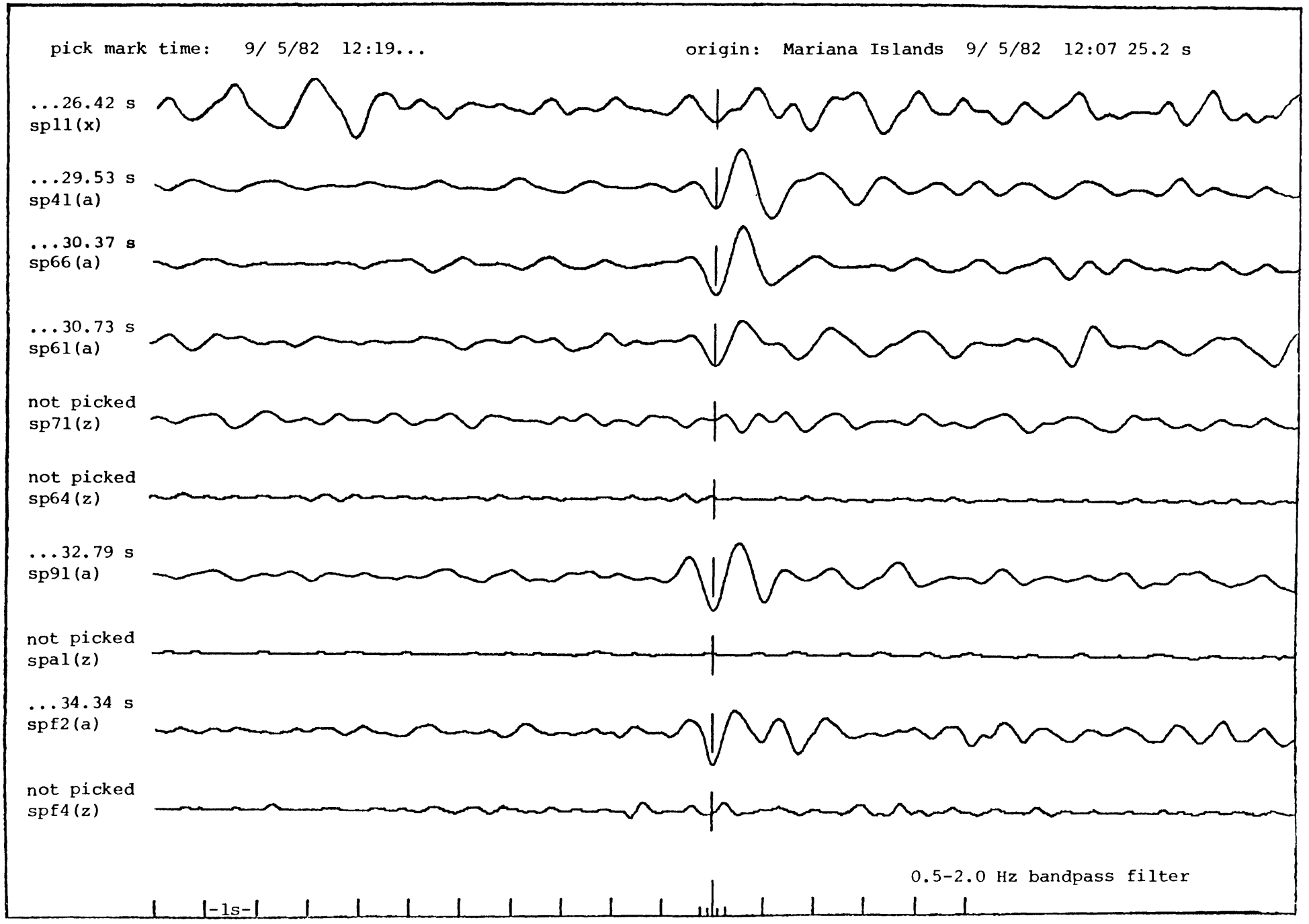


Figure 2.a. (continued)

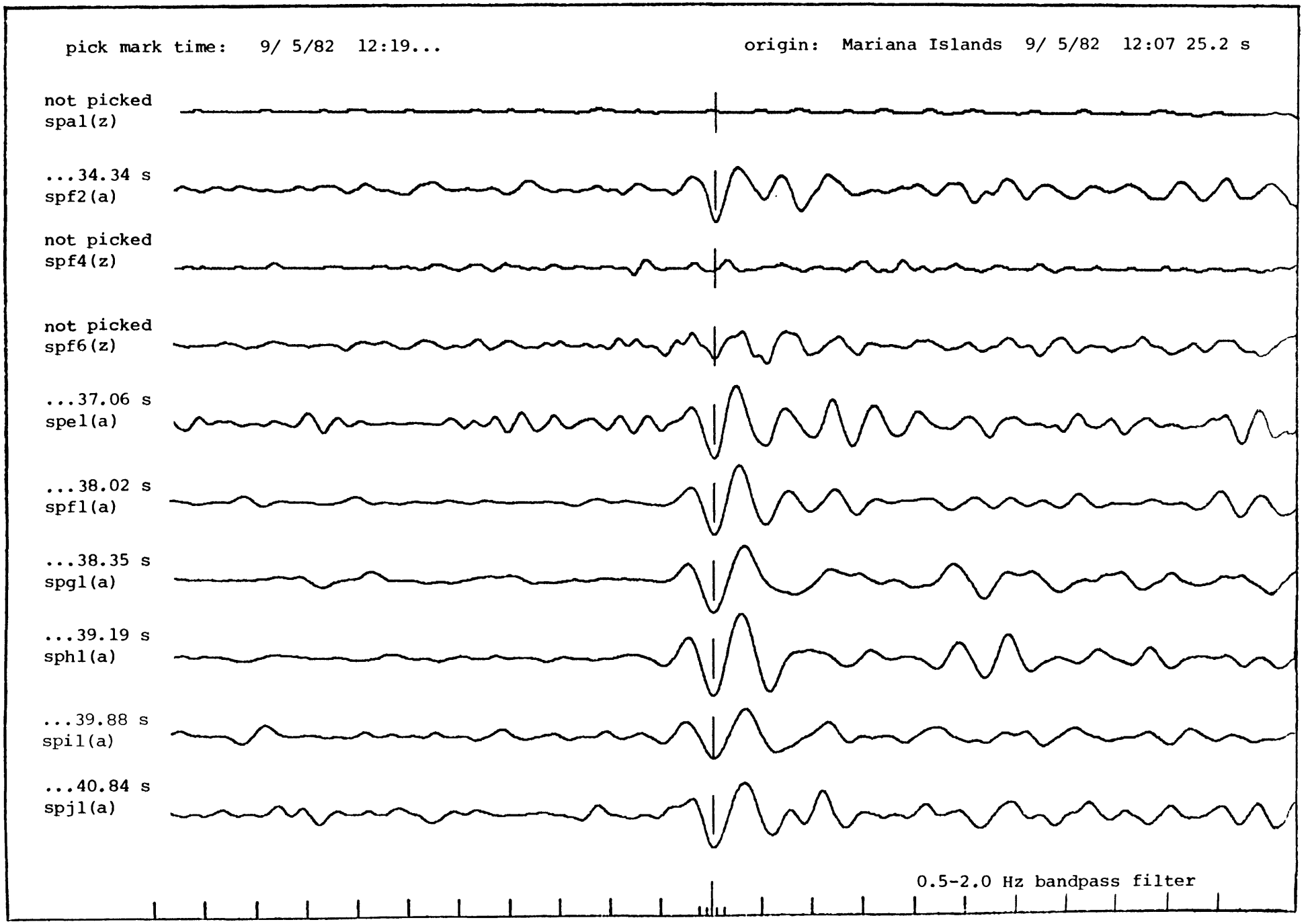


Figure 2.a. (continued)

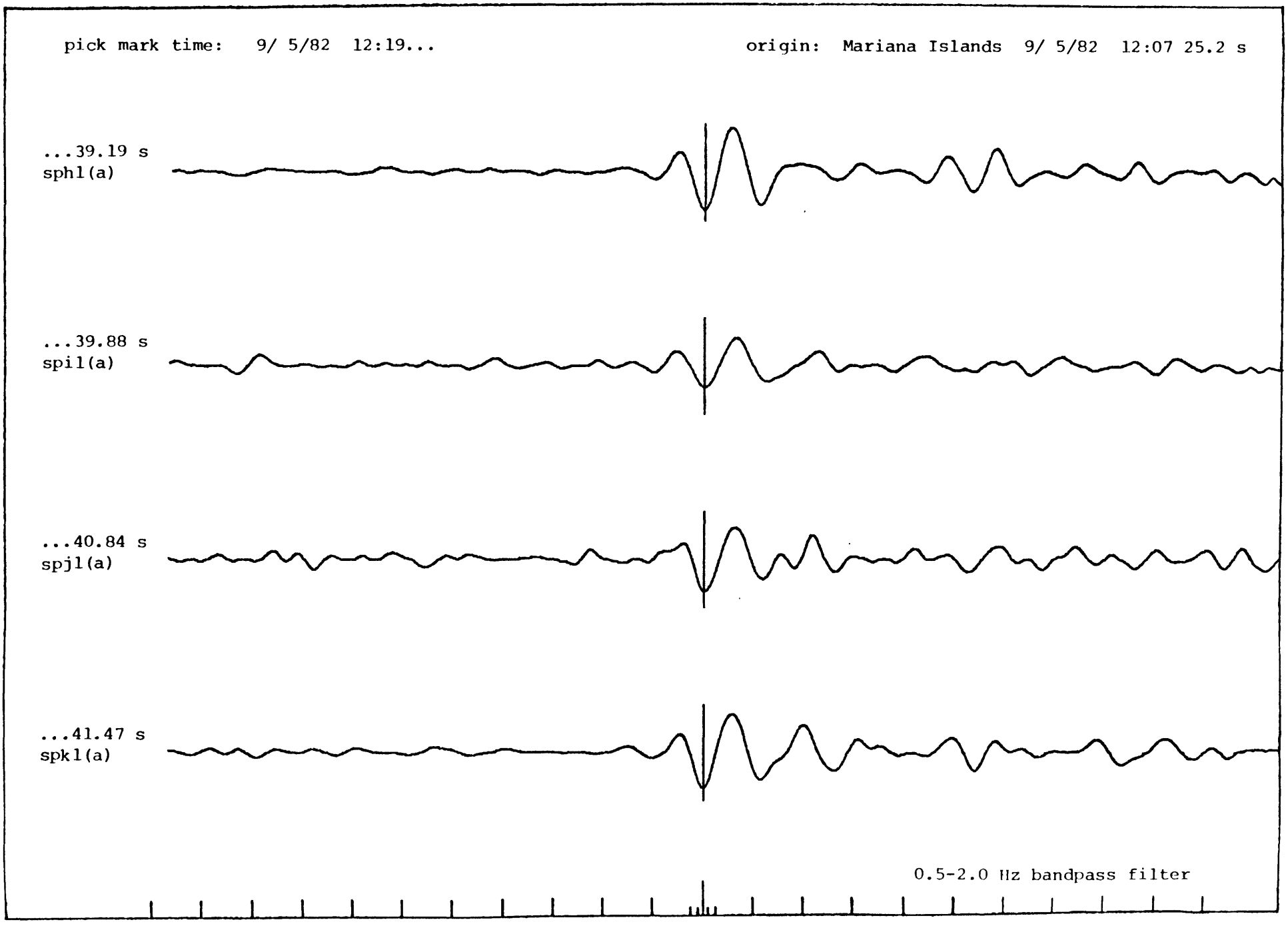


Figure 2.b. SE az. Delta=83° (typical unfiltered event)

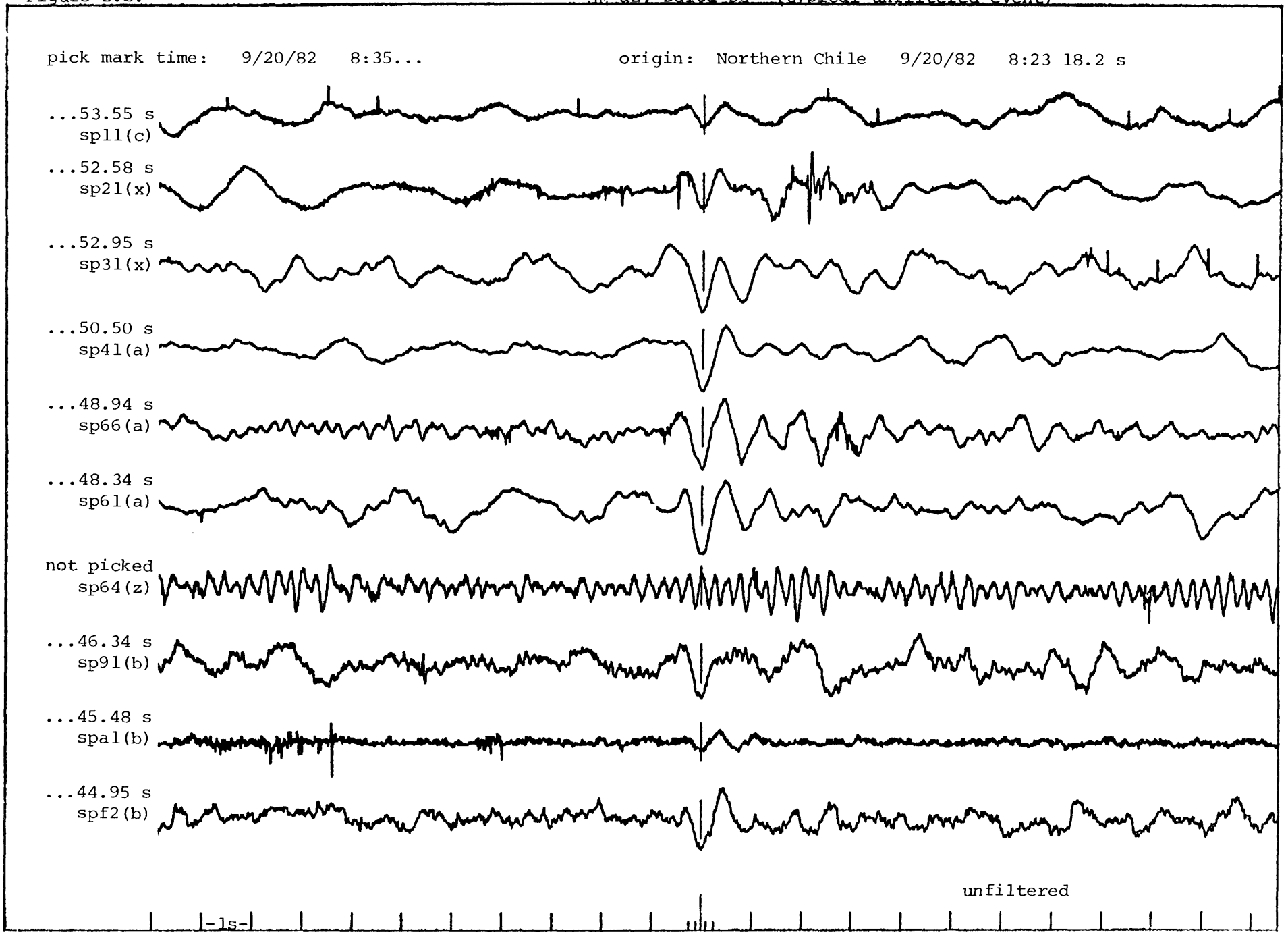


Figure 2.b. (continued)

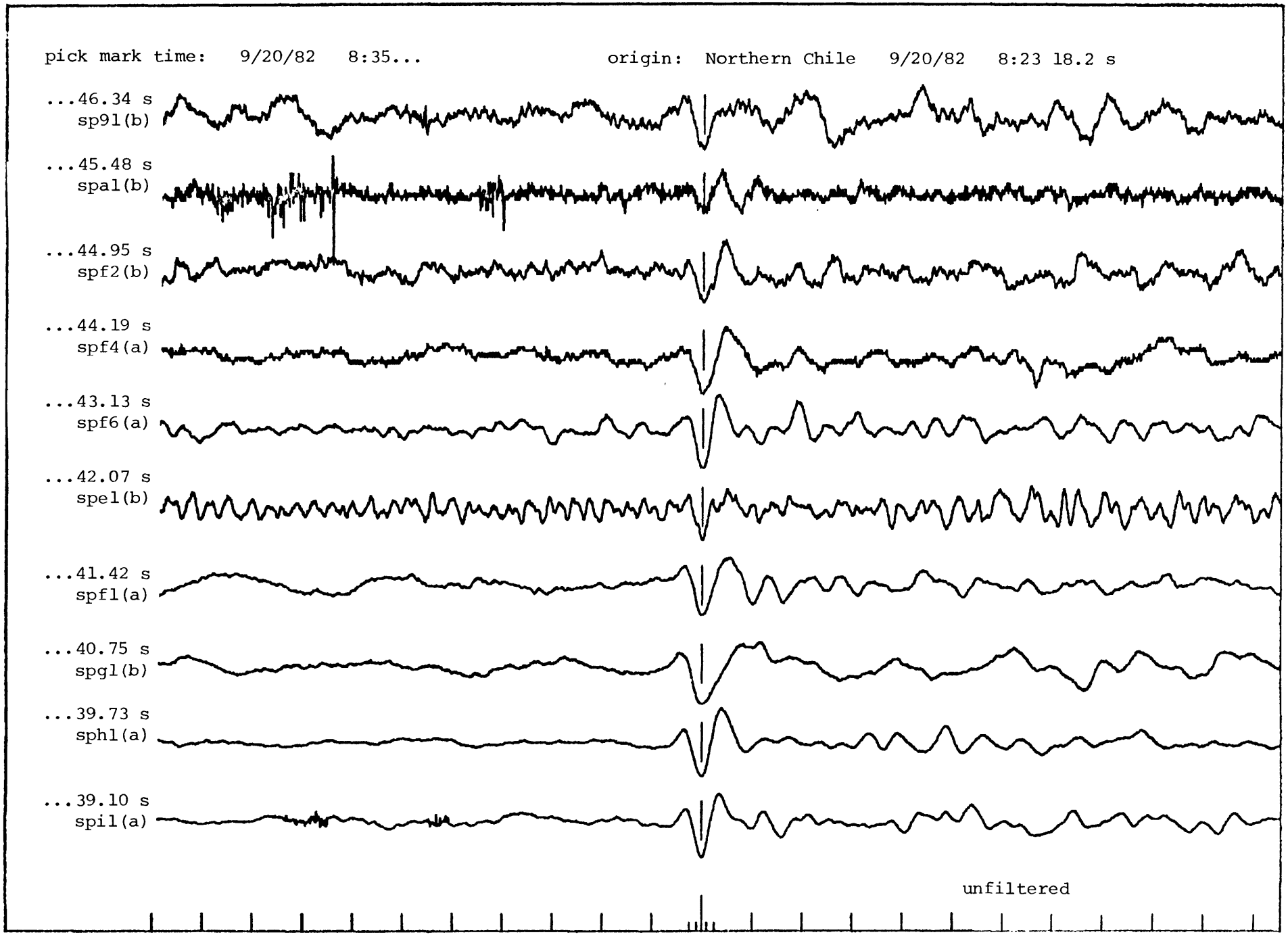


Figure 2.b. (continued)

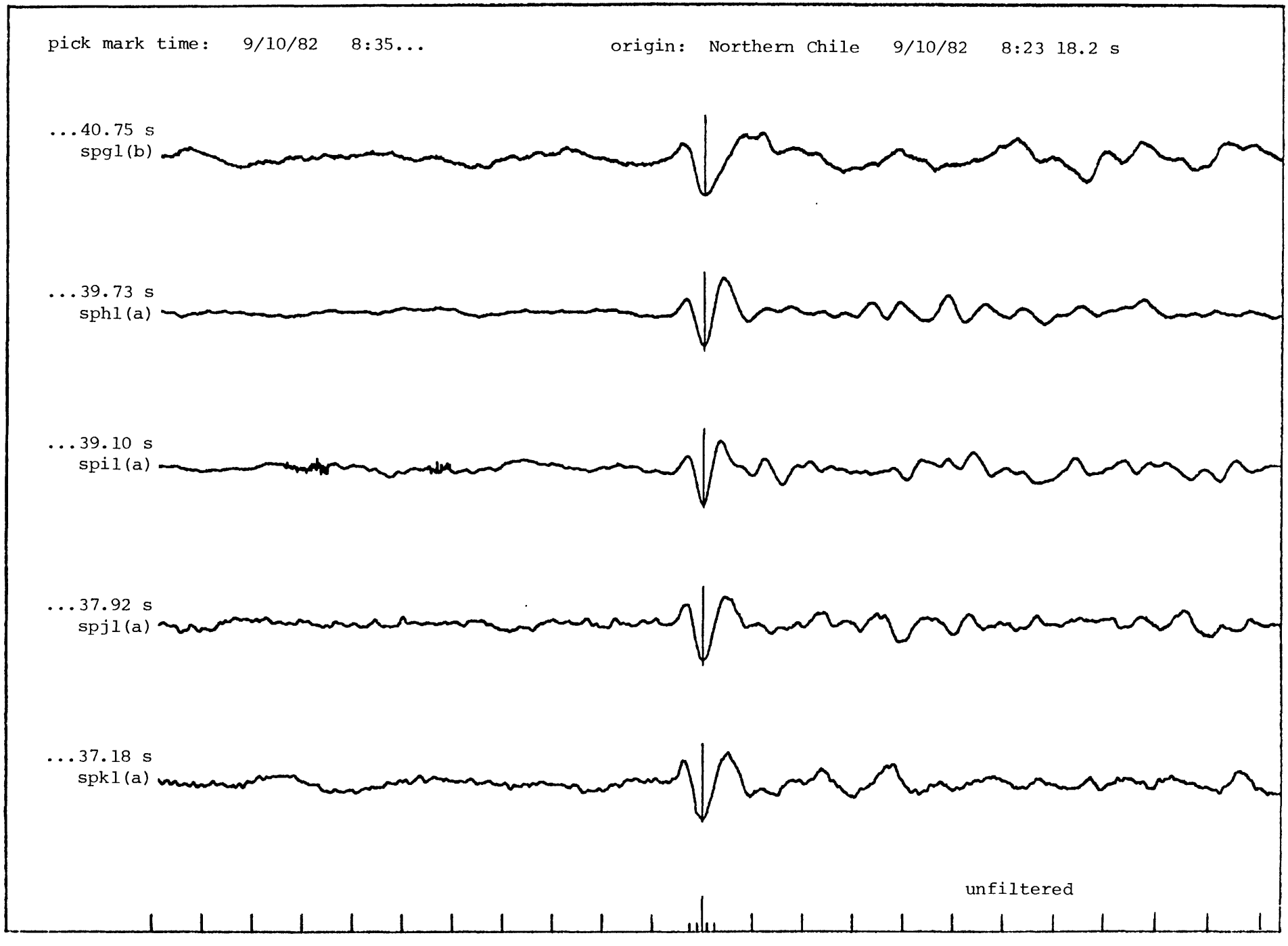


Figure 2.c.

SE az, Delta=75°

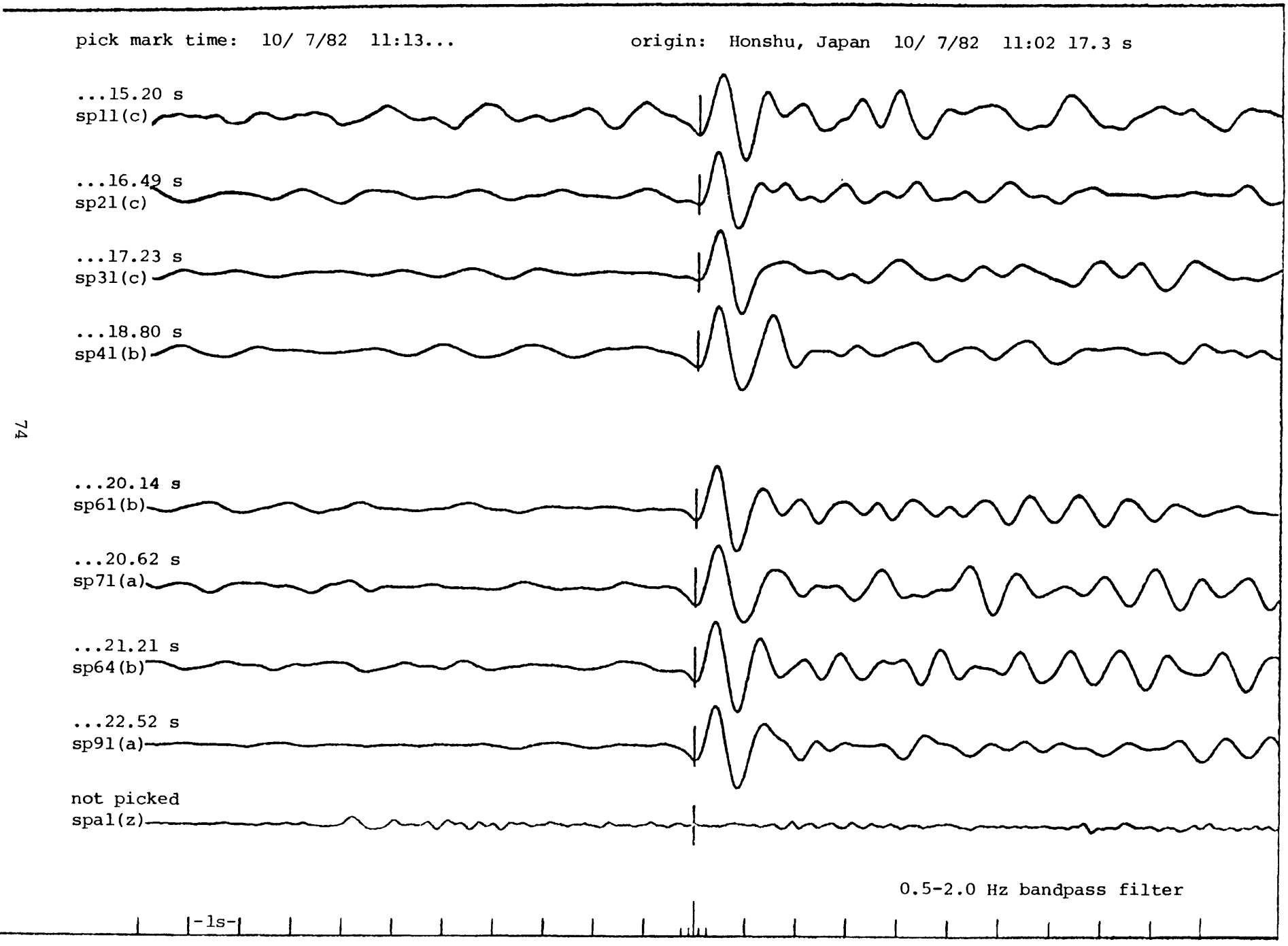


Figure 2.c. (continued)

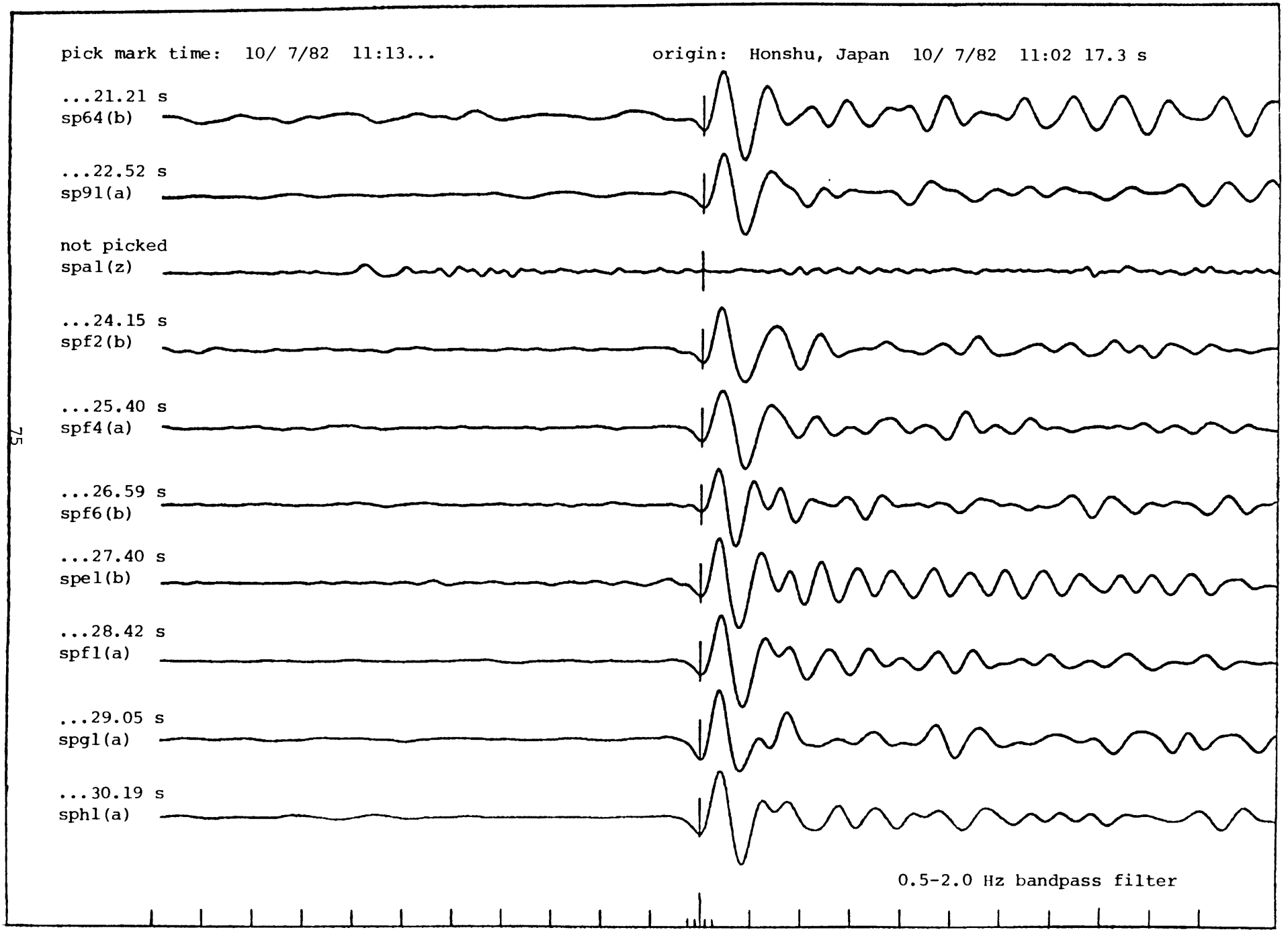


Figure 2.c. (continued)

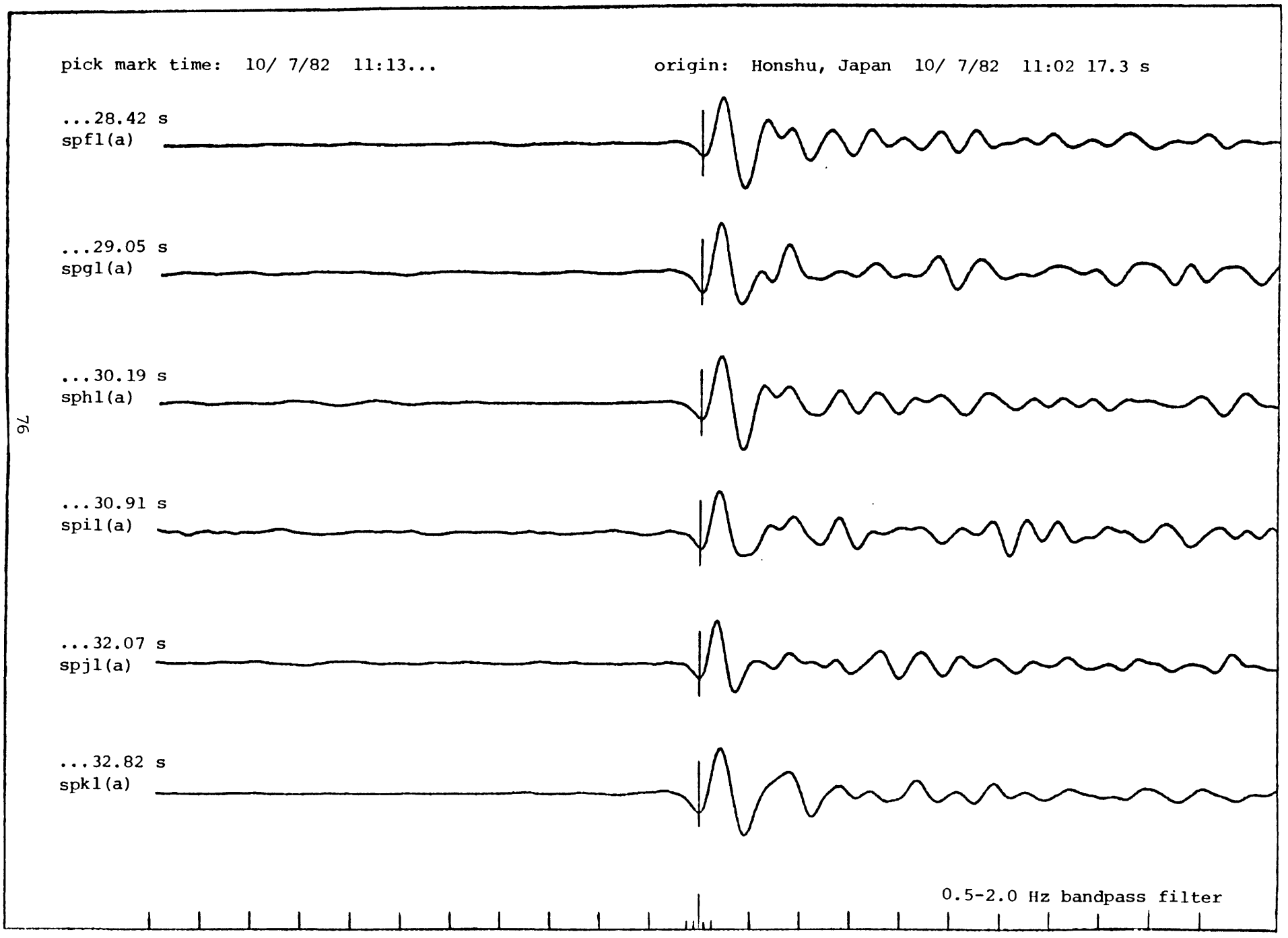


Figure 2.d.

NW az, Delta=37°

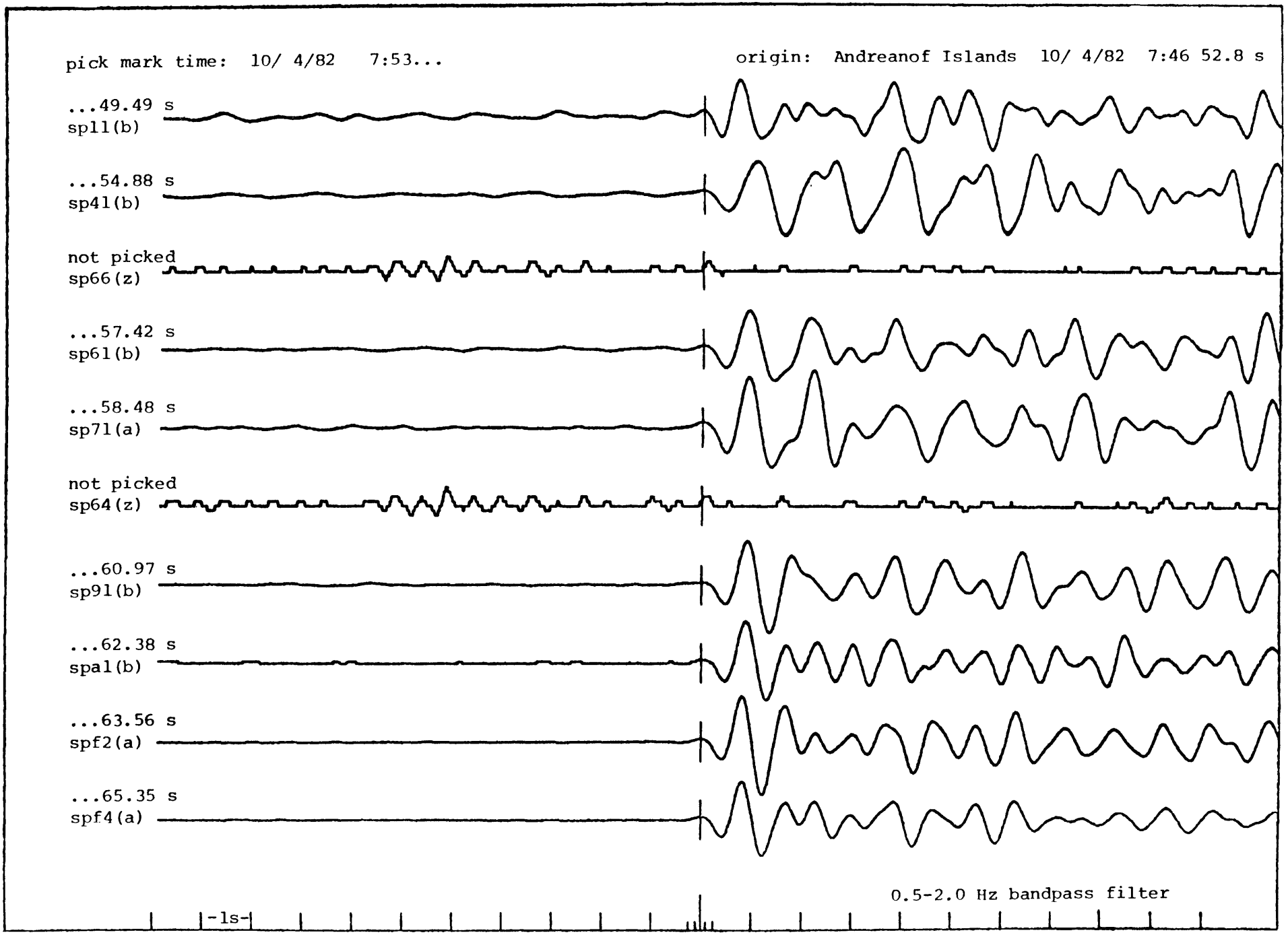


Figure 2.d. (continued)

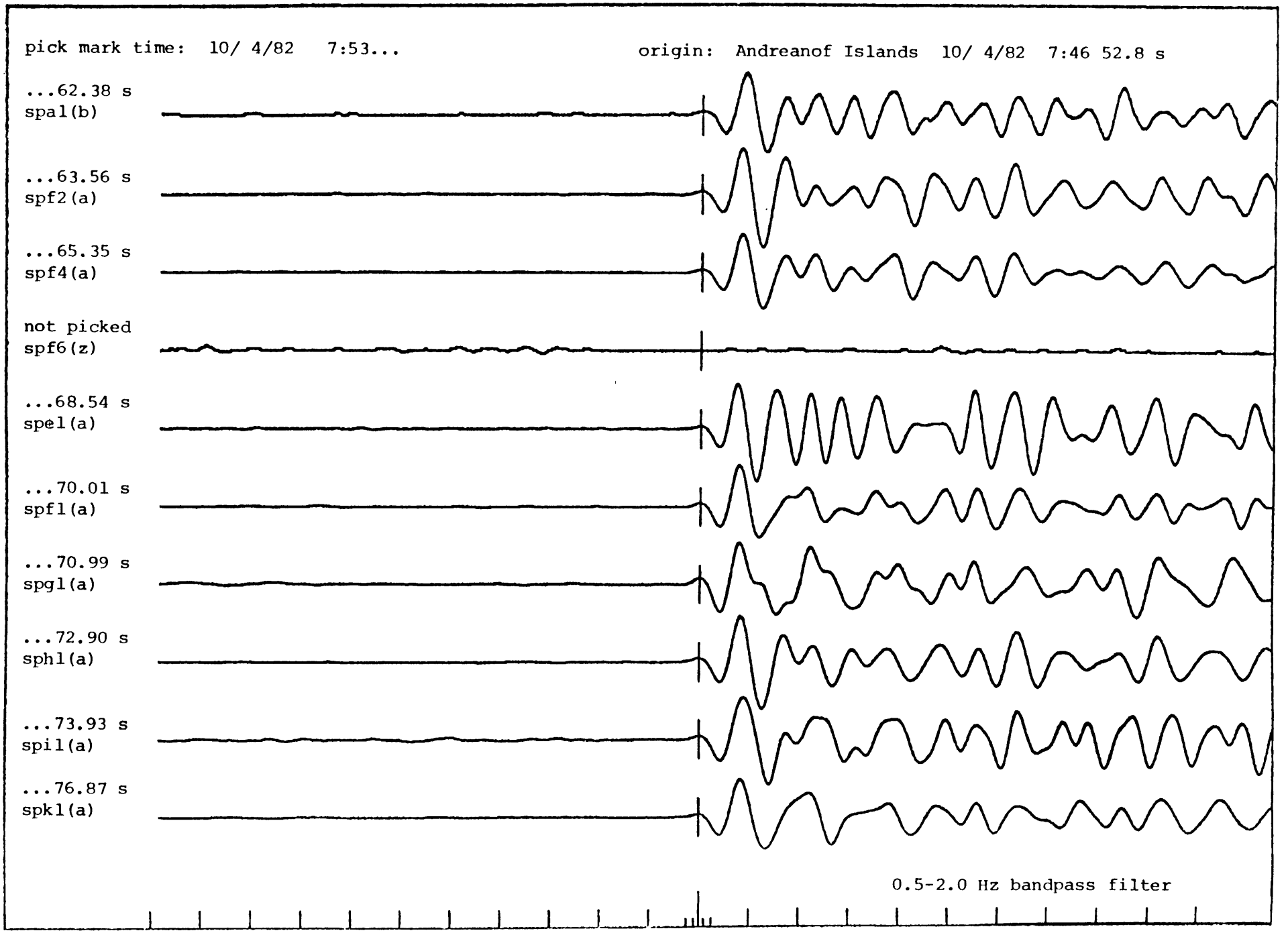


Figure 2.d. (continued)

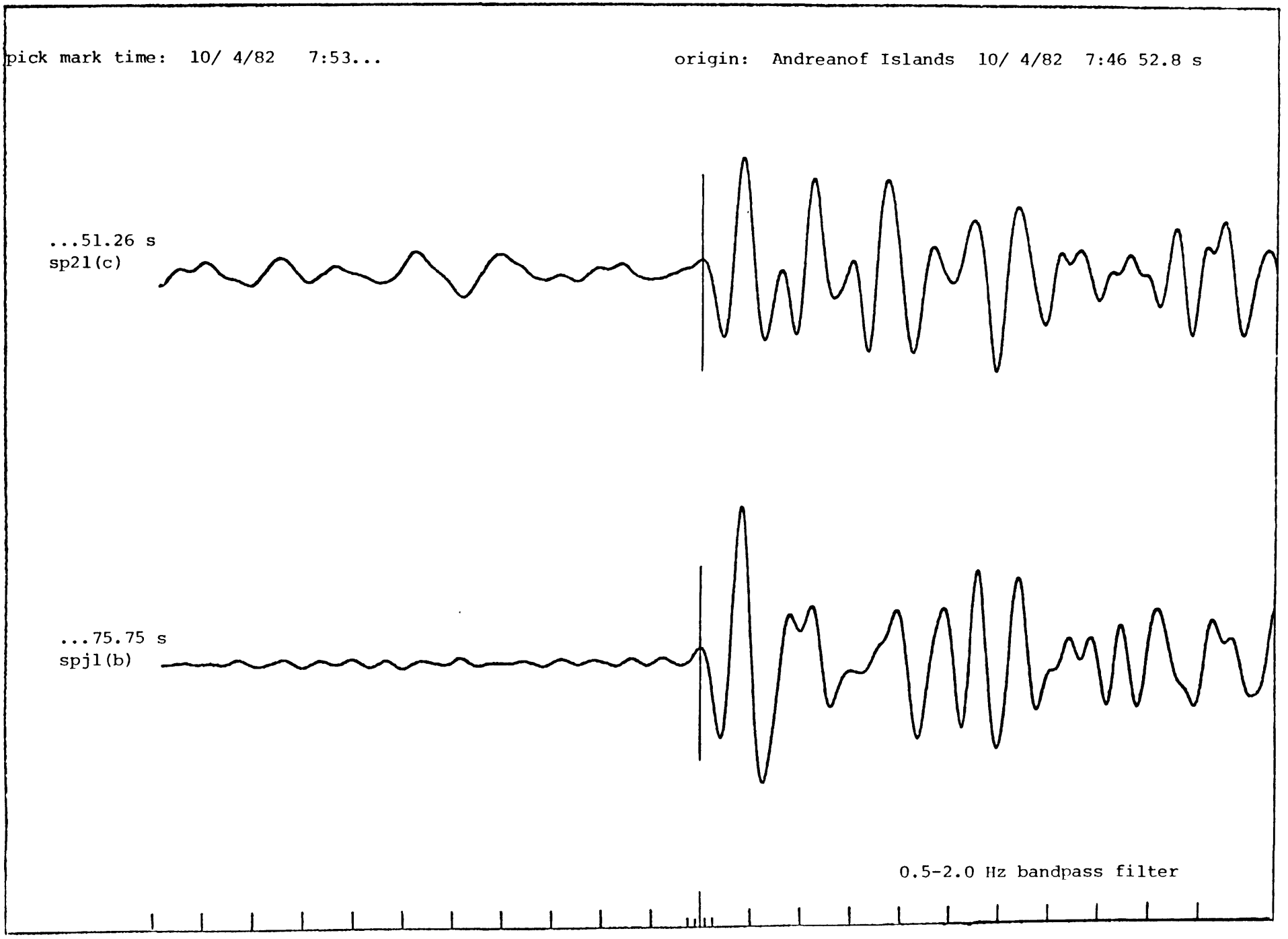


Figure 2.e.

SE az, Delta=39° (typical emergent event)

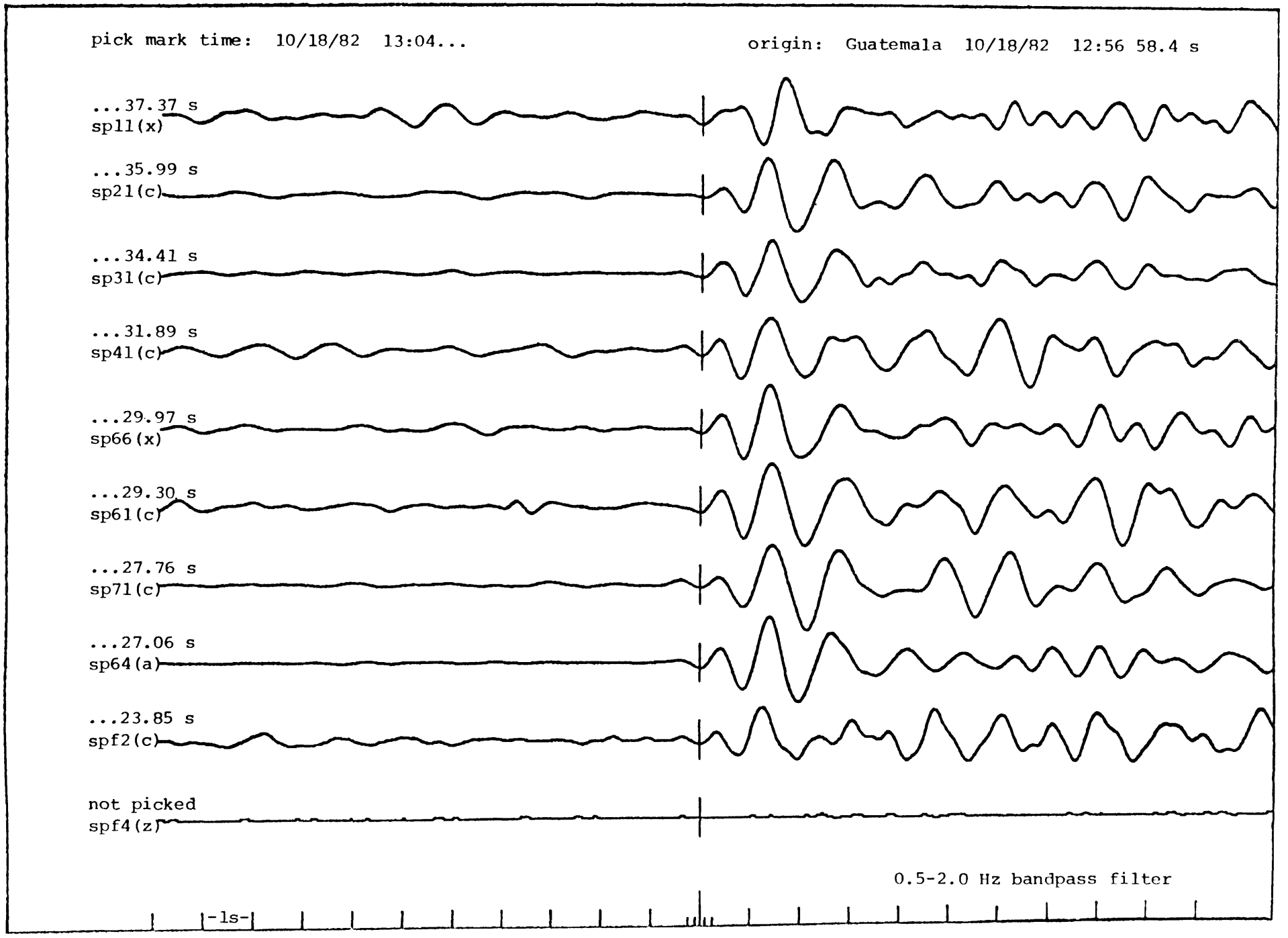


Figure 2.e.

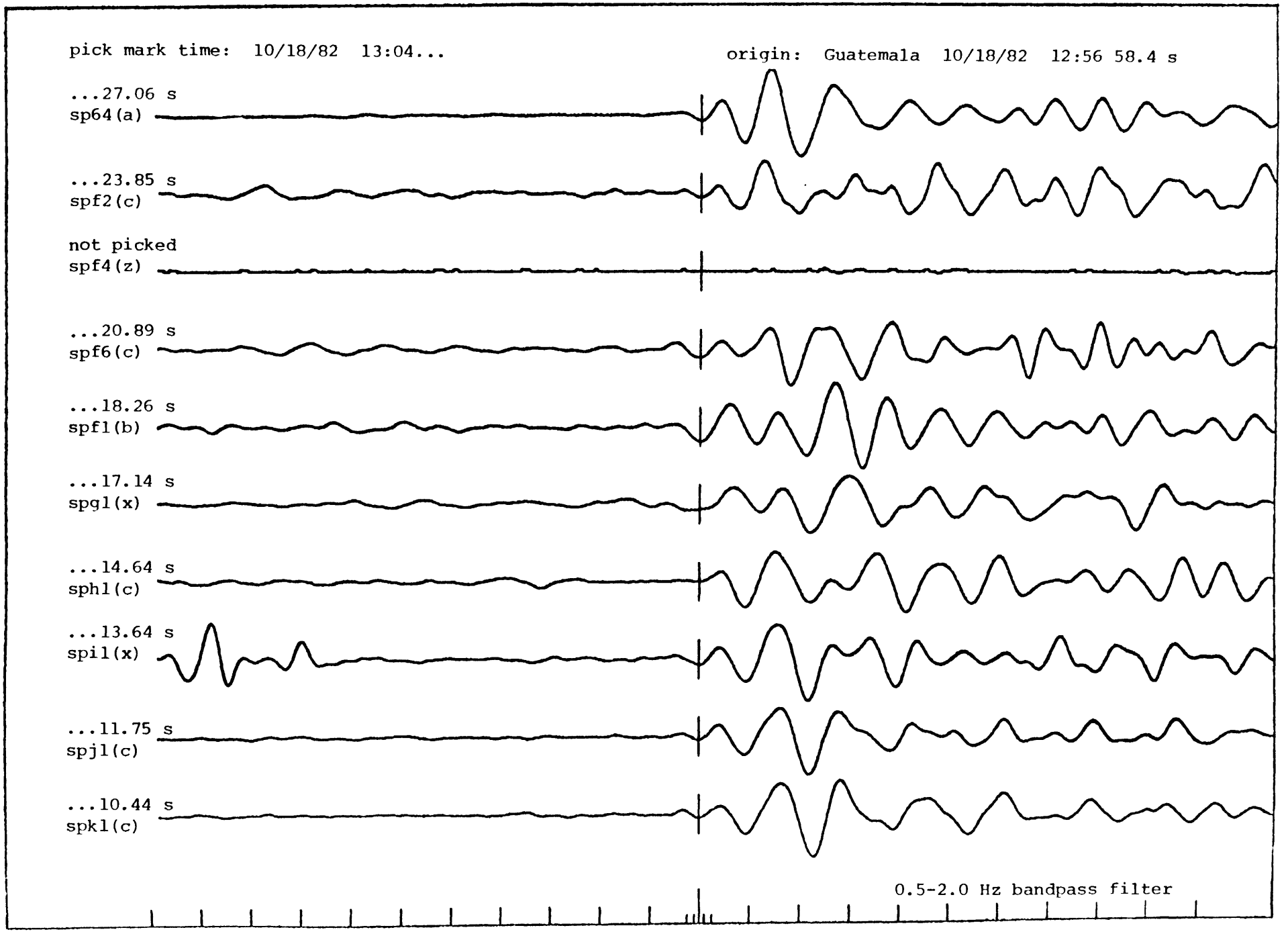

pick mark time: 10/18/82 13:04...
origin: Guatemala 10/18/82 12:56 58.4 s
...27.06 s
sp64(a)
...23.85 s
spf2(c)
not picked
spf4(z)
...20.89 s
spf6(c)
...18.26 s
spf1(b)
...17.14 s
spg1(x)
...14.64 s
sph1(c)
...13.64 s
spi1(x)
...11.75 s
spj1(c)
...10.44 s
spk1(c)
0.5-2.0 Hz bandpass filter

Figure 2.f.

NW az, Delta=123° (PkikP phase)

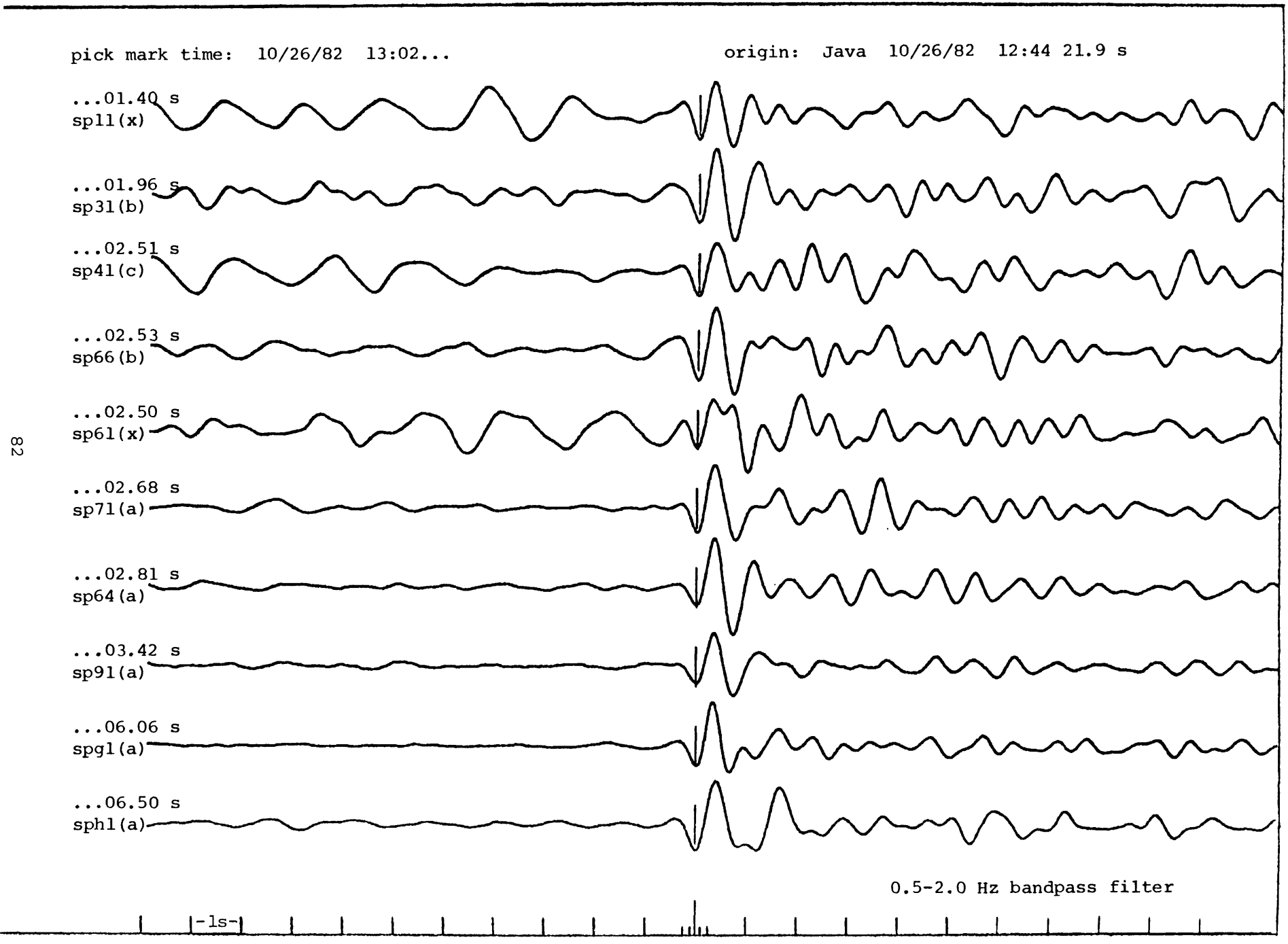


Figure 2.f. (continued)

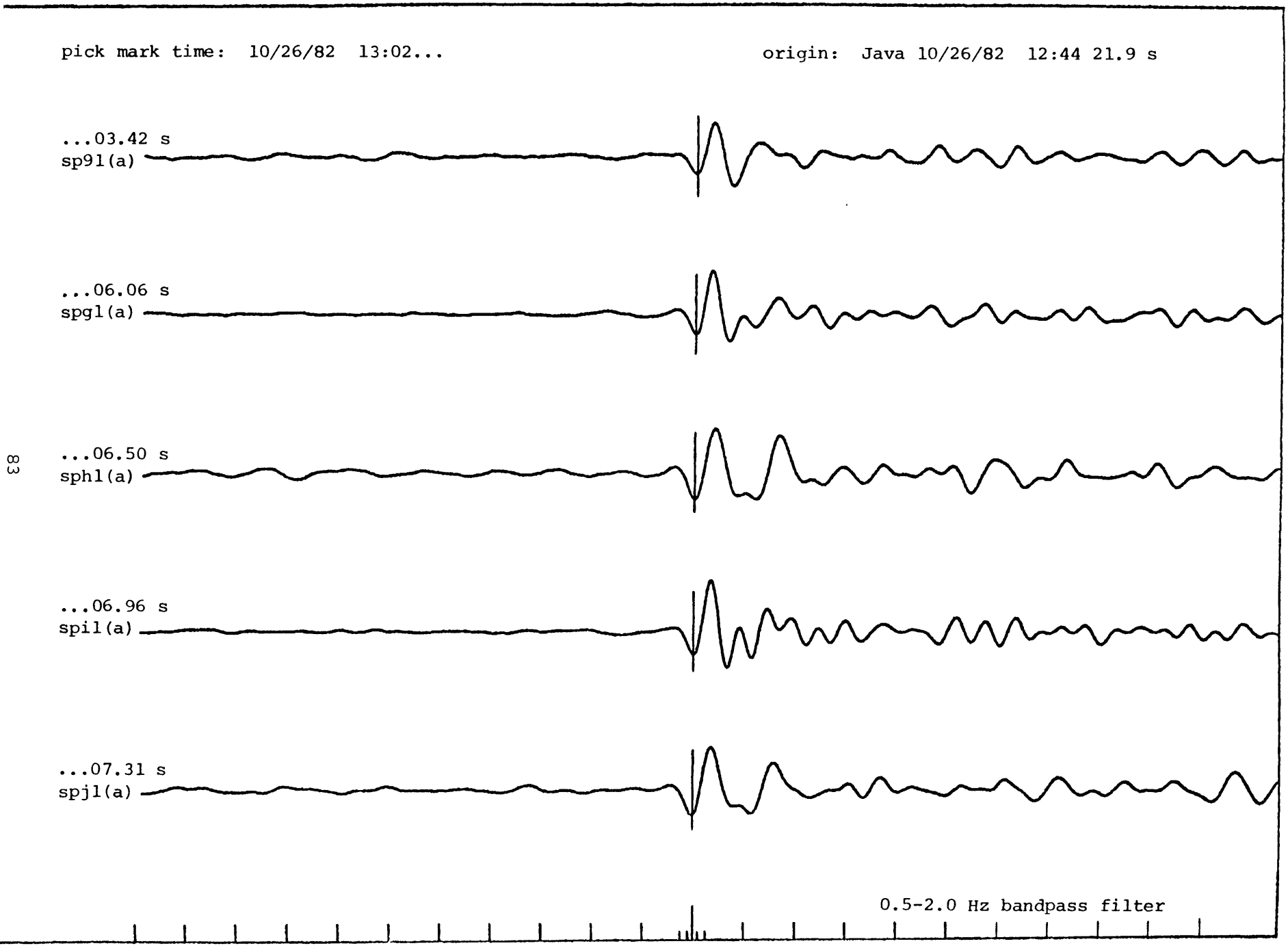


Figure 2.f. (continued)

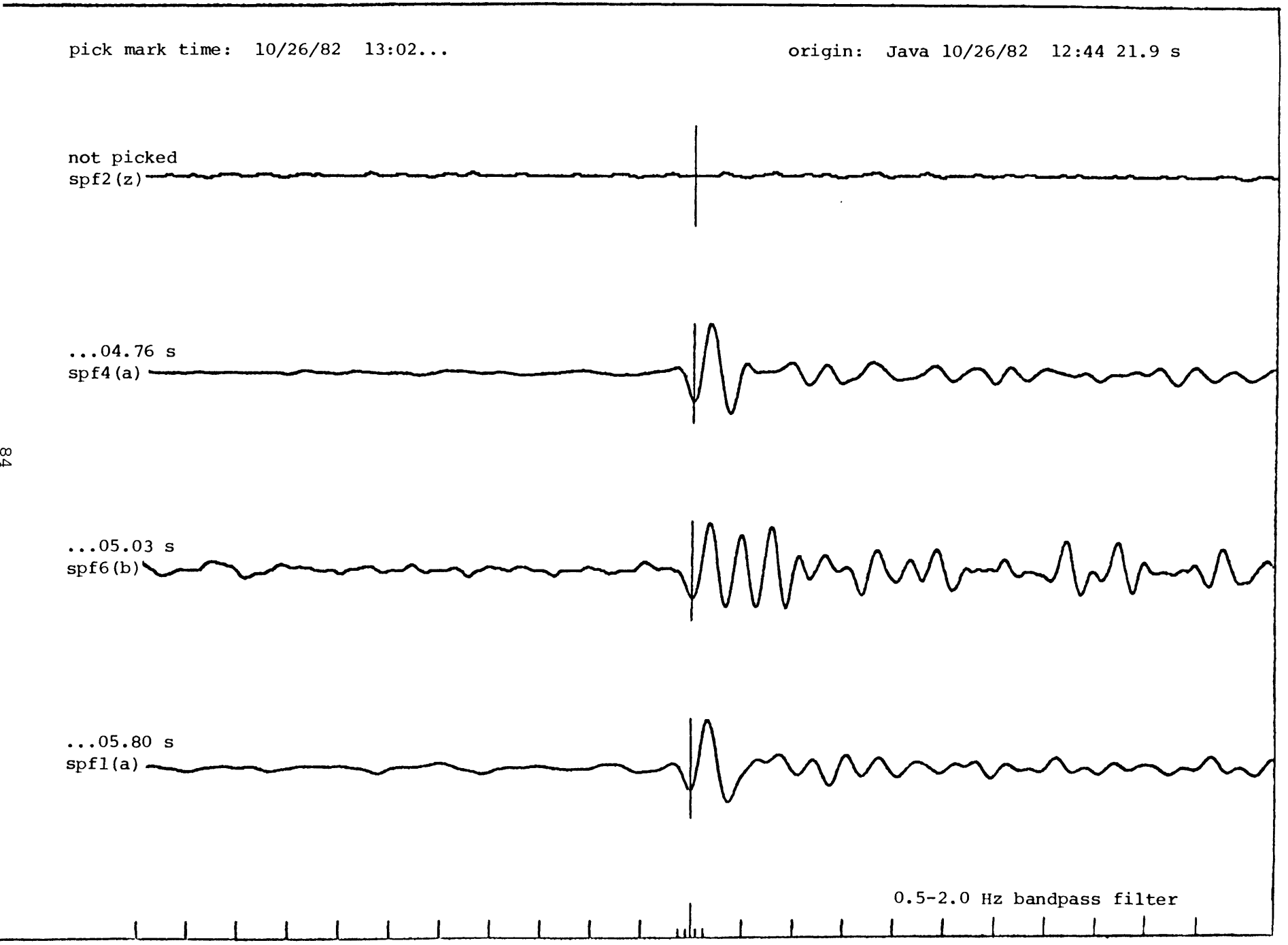


Figure 3.a. Residual versus station elevation for SE teleseisms

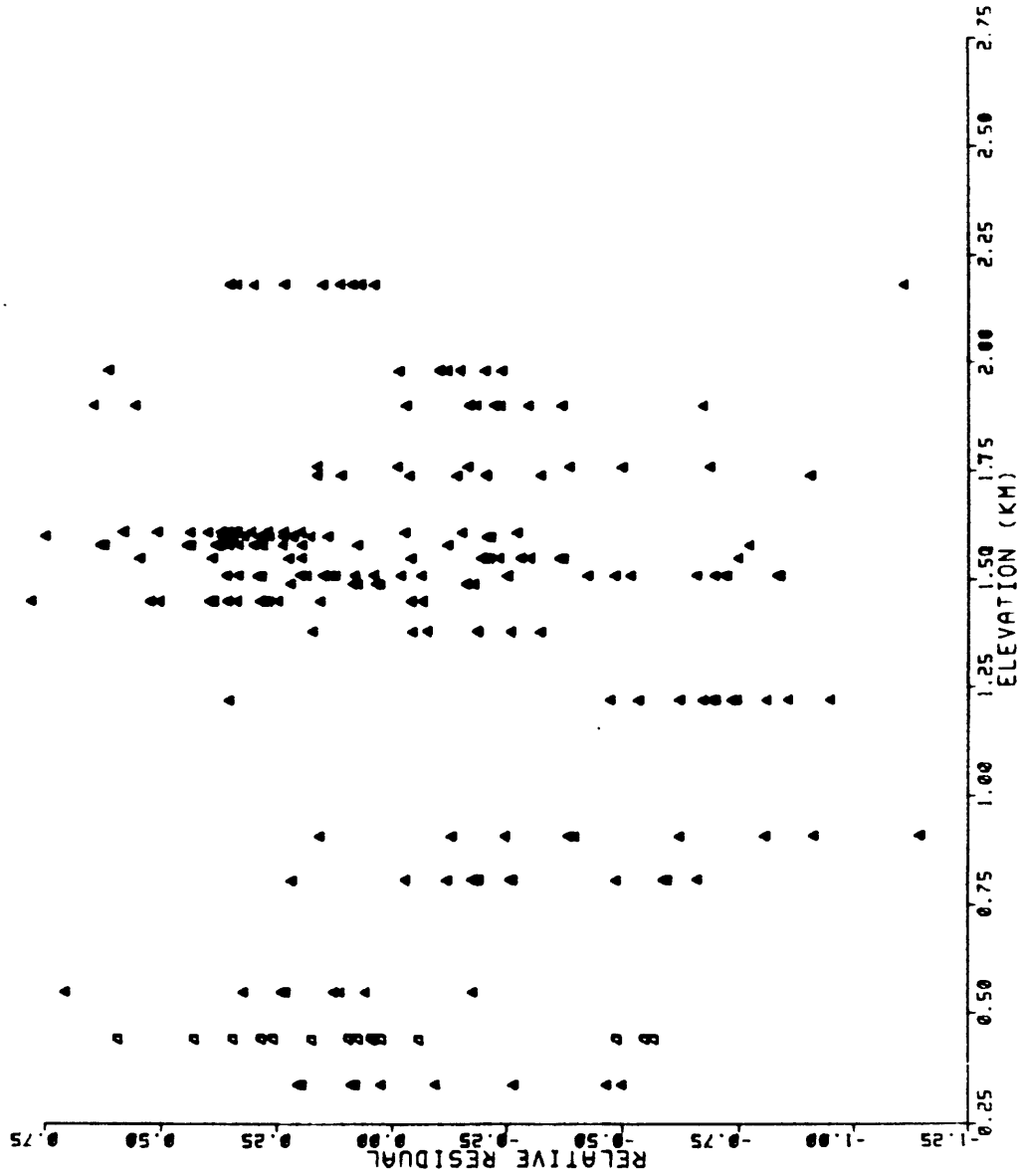


Figure 3.b. Residual versus station elevations for NW teleseisms

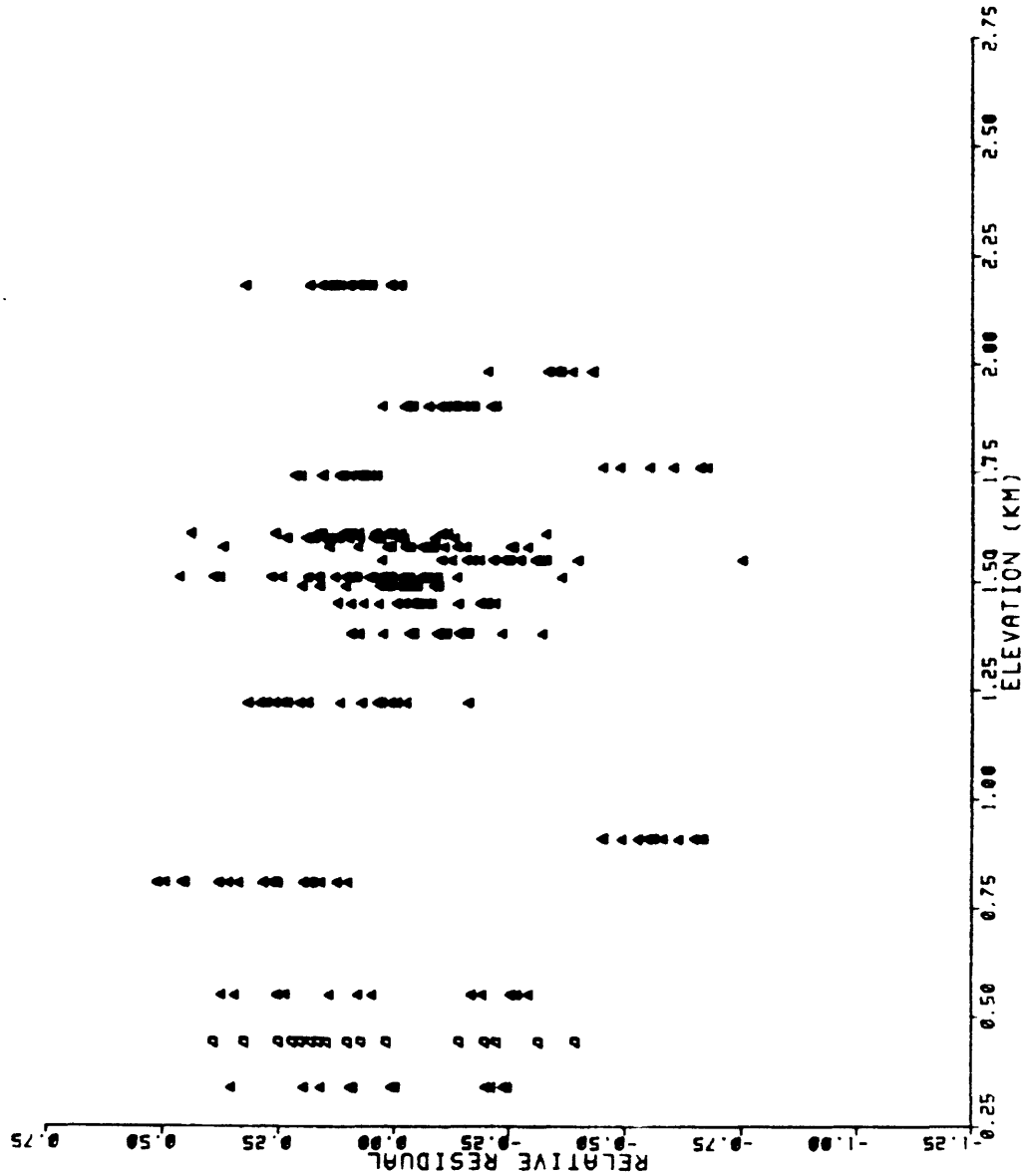


Figure 3.c. Residual versus station elevation for two SW teleseisms

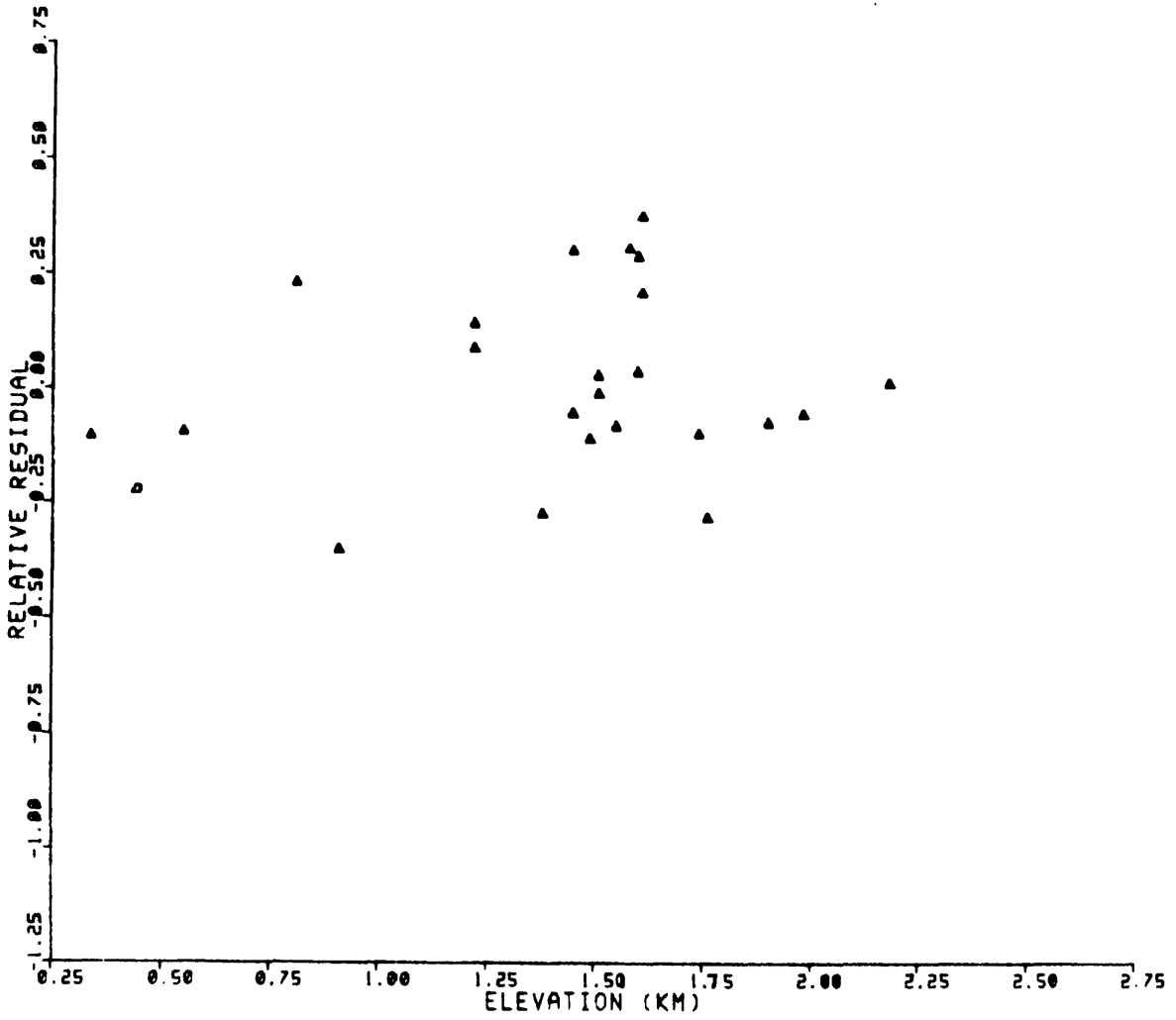


Figure 4

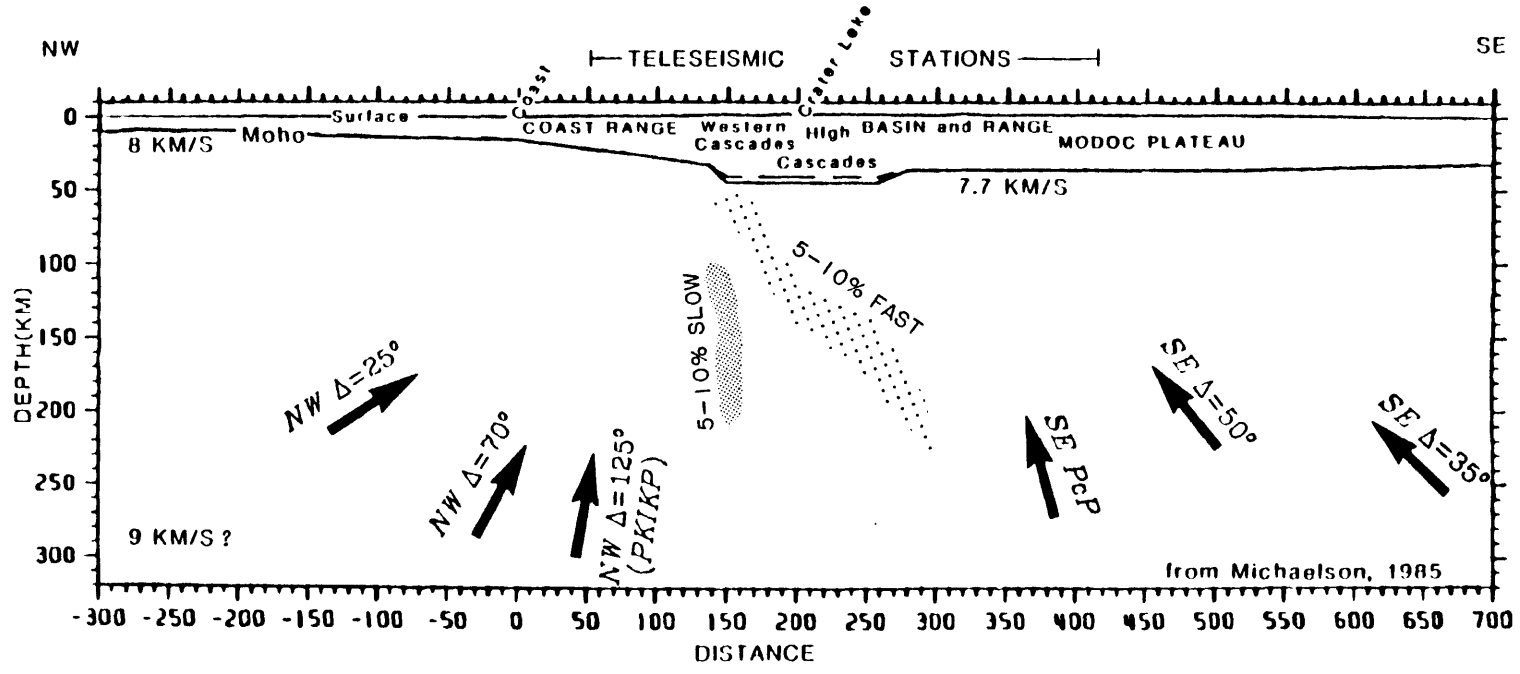

NW
TELESEISMIC
STATIONS
SE
Lassi
Crater Lake
Surface
Moho
8 KM/S
COAST RANGE
Western Cascades
High
Cascades
BASIN and RANGE
MODOC PLATEAU
7.7 KM/S
5-10% FAST
5-10% SLOW
NW Δ=25°
NW Δ=70°
NW Δ=125° (PKIKP)
SE PcP
SE Δ=50°
SE Δ=35°
9 KM/S ?
from Michaelson, 1985
DEPTH(KM)
DISTANCE
0
50
100
150
200
250
300
-300 -250 -200 -150 -100 -50 0 50 100 150 200 250 300 350 400 450 500 550 600 650 700

Figure 5.a.

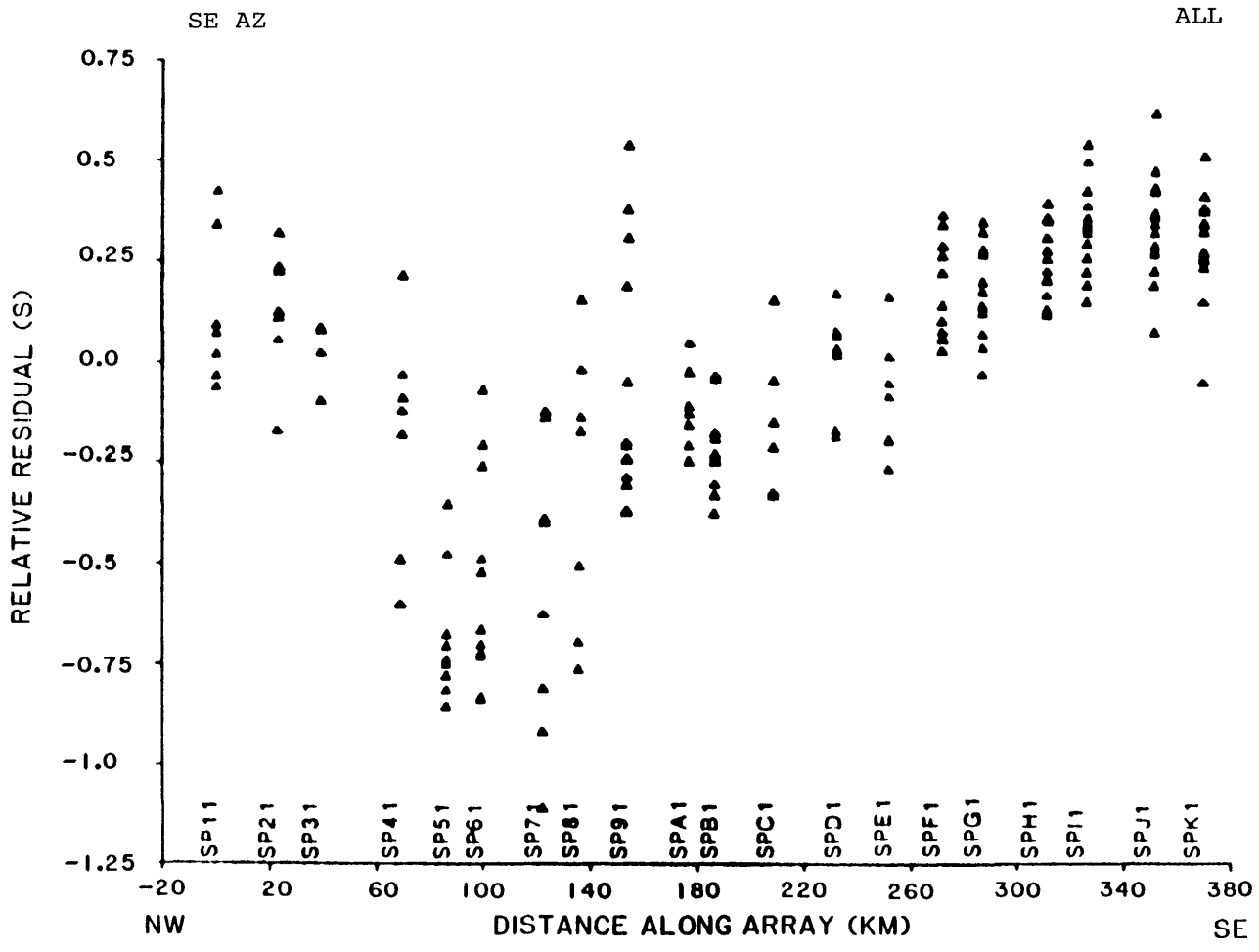

SE AZ
ALL
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.b.

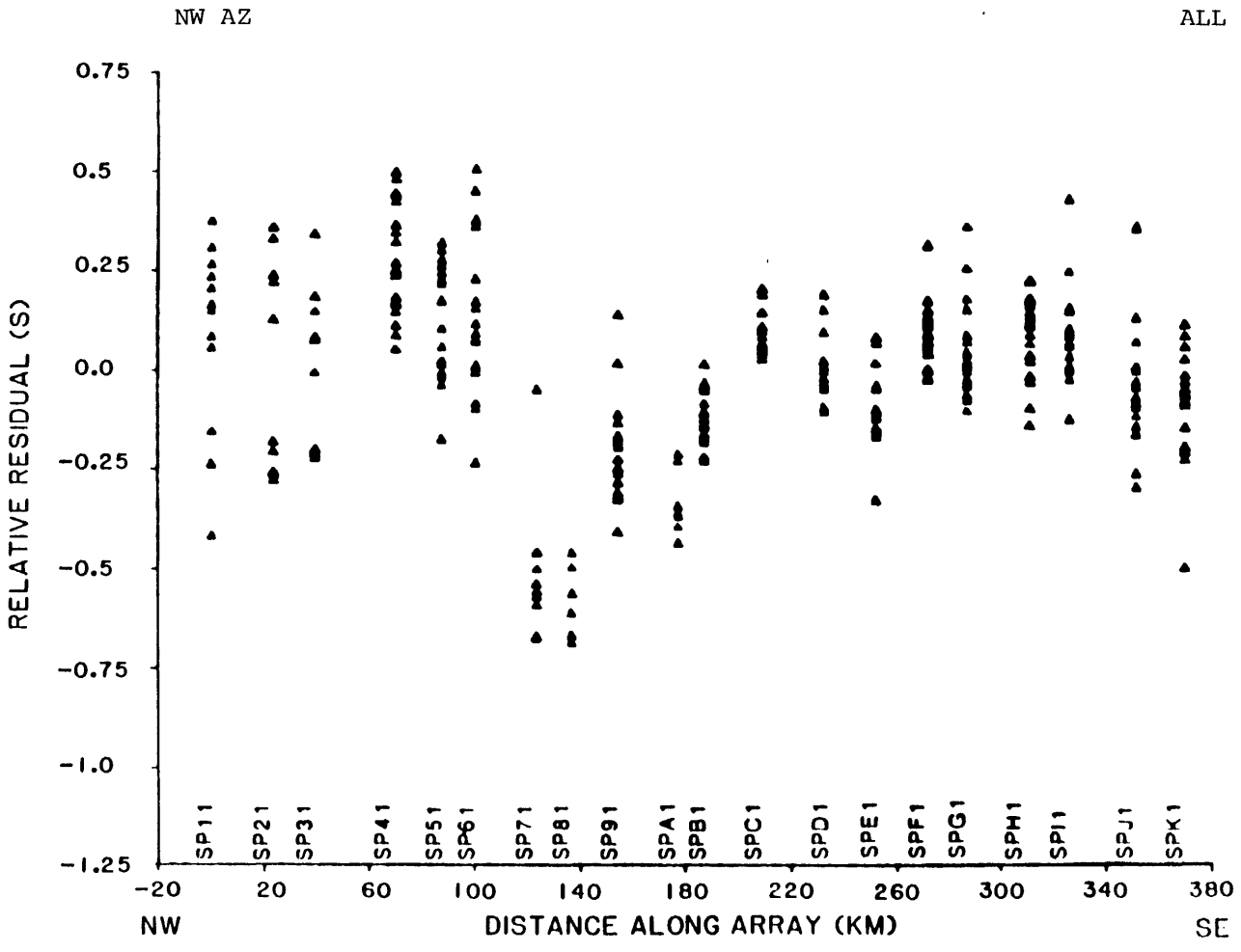

NW AZ
ALL
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.c.

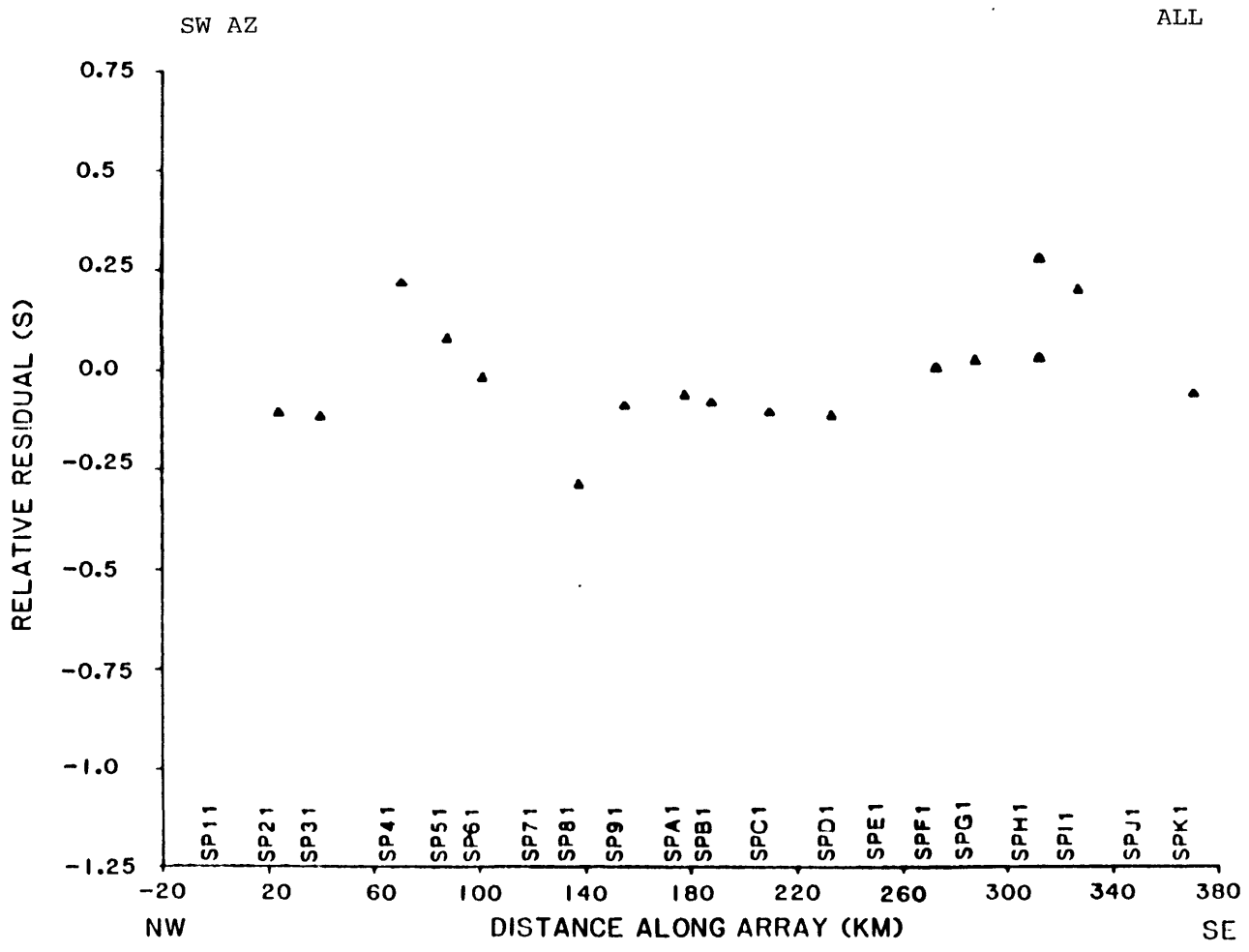

SW AZ
ALL
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.d.

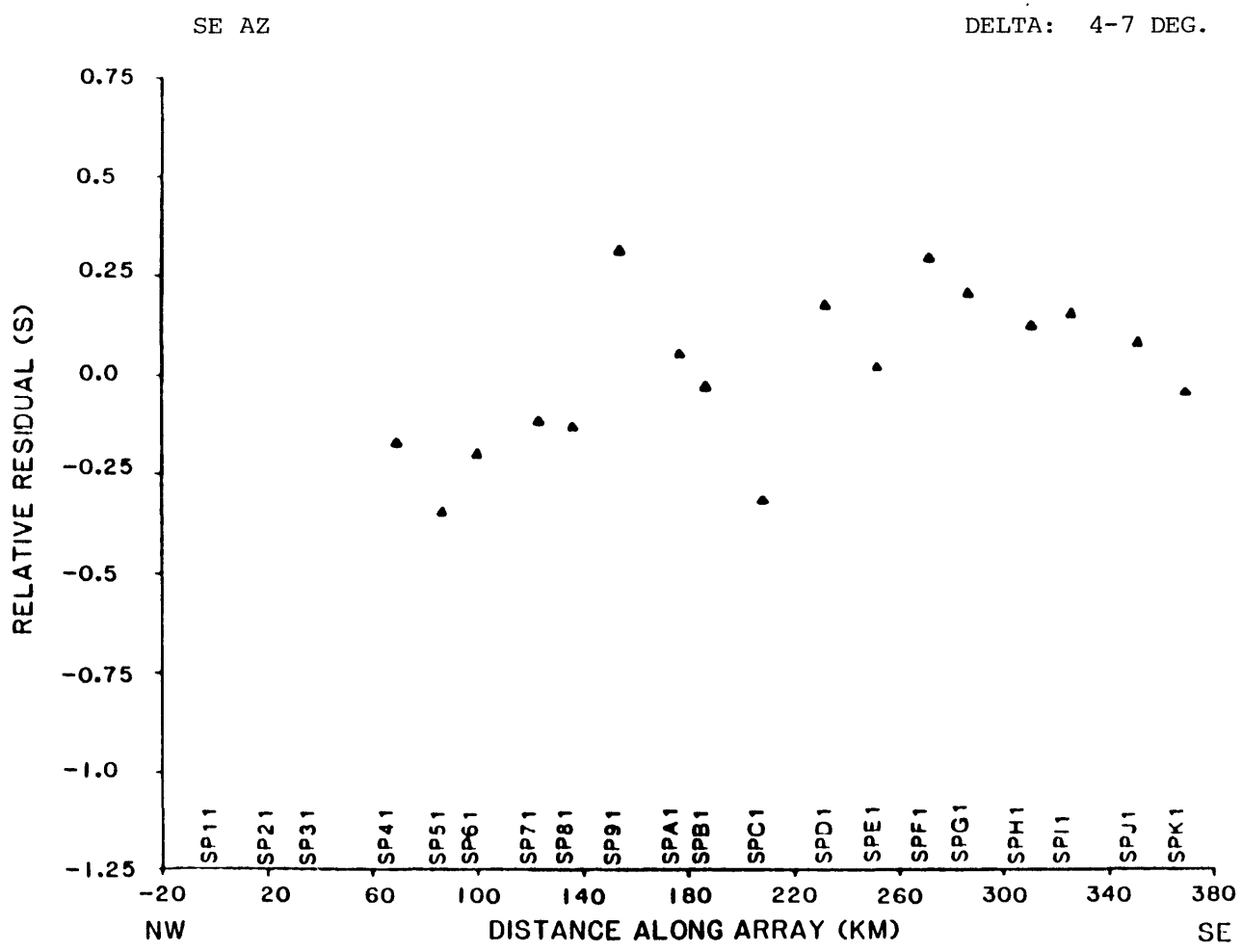

SE AZ
DELTA: 4-7 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.e.

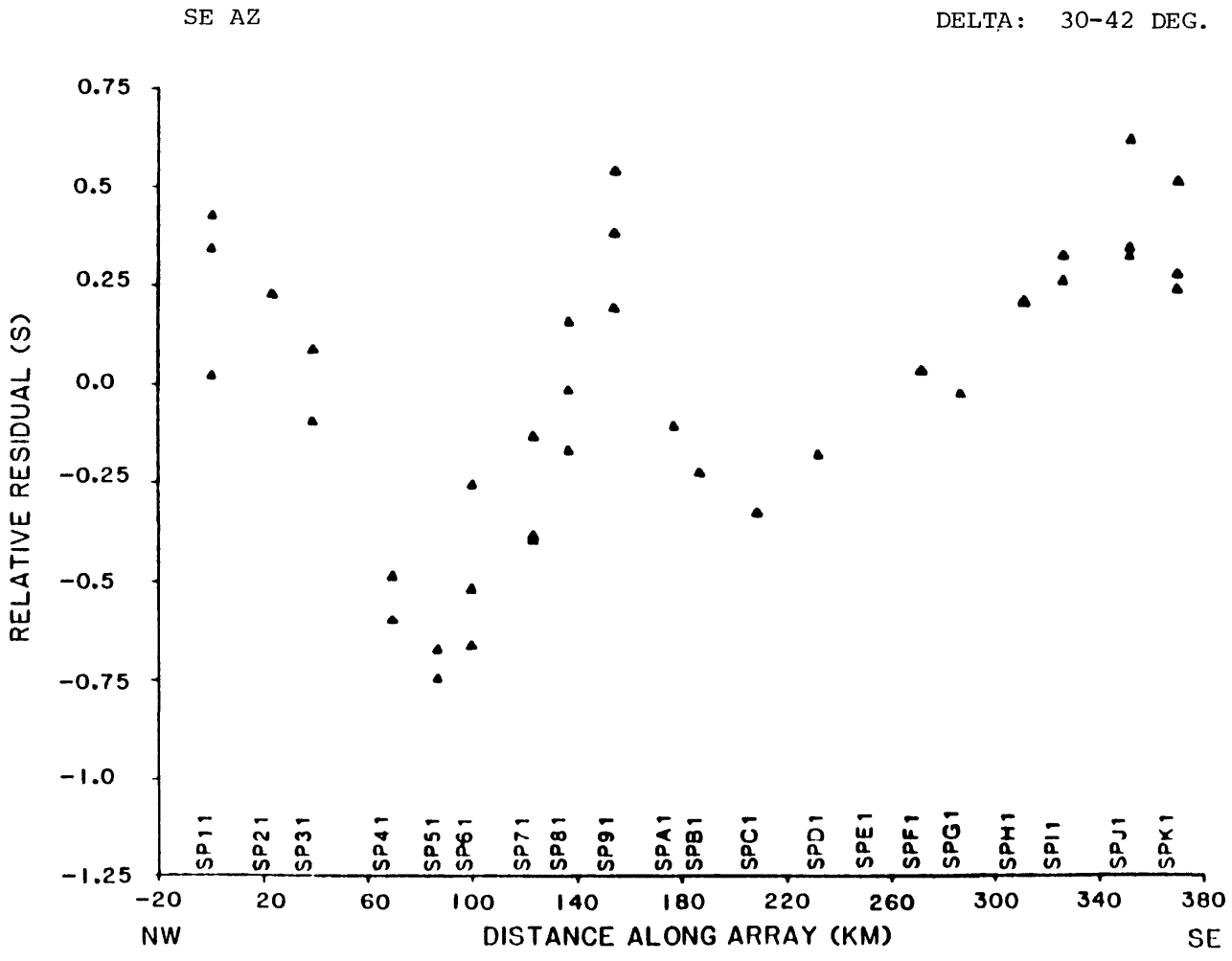

SE AZ
DELTA: 30-42 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.f.

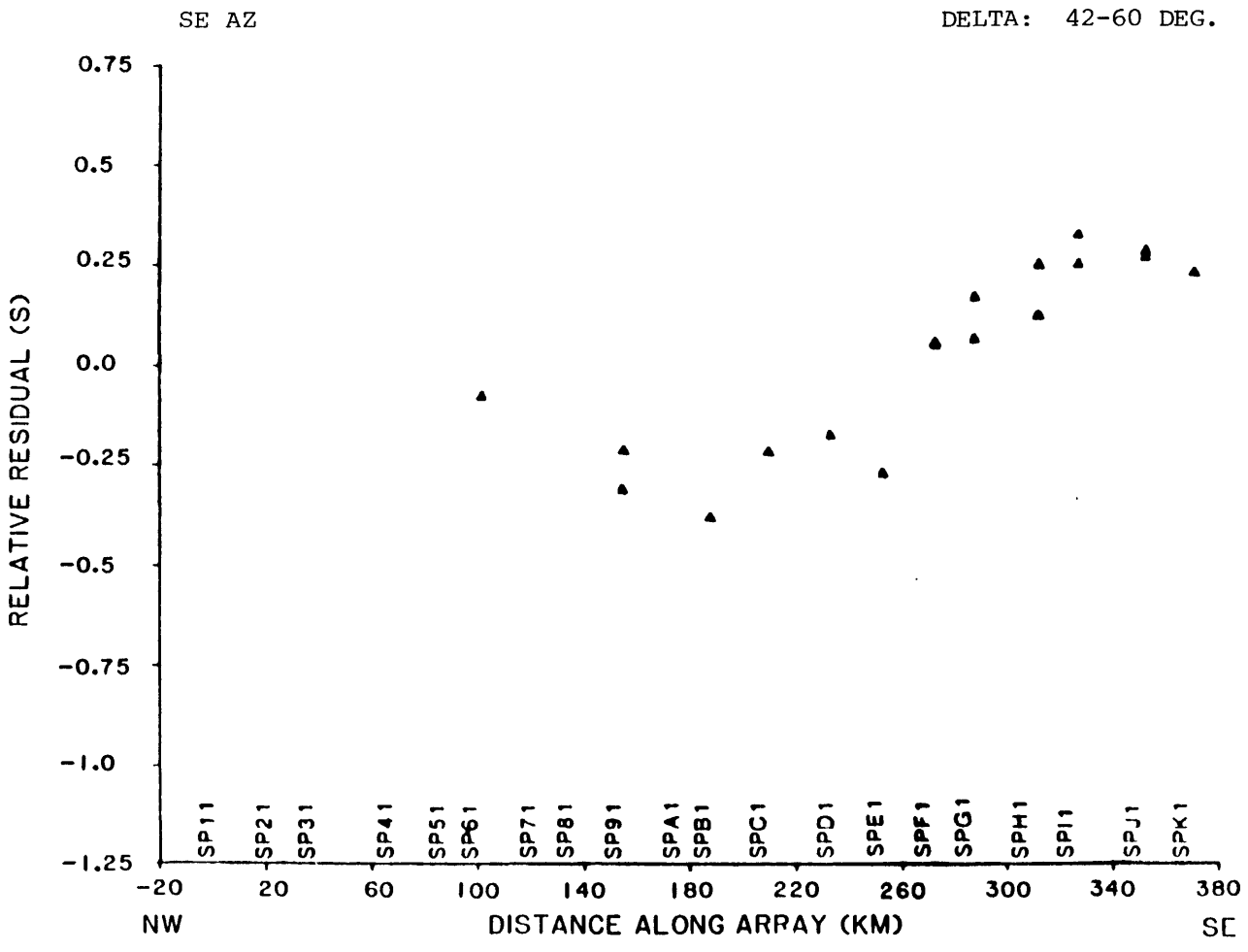

SE AZ
DELTA: 42-60 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.g.

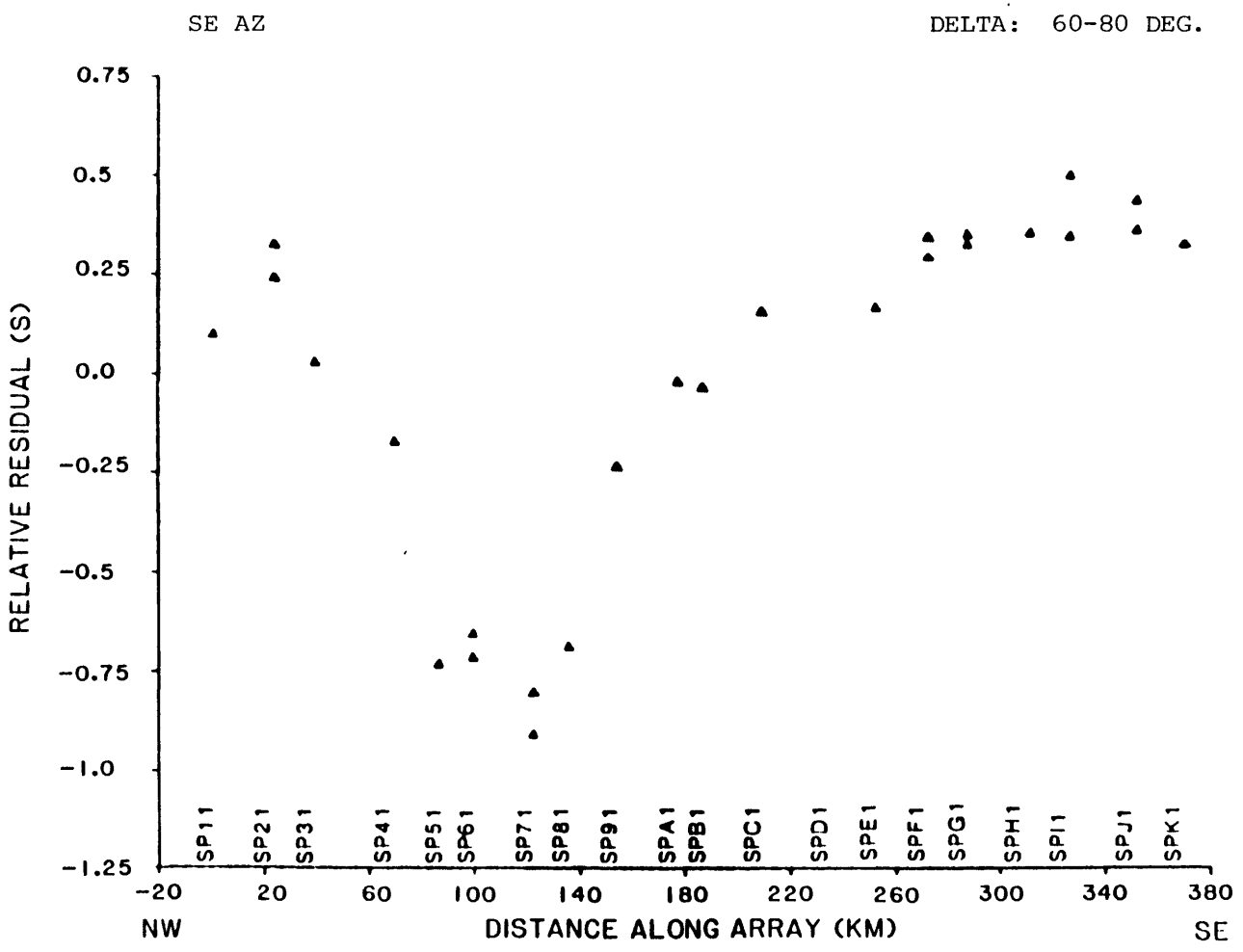

SE AZ
DELTA: 60-80 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.h.

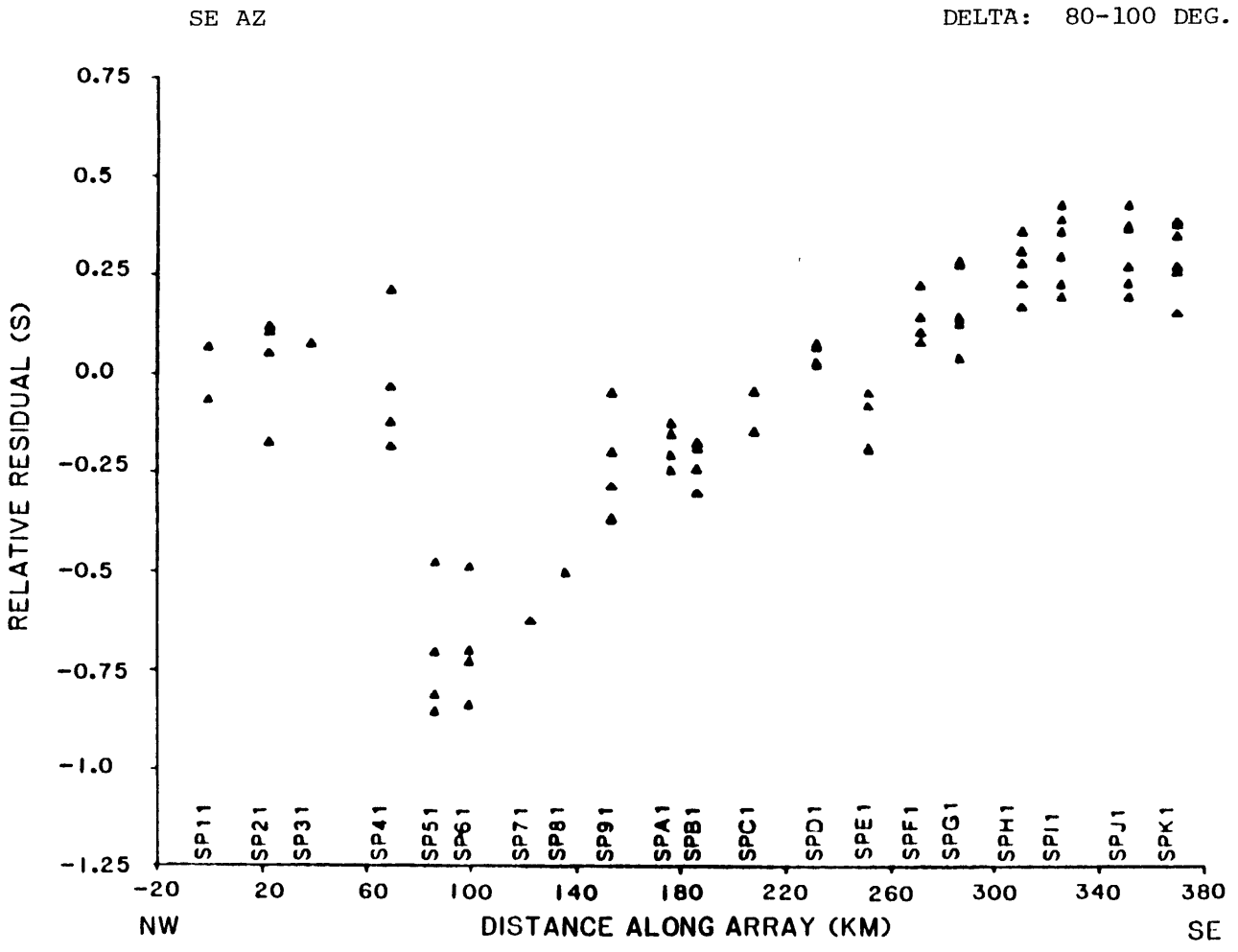

SE AZ
DELTA: 80-100 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.i.

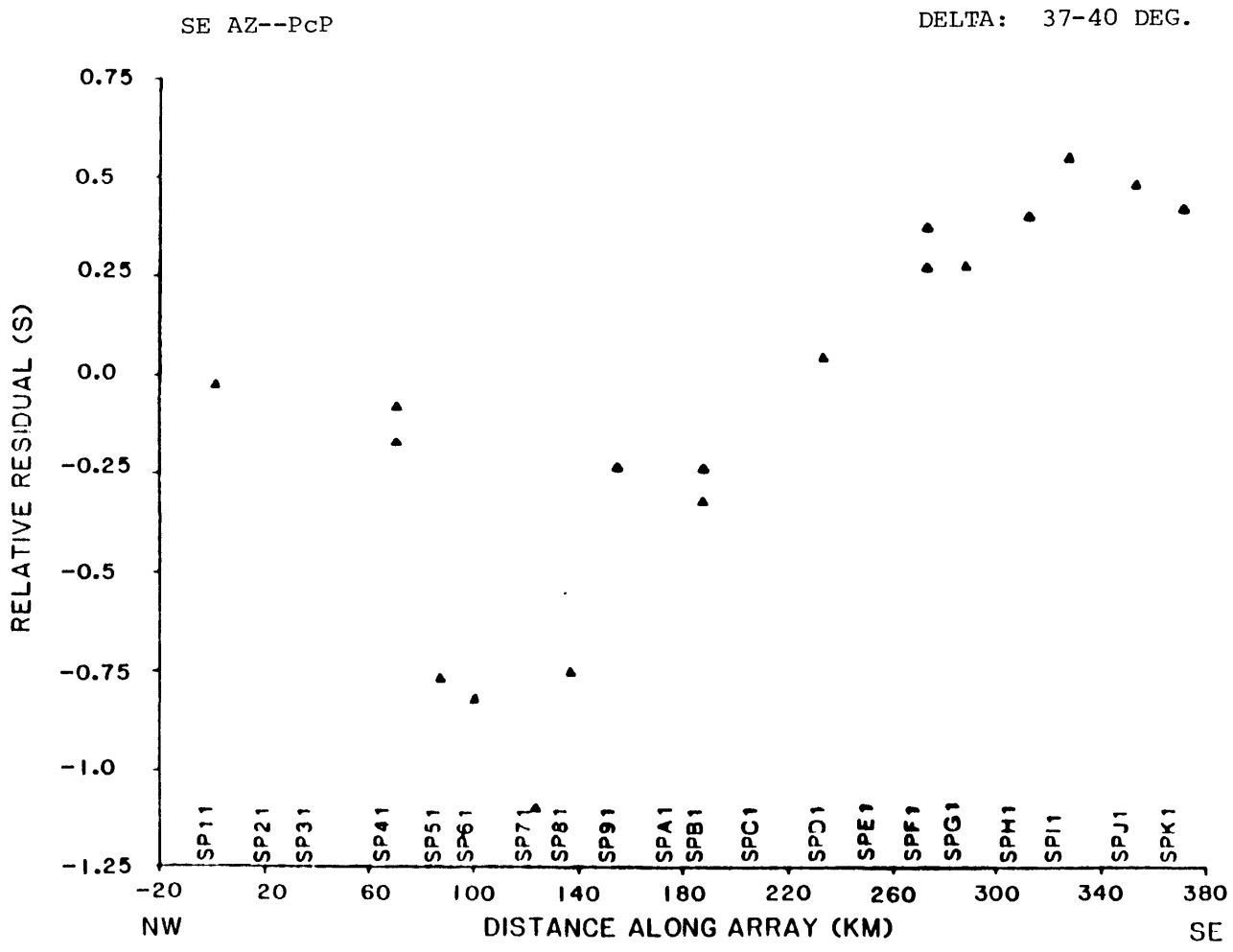

SE AZ--PcP
DELTA: 37-40 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.j.

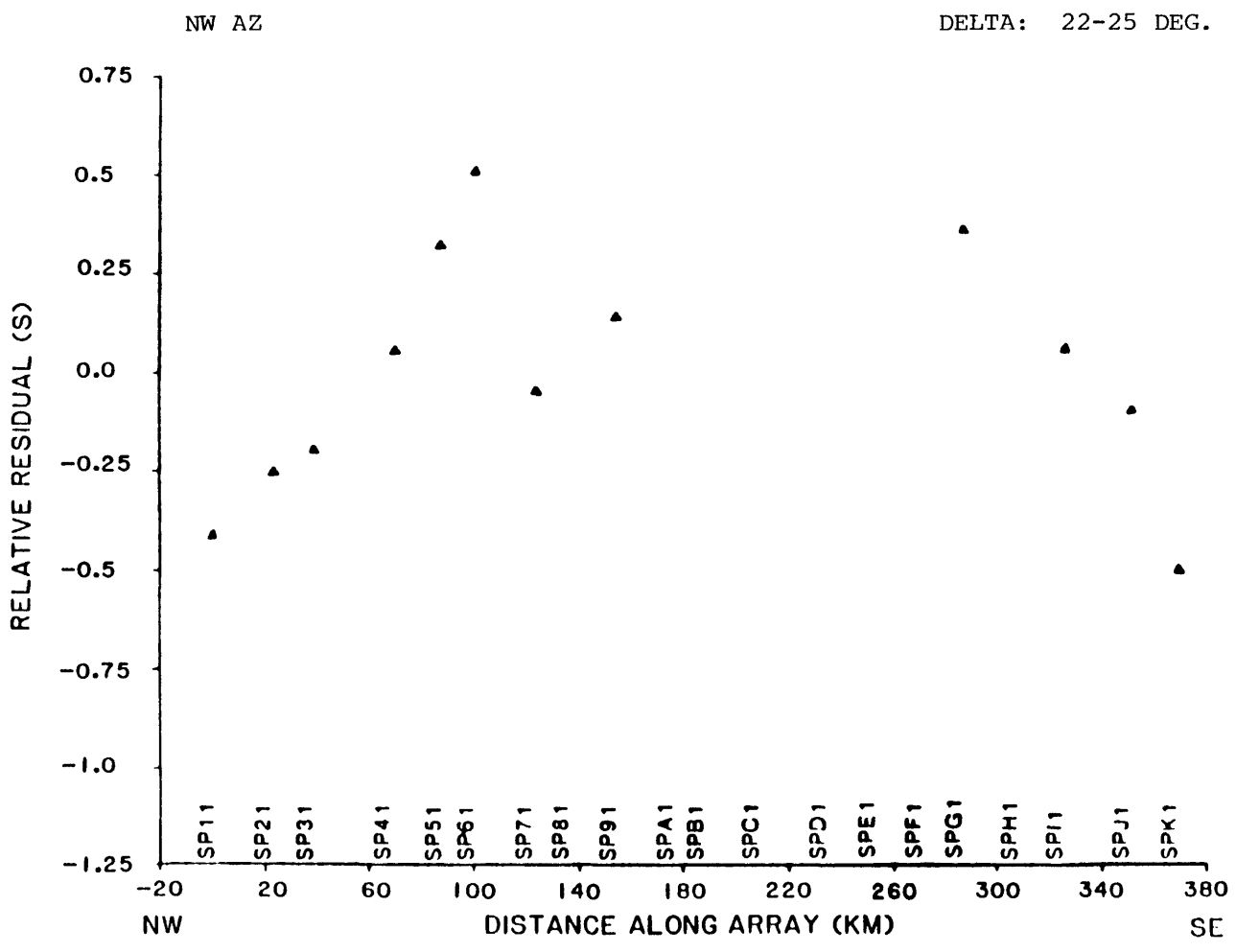

NW AZ
DELTA: 22-25 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.k.

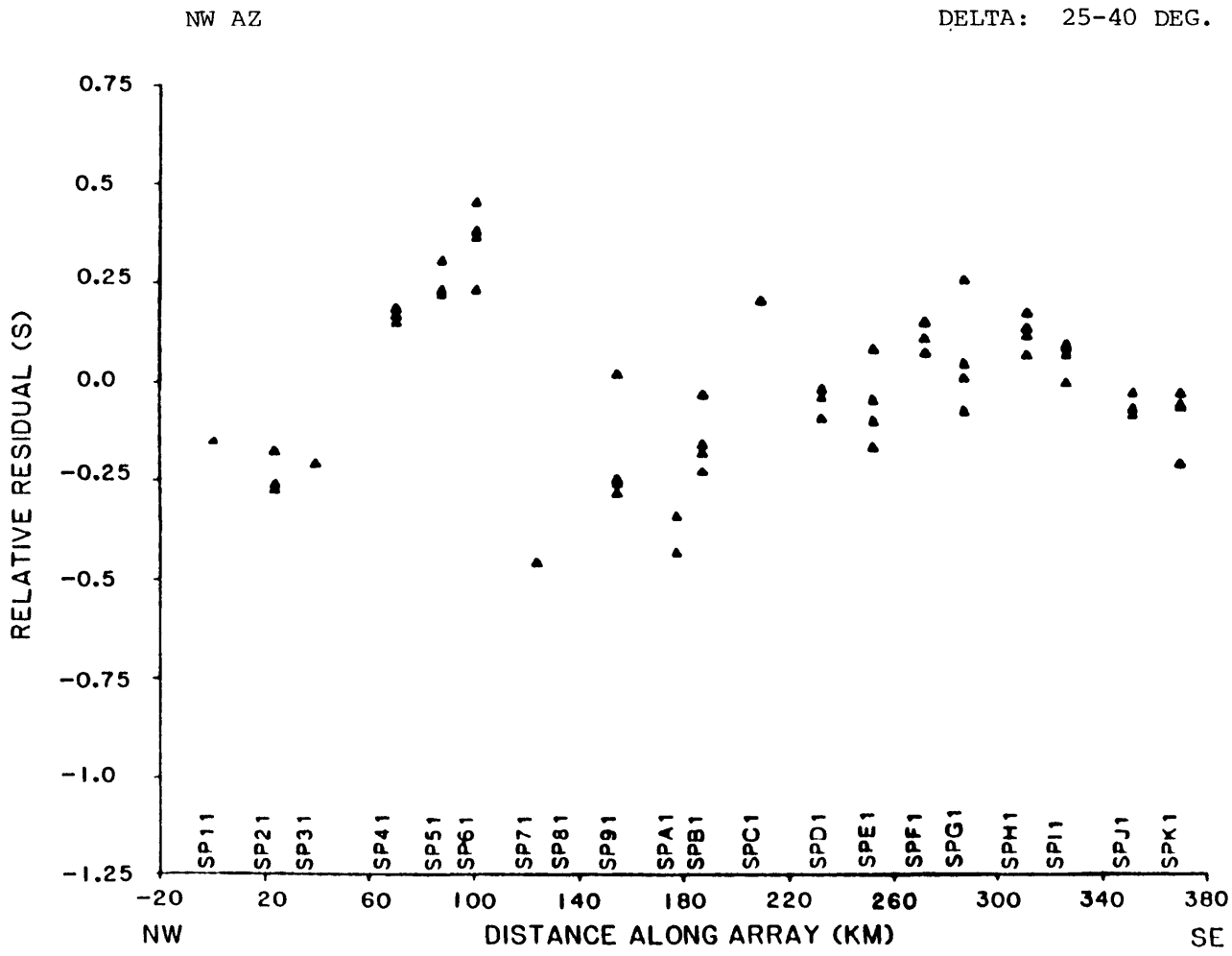

NW AZ
DELTA: 25-40 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.1.

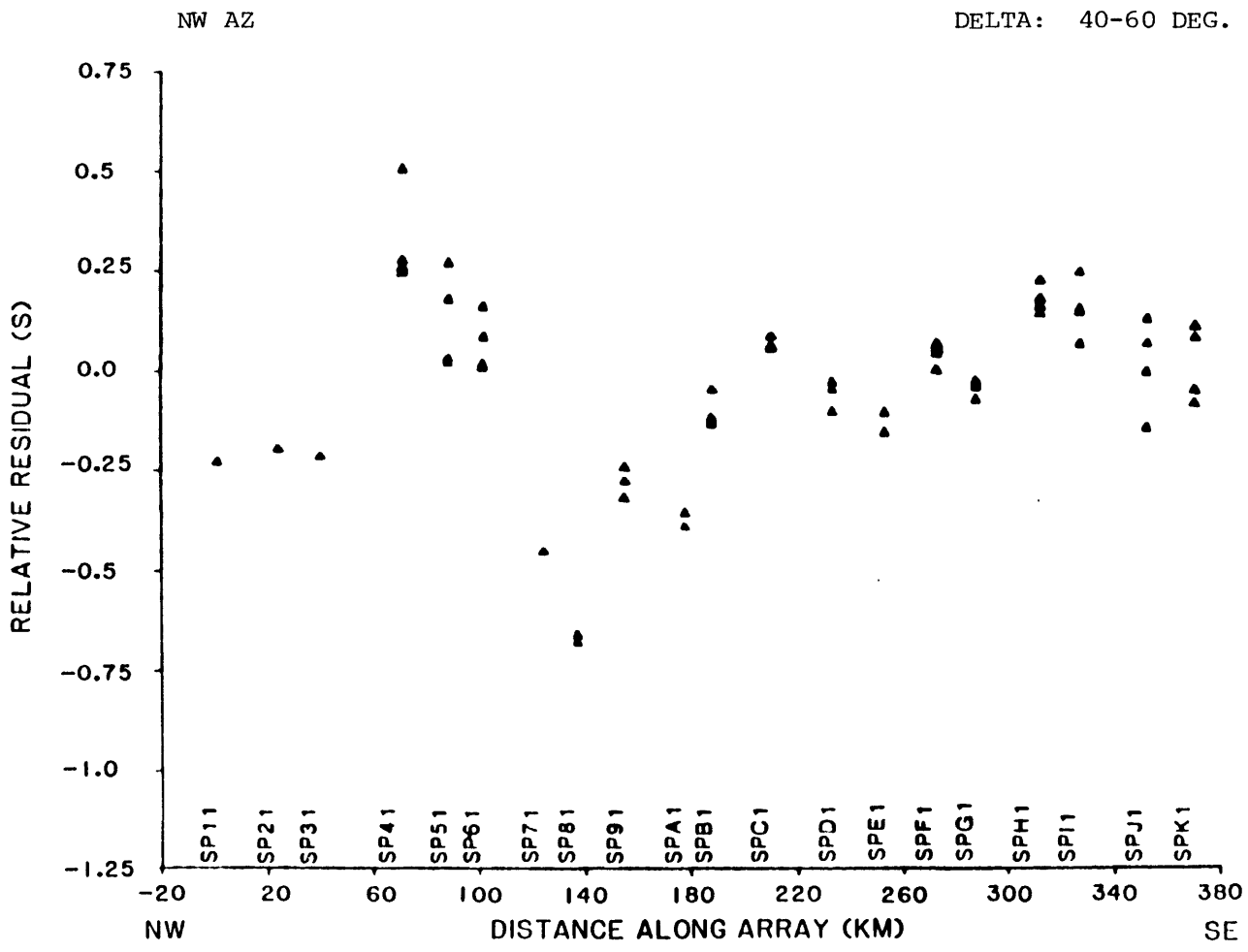

NW AZ
DELTA: 40-60 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.m.

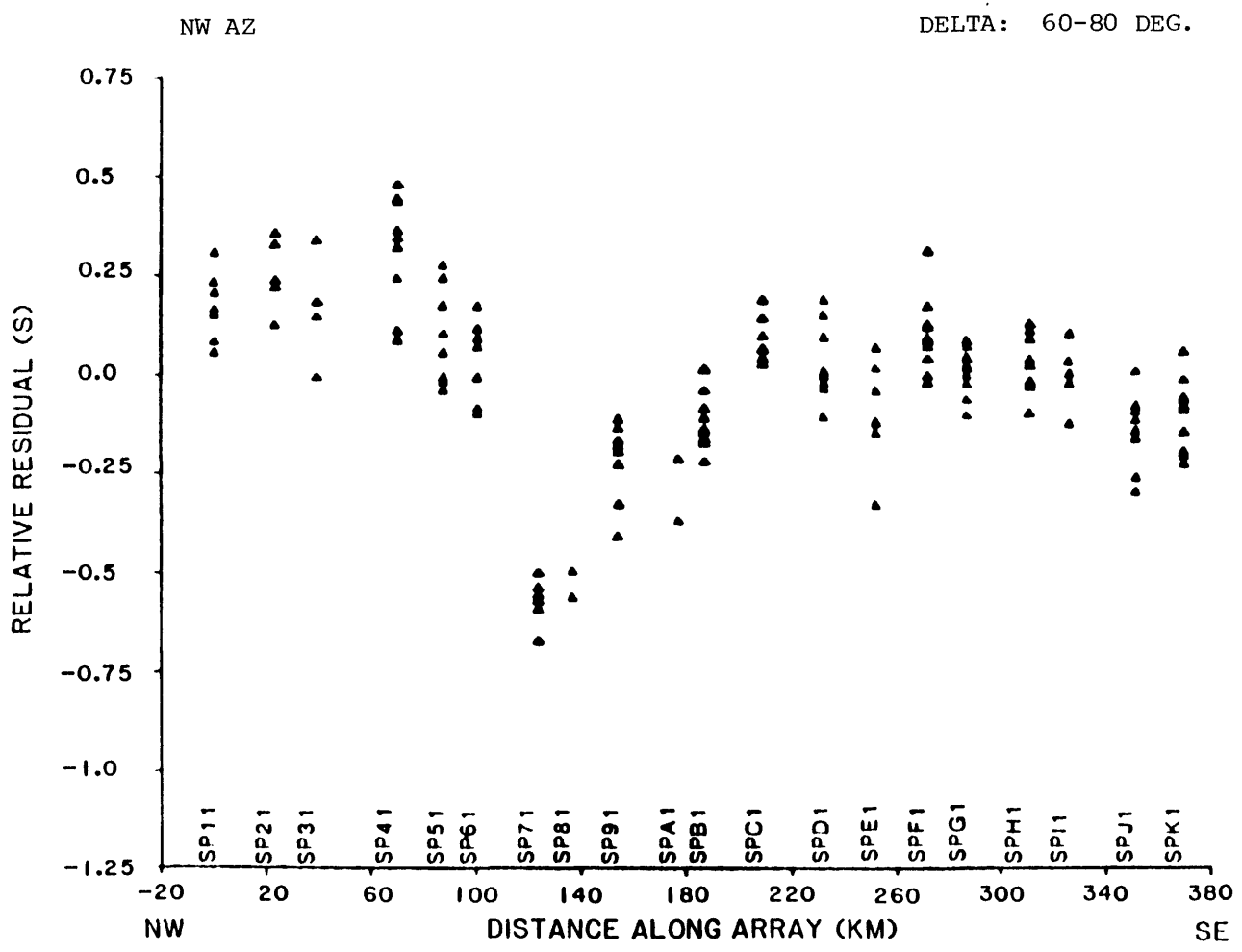

NW AZ
DELTA: 60-80 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.n.

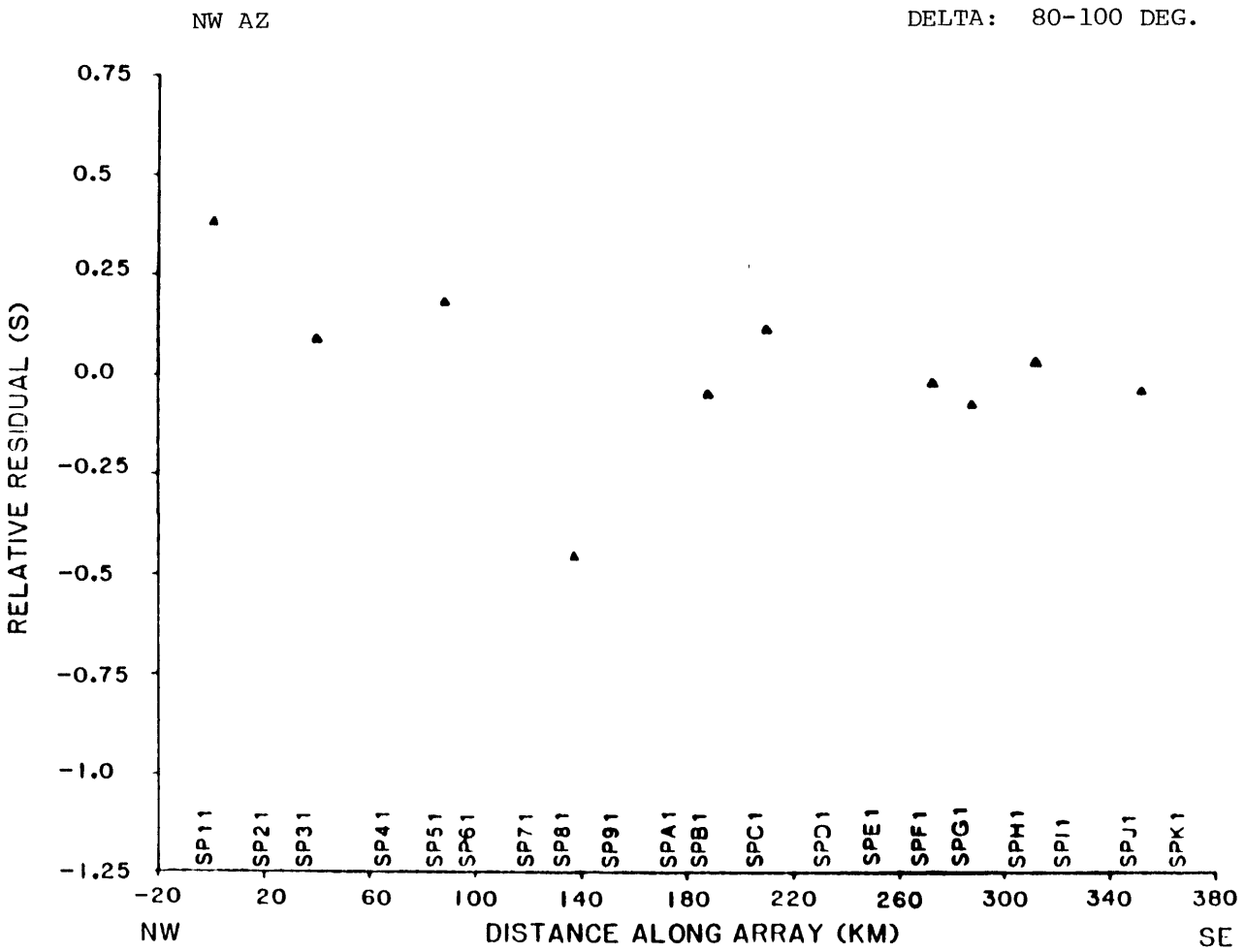

NW AZ
DELTA: 80-100 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.o.

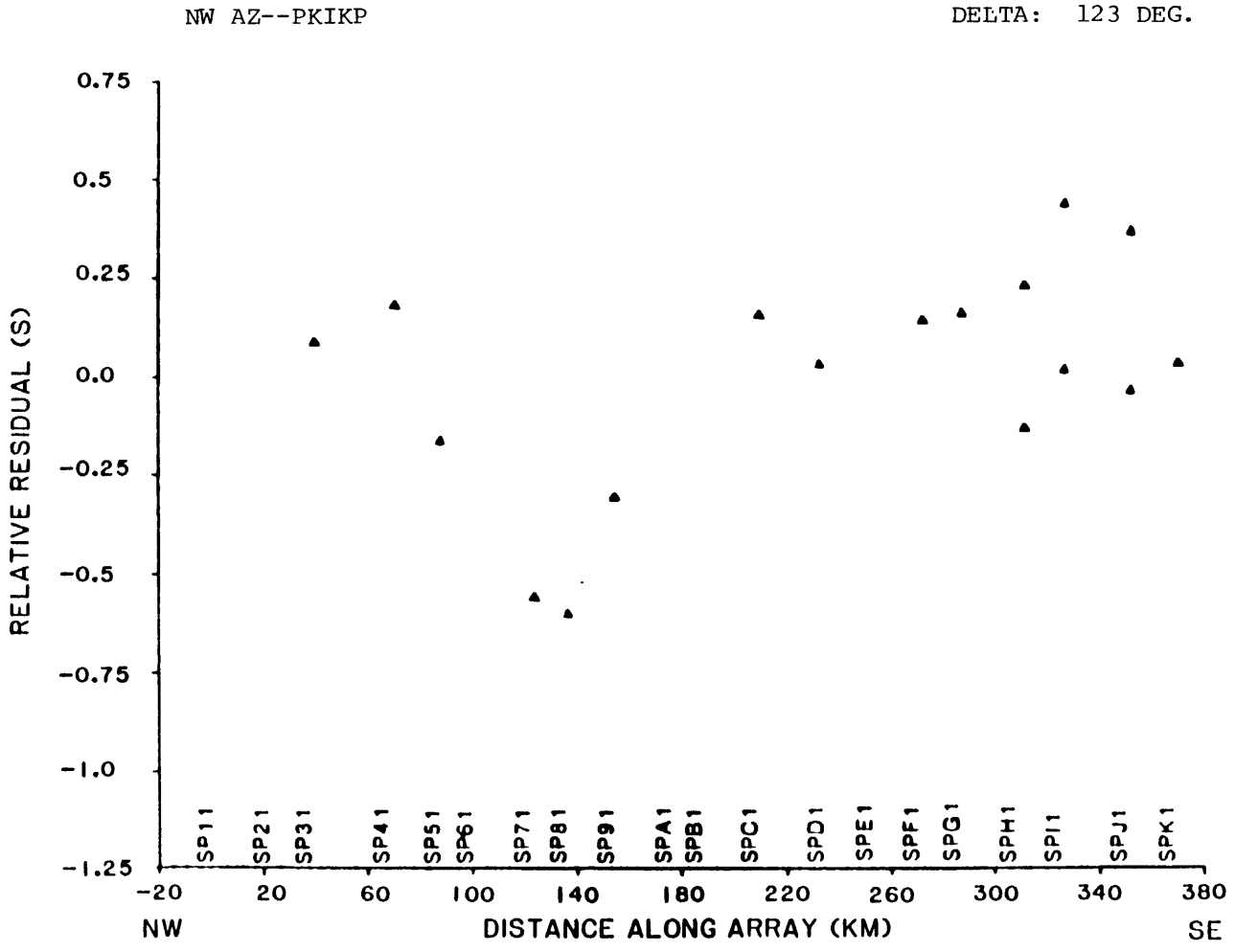
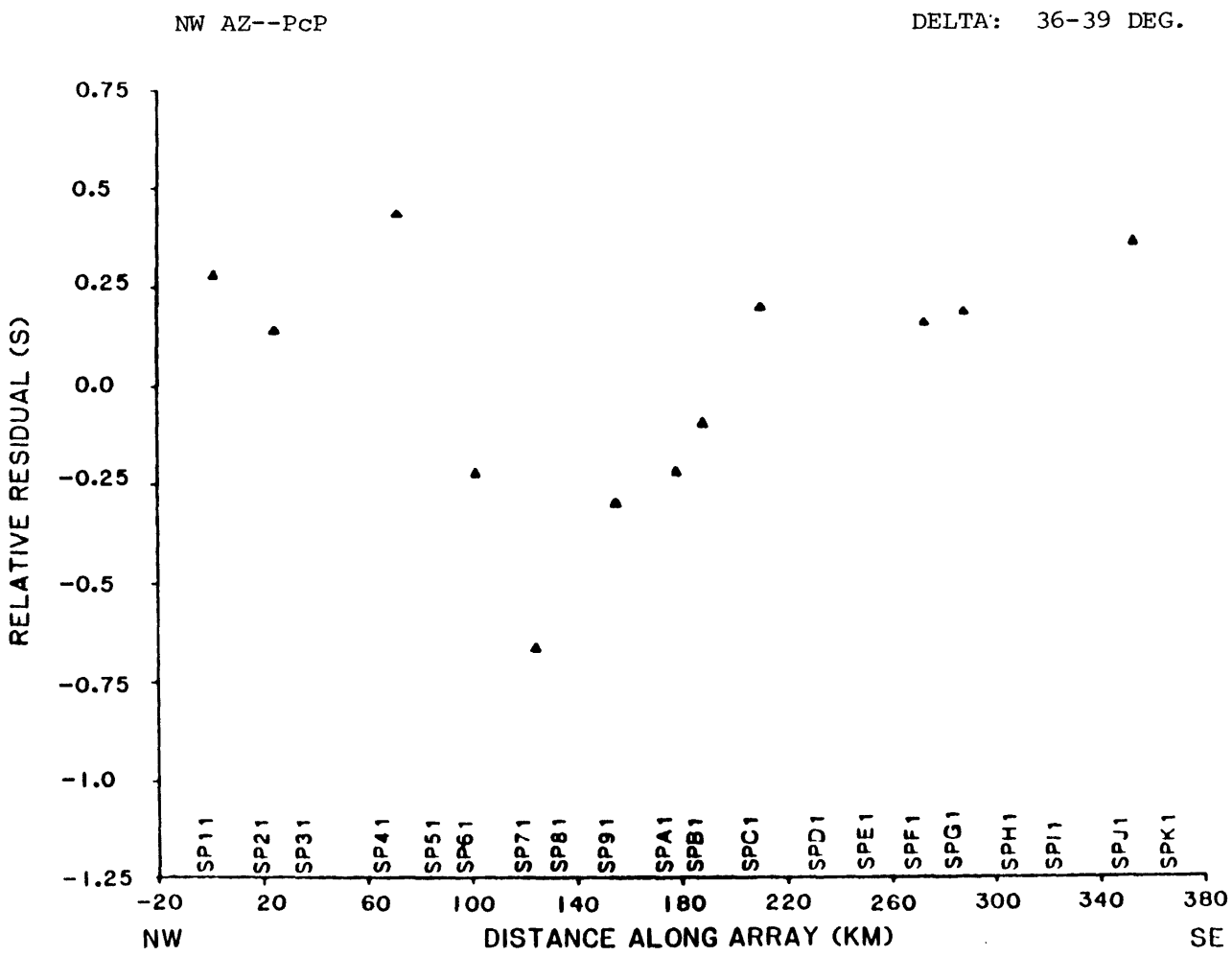

NW AZ--PKIKP
DELTA: 123 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE

Figure 5.p.


NW AZ--PcP
DELTA: 36-39 DEG.
RELATIVE RESIDUAL (S)
0.75
0.5
0.25
0.0
-0.25
-0.5
-0.75
-1.0
-1.25
SP11
SP21
SP31
SP41
SP51
SP61
SP71
SP81
SP91
SPA1
SPB1
SPC1
SPD1
SPE1
SPF1
SPG1
SPH1
SPI1
SPJ1
SPK1
-20
20
60
100
140
180
220
260
300
340
380
NW
DISTANCE ALONG ARRAY (KM)
SE