DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

DATA REPORT FOR THE GREAT VALLEY, CALIFORNIA, AXIAL SEISMIC REFRACTION PROFILES

Janice M. Murphy

Open–File Report 89–494

Menlo Park, California
1990

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INTRODUCTION

In 1981, 1982, and 1983 the U.S. Geological Survey (USGS) acquired seismic refraction data along seven transects in the Great (or Central) Valley of California and its bordering regions. These transects were part of a geophysical study of the Great Valley which also included seismic reflection data (Zoback et al., 1984), aeromagnetic, gravity (Cady 1975). These Geophysical data were combined with surface geological data and geological borehole data to better constrain interpretations of the structure and evolution of this classic Mesozoic and early Cenozoic forearc.

Data from the southern cross-strike (east-west) profile shown on the insert to figure 1 has been published by Murphy and Walter (1984). The three shorter cross-strike profiles will be presented in a future report. This report is a compilation of the refraction data from the three axial profiles (figure 1). The data have been archived at the National Geophysical Data Center in Boulder, Colorado. Tapes are available from

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
325 Broadway
Boulder, CO 80303

Appendix C contains a description of the tape format.

COMPLETED ANALYSIS

Three papers presenting analysis of the seismic refraction data from this report were written by Hwang and Mooney (1986), Colburn and Mooney (1986), and Holbrook and Mooney (1987). Holbrook and Mooney and Colburn and Mooney presented 2-D velocity models of the central and western axial profiles, derived by forward modeling travel times using a 2-D raytracing algorithm (Luetgert, 1988; Cerveny, 1977) and modeling amplitudes with ray theoretical synthetic seismograms McMechan and Mooney (1980). In contrast to this method, Hwang and Mooney used a reflectivity synthetic seismogram method (Fuchs and Muller, 1971; Kind, 1978; 1979) to model data from one of the shot points (SP 11) on the western profile. Comparision of all three models were presented in Colburn and Mooney.

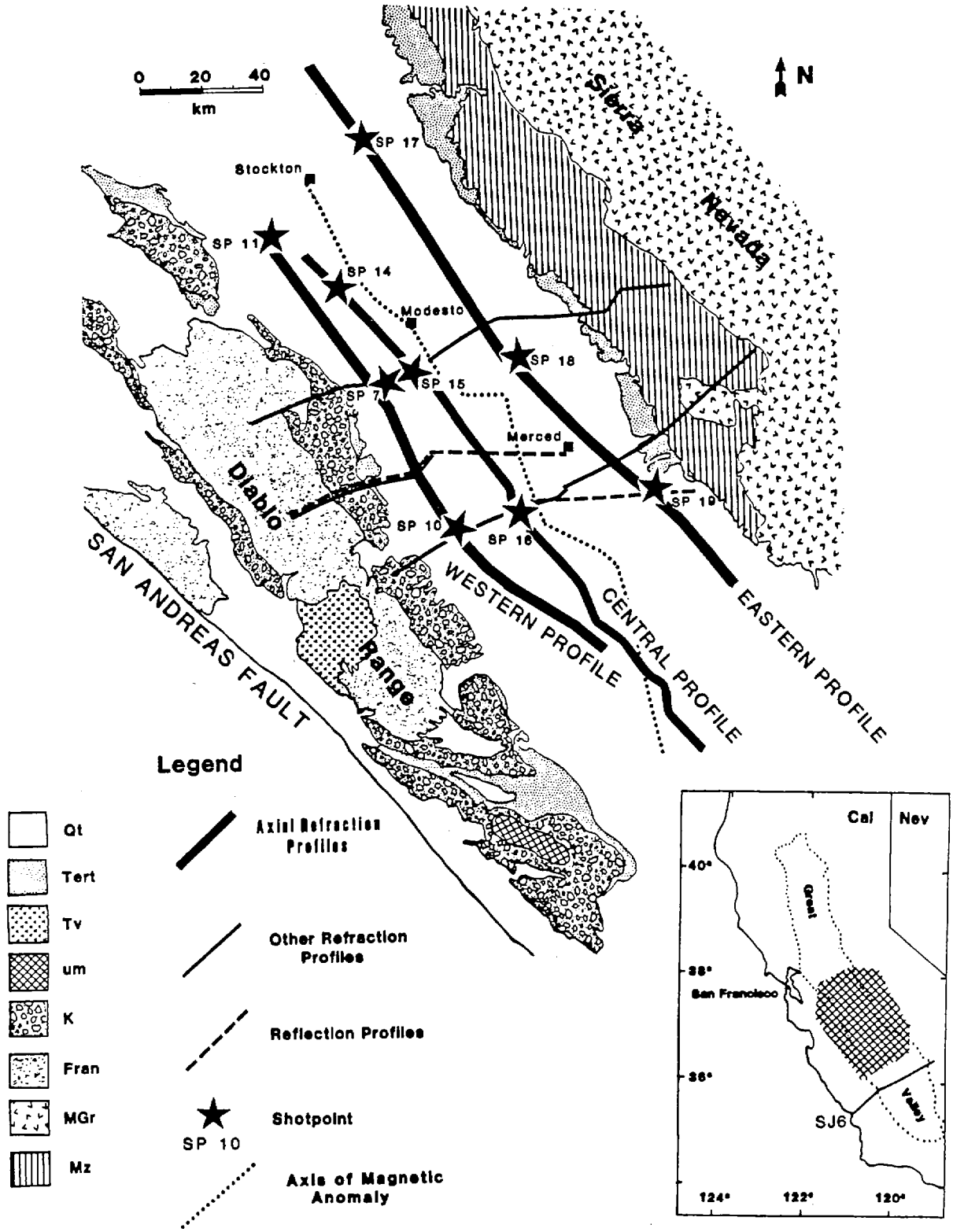

Figure 1. Map of the Great Valley, California showing locations of seismic profiles and generalized geology. Insert shows the southernmost profile (SJ6) - a coincident refraction-reflection transect. Qt = Quaternary sediments; Tert = Tertiary sediments; Tv = tertiary volcanics; um = ultramafics; K = Cretaceous sedimentary rocks, largely the Great Valley Sequence; Fran = Jurassic and Cretaceous Franciscan melange; MGr = Mesozoic granites and granodiorites of the Sierra Nevada; Mz = undifferentiated Mesozoic rocks, including Sierra greenstone belt.

Interpretation of a typical cross-strike (east-west) transect, constrained by all the geological and geophysical data sets, is presented by Wentworth et al. (1987). A more focused study of the Franciscan assemblage and Great Valley sequence interface is presented by Wentworth et al. (1984). These papers present evidence for overthrusting from the west and soleing of the Coast Range Thrust into the basement.

DESCRIPTION OF THE AXIAL PROFILES

Three profiles were deployed along the axis of the Great Valley between October 1981 and June 1982 (figure 1). The western profile extended from Tracy, California southeast to Mendota, California (west of Fresno). Three shots, fired at shot points 11, 7, and 10, were recorded along this profile. Shot points 10 and 11 were located within the profile and shot point 7 was 4 kilometers east of the profile. Within the northern portion of the profile, between shot points 10 and 11, the seismic recorder station spacing was 1 kilometer; south of shot point 10 the spacing was increased to 5 kilometers. Along the central profile seismic recorders were deployed from Manteca, California southeast to Helm, California (southeast of Fresno) with a station spacing of approximately 2 kilometers. In-line shots fired at shot points 14, 15, and 16 were recorded along this profile. The profile deployed along the eastern edge of the Great Valley extended southeast from Herald, California (Northeast of Lodi) to Madera, California (northwest of Fresno) with a station spacing of 2 kilometers. Three in-line shots were fired at shot points 17, 18, and 19.

Locations and elevations for seismic recordering stations and shot points were determined using USGS 1:24,000 topographic maps. All the locations (Appendix A) are estimated to be accurate to within 15 meters.

Seismic sources were generated in 20 cm X 40 m drilled holes. Each hole was filled with an ammonium nitrate explosive and fired automatically with a shooting system described by Healy et al. (1982). A signal from a USGS master reference clock triggered the shooting system to fire an electic blasting cap, which sequentially caused the primacord, boosters, and the blasting agent to detonate. The blasting cap detonation signal (cap break), the USGS master reference clock's IRIG E time code, and the radio-recieved WWVB time code were recorded on a Kiowa paper strip-chart record. The shot origin times were read from the cap break on the paper record assuming that the explosives detonated at the exact time of the cap break. The reported shot times (table 1) are accurate to within $\pm$ 2 milliseconds

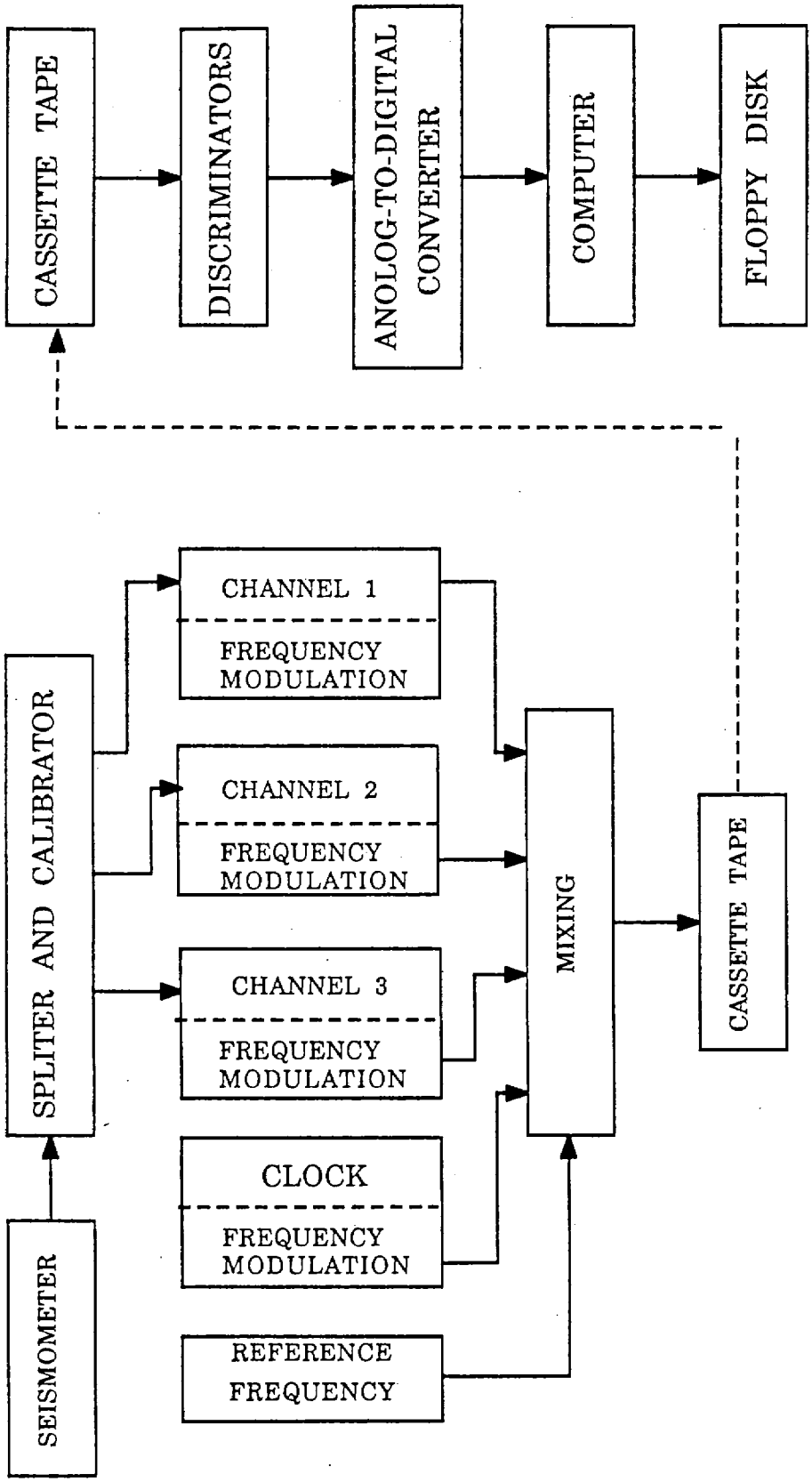

Figure 2. Schematic of the data acquisition and processing system.

SHOT LIST

Shot Number	Shot Point	Date	Shot Time (Day,Hour,Min,Sec)
4	14	JUN 24, 1982	176:06:00:00.010
5	15	JUN 24, 1982	176:06:15:00.005
6	16	JUN 24, 1982	176:06:30:00.150
7	17	JUN 30, 1982	182:06:00:00.009
8	18	JUN 30, 1982	182:06:15:00.005
9	19	JUN 30, 1982	182:06:30:00.014
12	10	OCT 16, 1981	289:06:30:00.210
13	7	OCT 16, 1981	289:06:45:00.012
14	11	OCT 16, 1981	289:07:00:00.017

Table 1. Shot list. Shot times are Universal Time (UT)

INSTRUMENTATION AND DATA REDUCTION

The recording instruments used in the seismic-refraction surveys have been described by Murphy (1988) (figure 2). During the anolog recording process, ground motion is sensed by a 2-Hz vertical-component seismometer. The voltage output from the seismometer is split without amplification and sent to three parallel amplifier circuit boards. Each circuit board amplifies the seismic signal in three stages and then frequency modulates the signal. Amplification at the last two stages can be set by the user. An internal precision clock signal is also frequency modulated. The three data carrier frequencies, the clock carrier frequency, and a tape-speed compensation carrier frequency are summed and recorded on a cassette tape.

Prior to deployment, field technicians program the memory and synchronize the clock unit of each instrument with a USGS master reference clock (the same clocks used to trigger the shooting system). After the shots have been recorded, the clock unit of each instrument is compared to the master reference clock, and a clock drift time (in milliseconds) is recorded in the field notes. USGS master clocks, which drift approximately one millisecond per week, are periodically checked against the standard WWVB time signal.

Information pertaining to the operation of each instrument is entered on data sheets. Chronometer corrections at shot time are calculated from each clock drift time assuming a linear drift rate (Appendix B). Both the data sheets and the chronometer corrections are written to a file which is used by the digitizing program. During the digitizing process, the cassette tapes are played back, and the signals are demultiplexed and demodulated. To

prevent accidental shifting of the data-carrier frequencies, the tape-speed compensation carrier frequency is demultiplexed and sent to a circuit board which continuously adjusts the speed of the tape deck such that the tape-speed compensation carrier frequency matches a locally generated reference frequency. An anolog-to-digital converter converts the signals to digital data which are stored on 8-inch floppy disks. The analog data were digitized for 20 seconds, starting (X/6 - 2) seconds prior to shot time, where X is the shot point to recorder distance in kilometers (Appendix B). The sampling rate for digitizing is 200 samples per second.

The complete system velocity response is roughly flat between 2 and 30 Hz and the approximate ground motion is given by

$$A_g(t) = \frac{A(t)}{R_{GLE}\, R_{SA}\, R_{VCO}\, D_{DSC}\, D_{ADC}} = \frac{A(t)}{(409.6)\, R_{SA}}$$

where A(t) is the amplitude response and R_{GLE}, R_{SA}, R_{VCO}, D_{DSC}, and D_{ADC} are the amplitude factors of the major components (table 2, figure 3). The recording unit also performs and records a series of diagnostic tests and calibrations prior to each separate seismic window. The calibrations provide a complete system calibration scheme and are used to verify the actual gain of each data channel and the operation of the seismometer.

TABLE 2.

Amplitude response values for the major components of the data acquisition system

component	value
R_{GLE}	1 V/cm/sec
R_{SA}	dimensionless gain variable V/V
R_{VCO}	25 Hz/V
D_{DSC}	0.04 V/Hz
D_{ADC}	409.6 counts/V

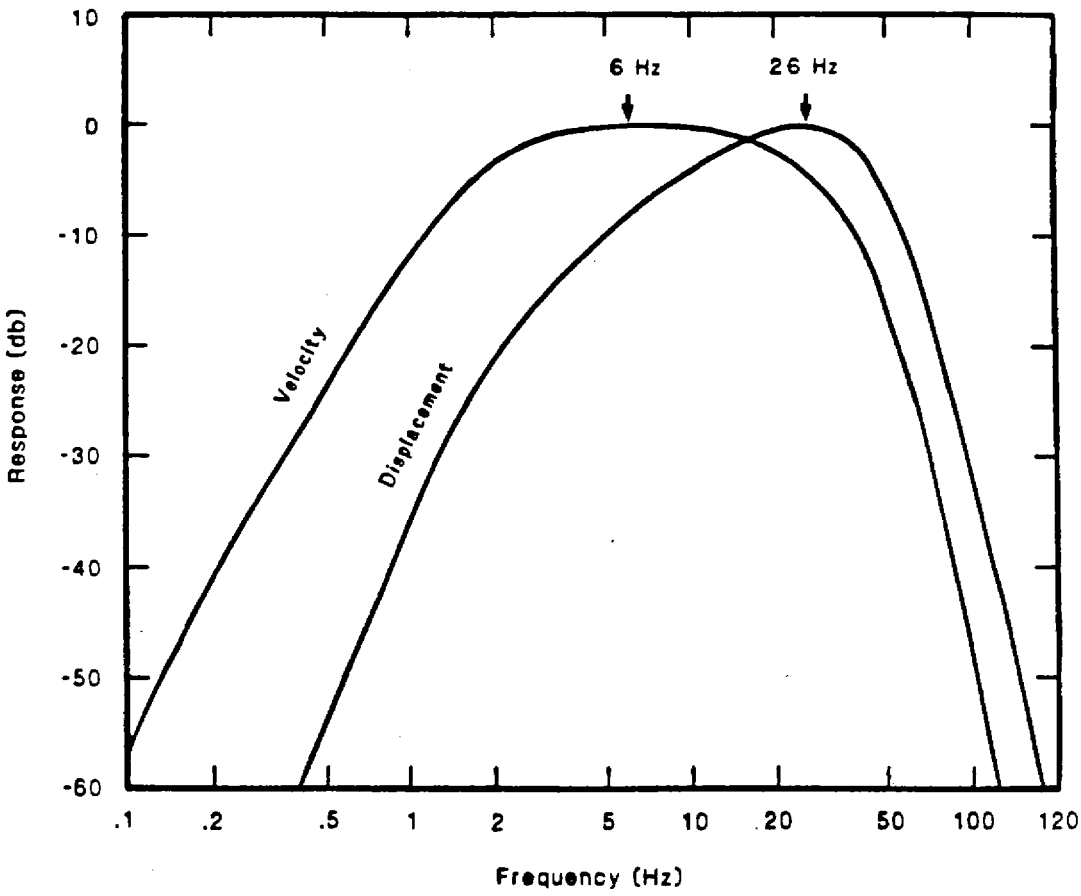

Figure 3. Theoretical transfer-function curves for the USGS short-period seismic refraction system (both recorder and digitizer). Solid lines are the displacement and velocity normalized amplitude. (From Dawson and Stauber, 1986)

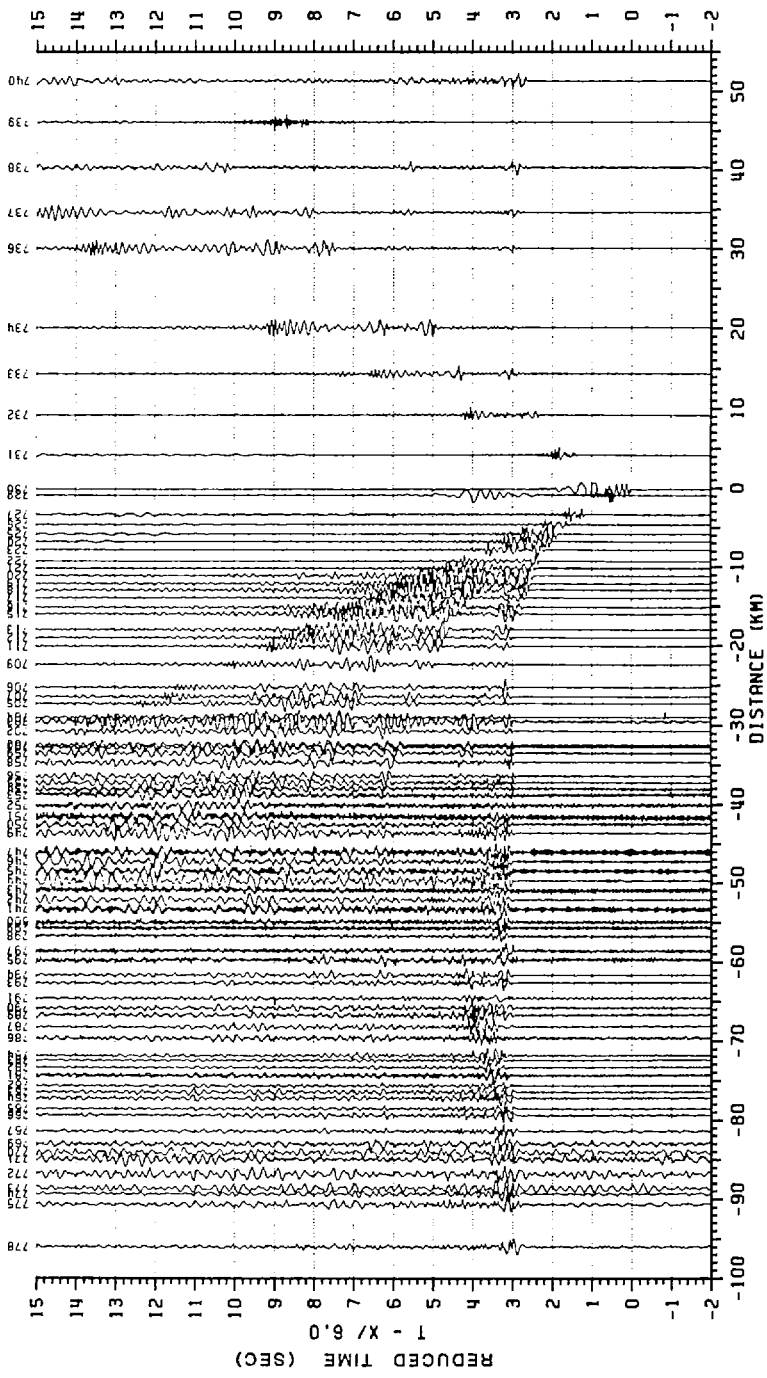

Figure 4. WESTERN PROFILE

SHOT 12 SHOT POINT 10

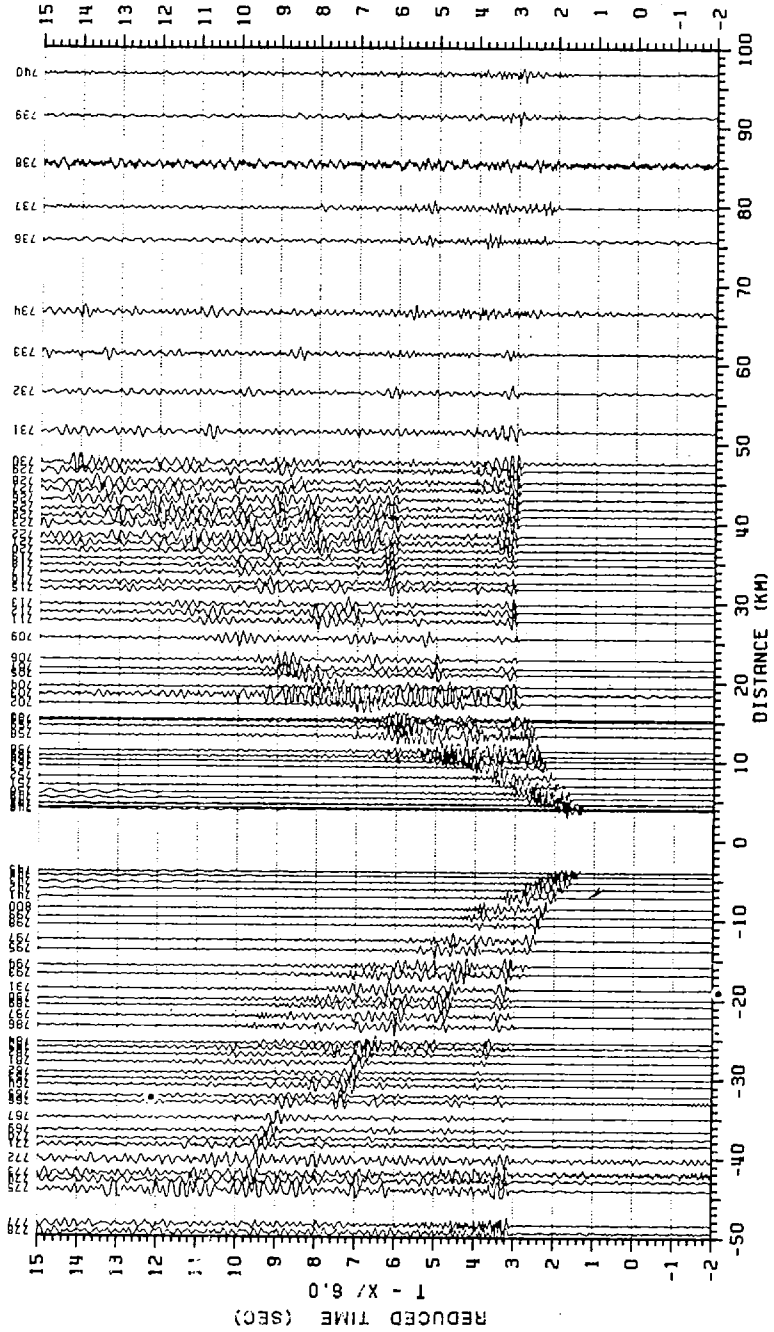

Figure 5. WESTERN PROFILE

SHOT 13 SHOT POINT 7

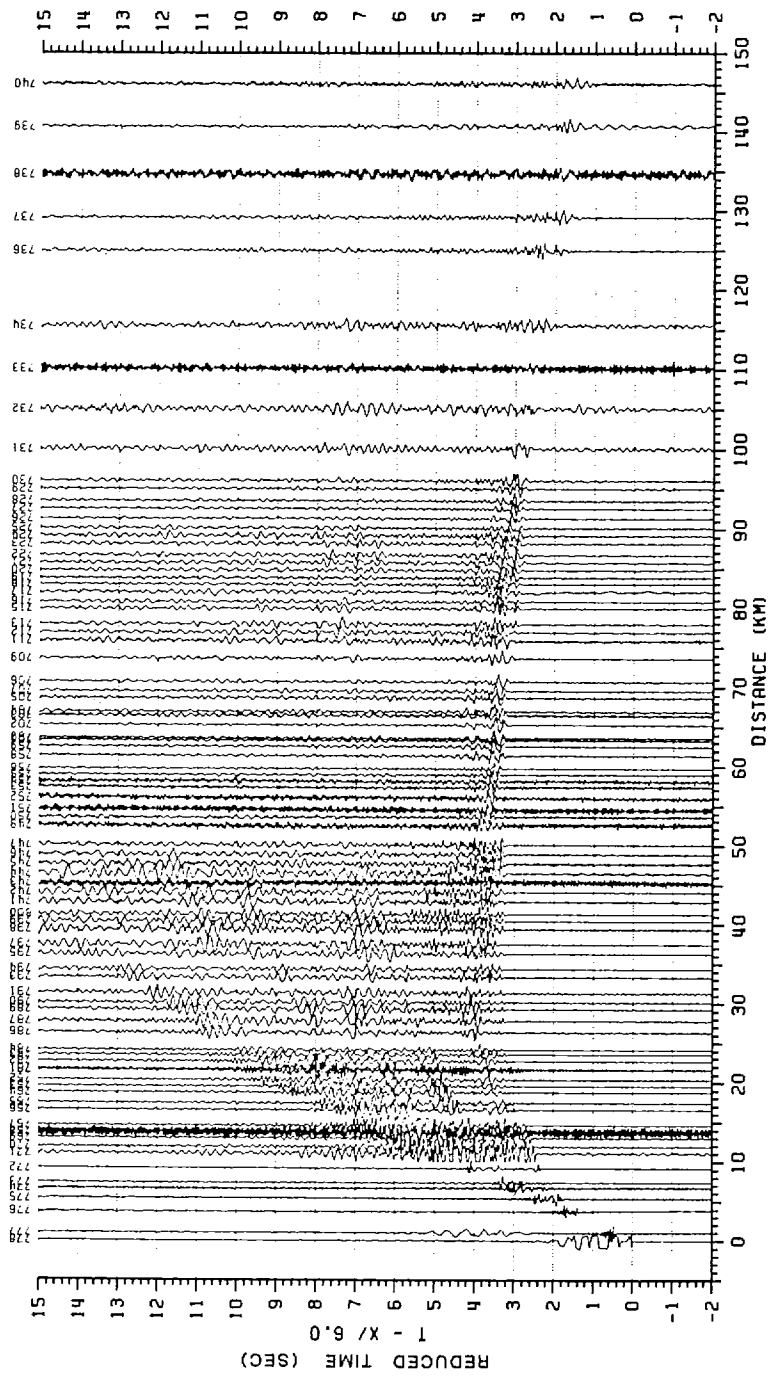

Figure 6. WESTERN PROFILE

SHOT 14 SHOT POINT 11

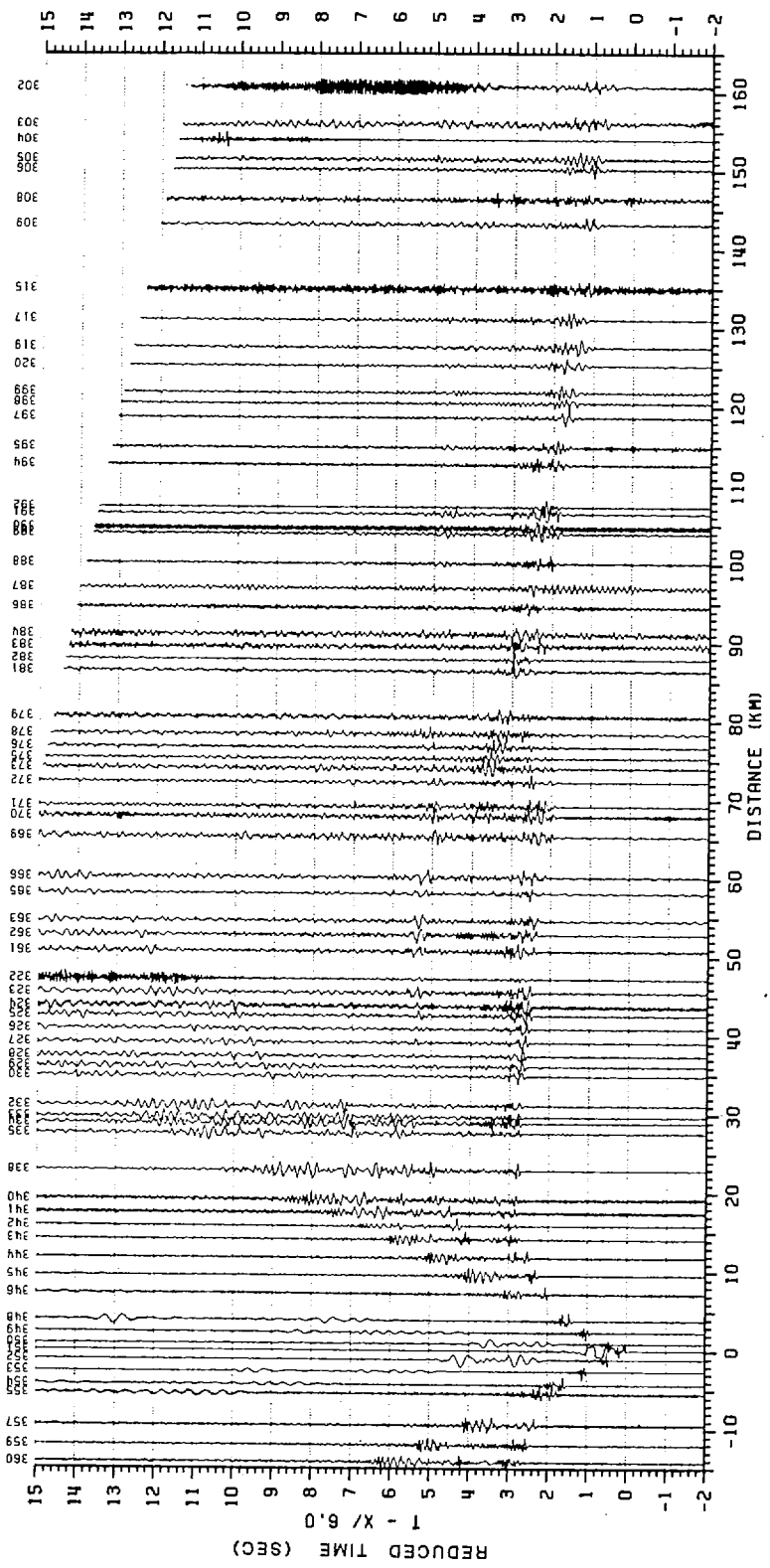

Figure 7. CENTRAL PROFILE

SHOT 4 SHOT POINT 14

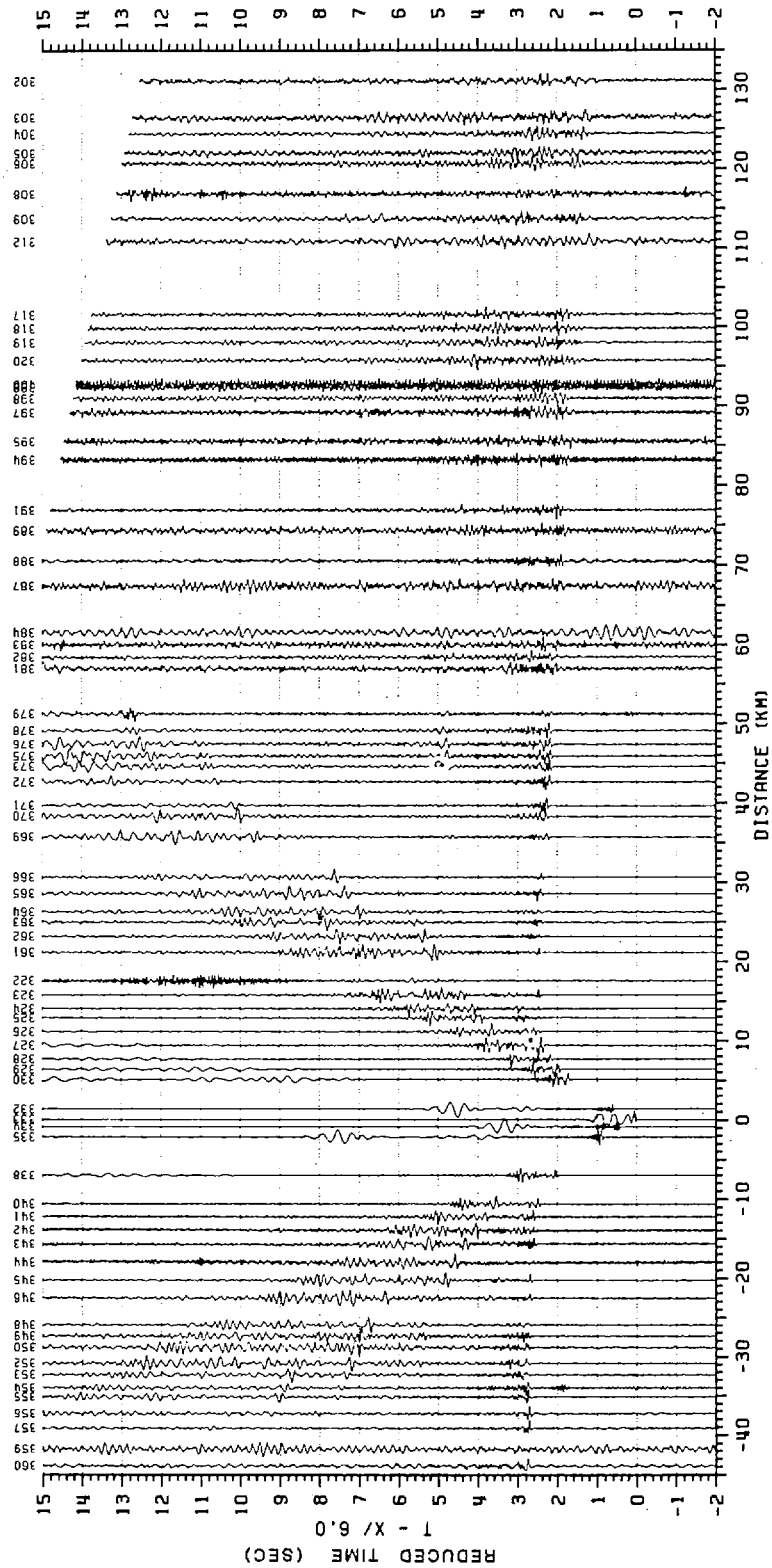

Figure 8. CENTRAL PROFILE

SHOT 5 SHOT POINT 15

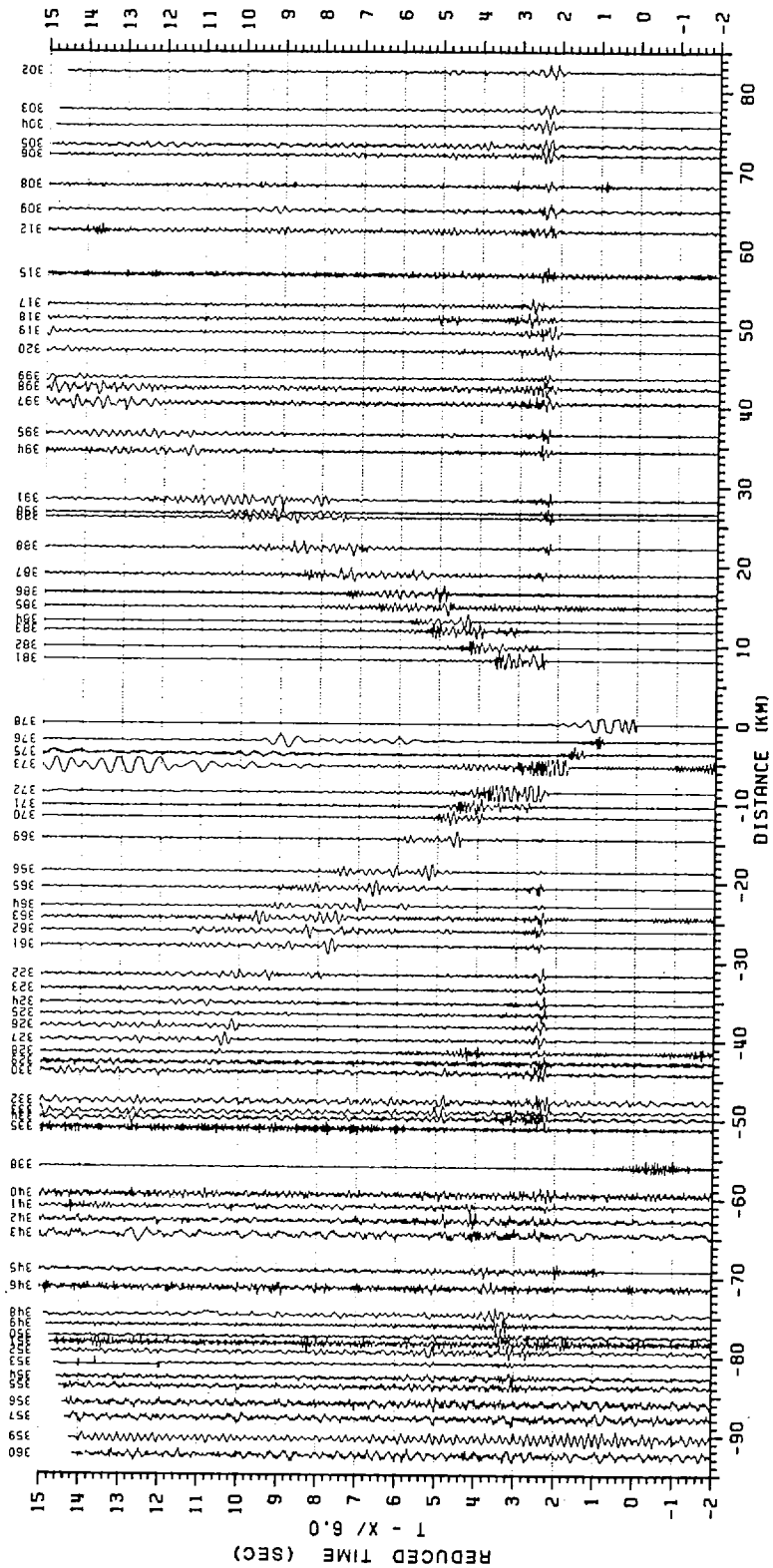

Figure 9. CENTRAL PROFILE

SHOT 6 SHOT POINT 16

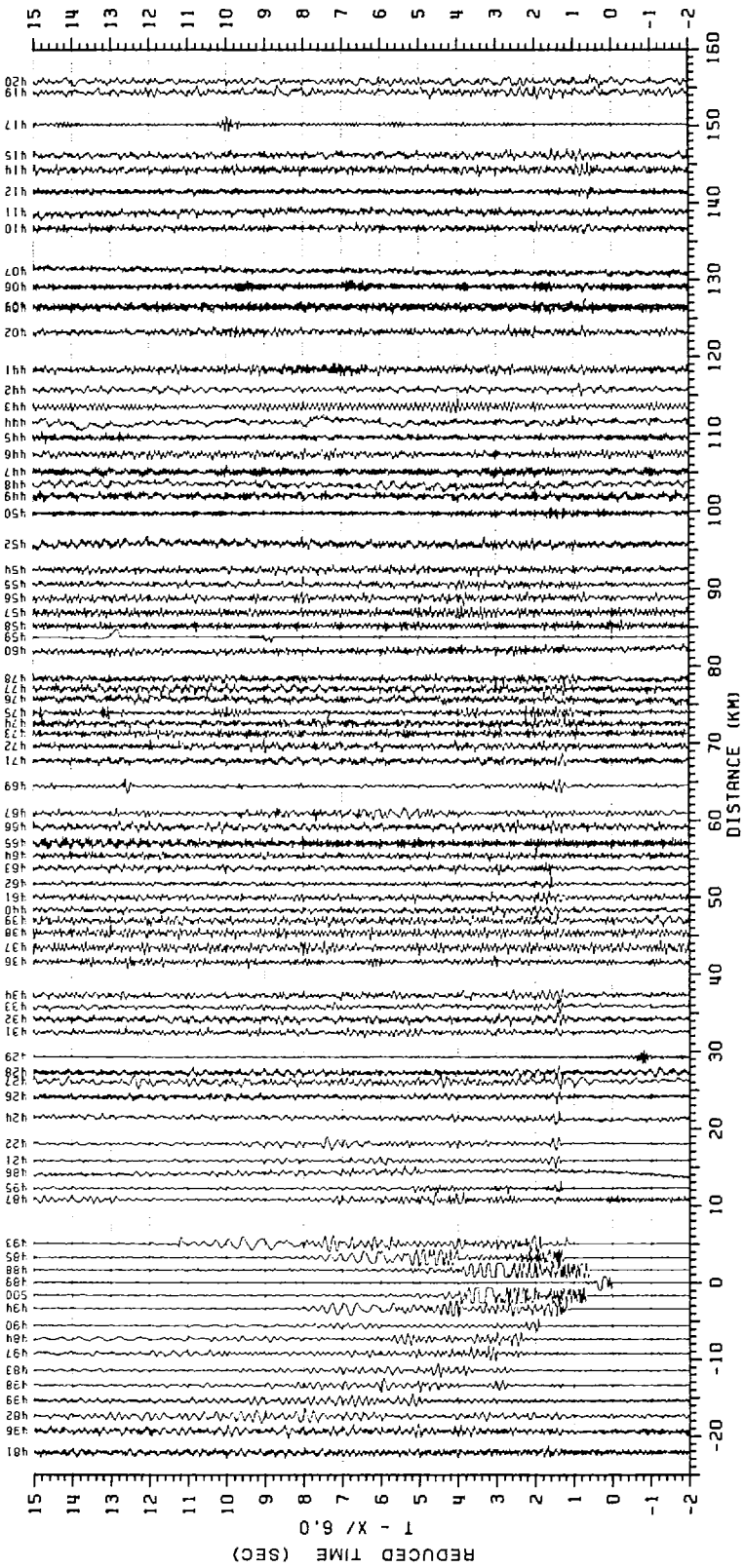

Figure 10. EASTERN PROFILE

SHOT 7 SHOT POINT 17

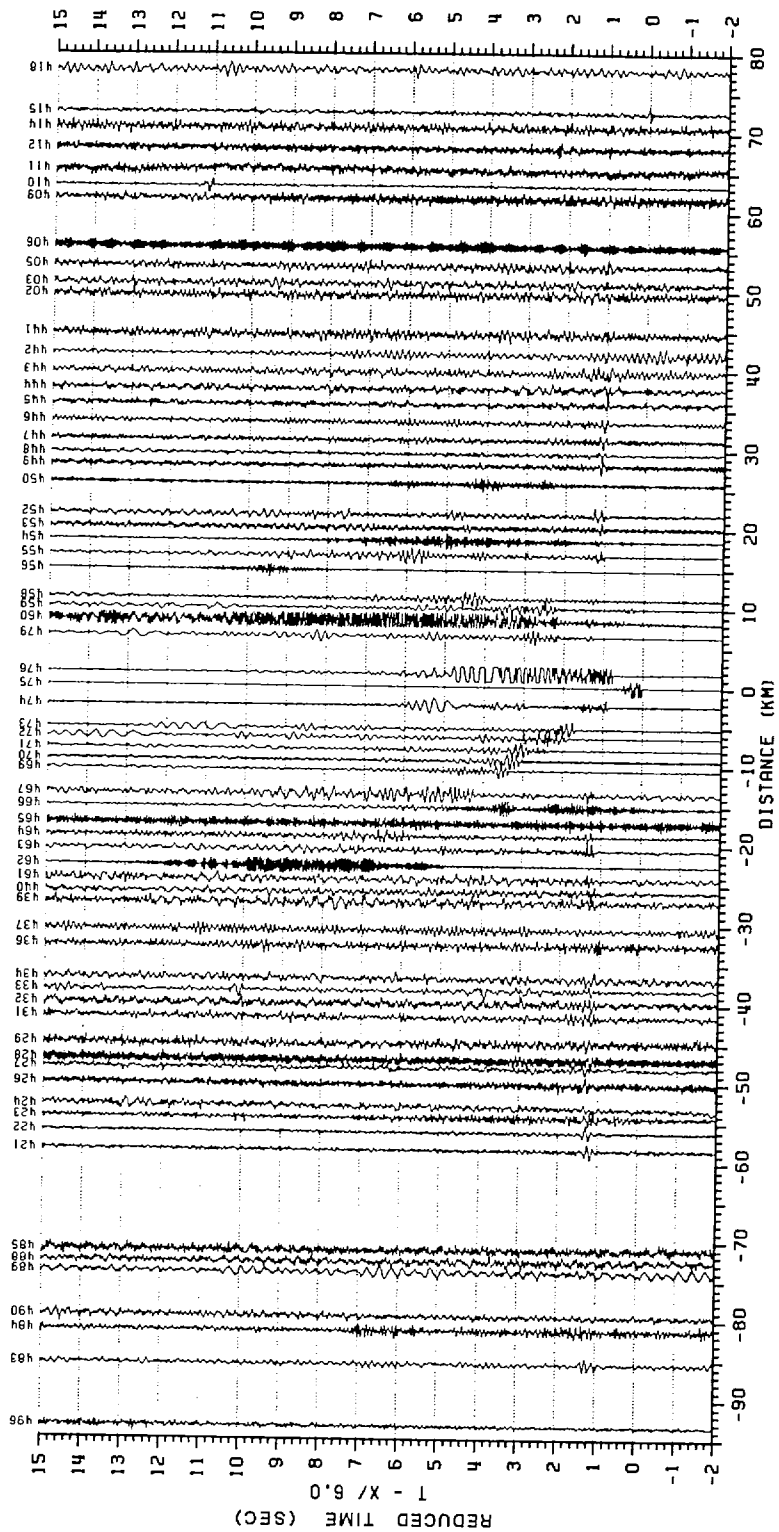

Figure 11. EASTERN PROFILE

SHOT 8 SHOT POINT 18

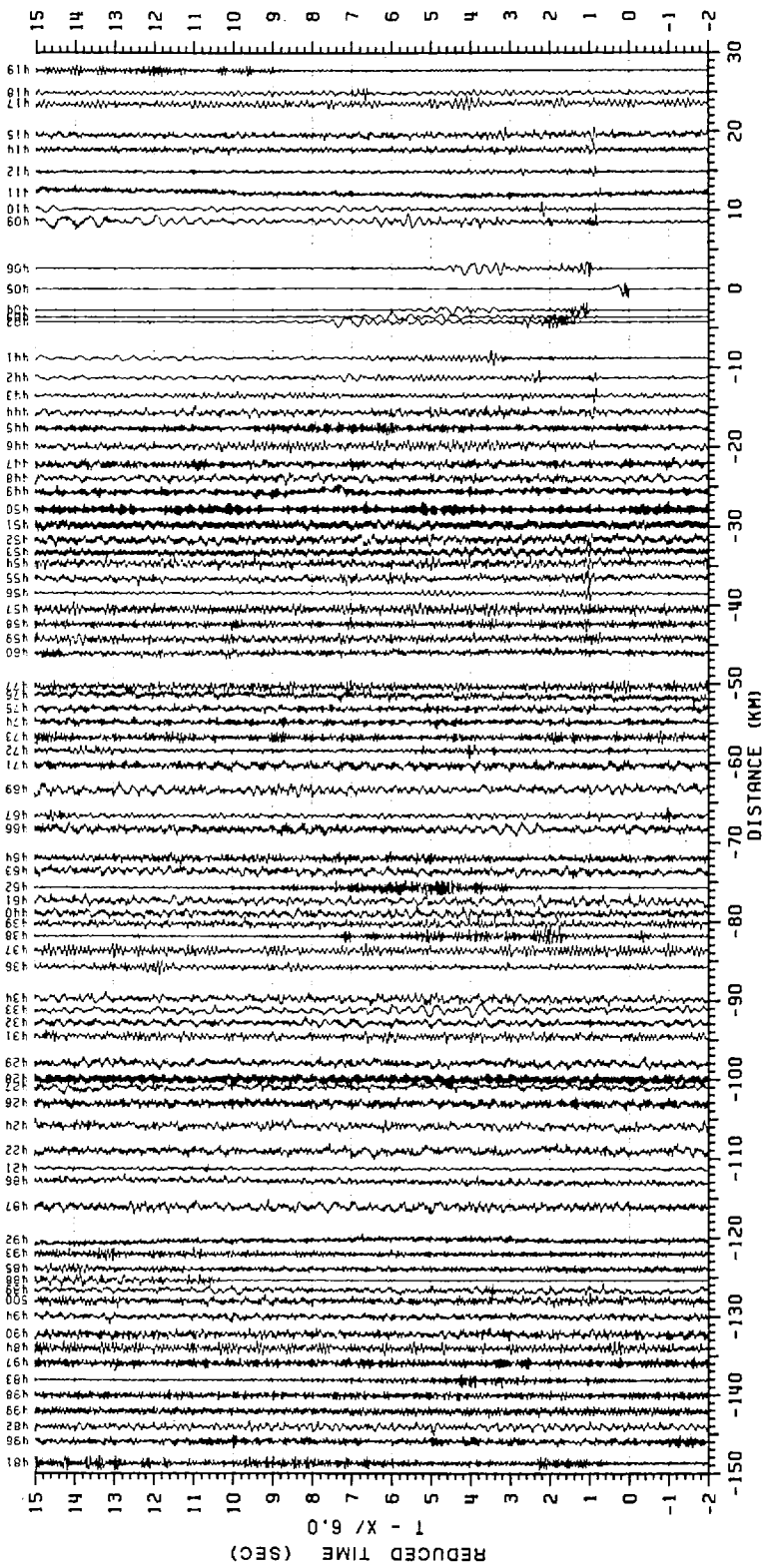

Figure 12. EASTERN PROFILE

SHOT 9 SHOT POINT 19

REFERENCES

Cady, J.W., 1975. Magnetic and gravity anomalies in the Great Valley and western Sierra Nevada metamorphic belt, California Province, Geol. Soc. AM., Spec. Paper 168, 56 pp.

Cerveny, V., Molotkov, I.A., and Psencik, I., 1977. Ray method in seismology, Charles University press, Prague, 214 pp.

Colburn R.H., and Mooney, W.D., 1986. Two-dimensional velocity structure along the synclinal axis of the Great Valley, California, Bull. Seismol. Soc. Am., 76, 1305-1322.

Fuchs, K. and Muller, G., 1971. Computation of synthetic seismograms with the reflectivity method and comparison with observations, Geophys. J. R. Astr. Soc. 23, 417-433

Healy, J.H., Mooney, W.D., Blank, H.R., Gettings, M.E., Kolher, W.M., Lamson, R.J., and Leone, L.E., 1982. Sudi Arabian seismic deep-refraction profile: final project report, U.S. Geological Survey Open-file Report USGS-OF-02-37, 141 pp.

Holbrook, W.S., and Mooney, W.D., 1987. The crustal structure of the axis of the Great Valley, California, from Seismic refraction measurements, Tectonophysics, 140, 49-63.

Hwang, L., and Mooney, W.D., 1986. Velocity and Q structure of the Great Valley, California, based on synthetic seismogram modelling of seismic refraction data, Bull. Seismol. Soc. Am., 76, 1053-1067.

Kind, R., 1978. The reflectivity method for a buried source, J. Geophys. 44, 603-612.

Kind, R., 1979. Extensions of the reflectivity method, J. Geophys. 45, 373-380.

Luetgert, James H., 1988. Users Manual for RAY84/R83PLT interactive two-dimensional raytracing/synthetic seismogram package, U.S. Geological Survey Open-file Report 88-238, 52 pp.

McMechan G.A., and Mooney, W.D., 1980. Asymptotic ray therory and synthetic seismograms for laterally varying structures: theory and application to the Imperial Valley, California, Bull. Seismol. Soc. Am., 70, 2021-2035.

Murphy, J.M., and Walter, A.W., 1984. Data report for a seismic-refraction Investigation: Morro Bay to the Sierra Nevada, U.S. Geological Survey Open-file Report 84-642, 37 pp.

Murphy, J.M., 1988. USGS FM cassette seismic-refraction recording system, U.S. Geological Survey Open-file Report 88-570, 43 pp.

Wentworth, C.M., Blake, M.C., Jr., Jones, D.L., Walter, A.W., and Zoback, M.D., 1984. Tectonic wedging associated with the emplacement of the Franciscan assemblage, California Coast Ranges, in Franciscan geology of northern California., ed. Blake, M.C., Jr., Soc. Econ. Paleontologists and Mineralogists, Pacific Section, 43, 163-173.

Wentworth, Carl M., Zoback, Mark D., Griscom, Andrew, Jachens, Robert C., Mooney, Walter D., 1987. A transect across the Mesozoic accretionary margin of central California, Geophys. J. R. astr. Soc., 89, 105-110

Zoback, Mark D., and Wentworth, C.M., 1986. Crustal studies in central California using an 800-channel seismic reflection recording system, in Reflection seismology, a global perspective: Geodynamics series, vol. 13, pp 183-196, eds Barazangi, M., and Brown, L., American Geophysical Union, Washington, D. C.

Appendix A: Shot Point and Recorder Locations

SHOT POINT LOCATIONS

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
7	37 29.287	121 2.775	15
10	37 5.824	120 49.774	28
11	37 49.602	121 24.632	0
14	37 42.440	121 12.290	0
15	37 30.897	120 58.208	0
16	37 8.278	120 40.887	0
17	38 5.320	121 6.300	32
18	37 32.102	120 38.219	73
19	37 11.273	120 13.435	80

SEISMIC RECORDER STATION LOCATIONS

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
301	36 36.200	120 6.108	56
302	36 34.468	120 4.710	57
303	36 35.343	120 8.519	53
304	36 36.233	120 9.316	53
305	36 37.073	120 10.673	52
306	36 37.958	120 10.653	52
307	36 38.778	120 10.659	52
308	36 39.544	120 12.329	50
309	36 40.876	120 13.687	49
310	36 41.719	120 13.171	50
311	36 42.665	120 12.615	51
312	36 43.194	120 12.980	51
313	36 44.053	120 13.881	51
314	36 44.940	120 14.963	51
315	36 44.964	120 16.104	51
316	36 45.908	120 16.637	53
317	36 46.718	120 17.548	52
318	36 47.508	120 18.214	50
319	36 48.594	120 18.427	50
320	36 49.297	120 19.823	48
321	37 22.506	120 50.435	32
322	37 23.402	120 50.939	26
323	37 24.277	120 51.483	27
324	37 25.149	120 52.012	26
325	37 25.995	120 52.028	25
326	37 26.492	120 53.055	24
327	37 27.271	120 53.742	24
328	37 27.824	120 54.707	22
329	37 28.369	120 55.261	22
330	37 28.918	120 55.774	22
331	37 29.583	120 56.343	22
332	37 30.450	120 57.459	21
333	37 30.915	120 58.266	21
334	37 31.290	120 58.526	20
335	37 31.751	120 59.202	19
336	37 32.649	120 59.536	19
337	37 33.097	121 0.647	19
338	37 33.966	121 0.959	21
339	37 34.368	121 1.718	21
340	37 35.279	121 2.864	21
341	37 35.681	121 3.949	15
342	37 36.544	121 4.495	19
343	37 37.413	121 5.061	18
344	37 38.291	121 6.162	17
345	37 39.148	121 7.292	15
346	37 40.006	121 8.407	13
348	37 41.304	121 10.067	12
349	37 41.661	121 10.998	12
350	37 42.186	121 11.724	12
351	37 42.400	121 12.287	10
352	37 42.841	121 12.836	9
353	37 43.506	121 13.420	9
354	37 44.349	121 13.954	8
355	37 44.806	121 14.510	8
356	37 45.772	121 15.310	6
357	37 46.521	121 16.155	4
358	37 46.956	121 16.862	4
359	37 47.545	121 17.365	3
360	37 48.369	121 18.410	3
361	37 21.635	120 49.854	29
362	37 20.885	120 48.809	29
363	37 20.330	120 47.746	30
364	37 19.431	120 47.755	28
365	37 18.425	120 46.848	28
366	37 17.449	120 46.131	27
367	37 16.757	120 45.626	26
368	37 16.379	120 44.493	27
369	37 15.947	120 42.929	28
370	37 14.540	120 42.321	28
371	37 13.787	120 42.063	28
372	37 12.906	120 40.170	29
373	37 11.172	120 40.907	29
375	37 10.307	120 40.920	28
376	37 9.442	120 40.741	30
377	37 8.895	120 41.636	29
378	37 8.268	120 40.842	28
379	37 7.687	120 39.364	29
380	37 7.016	120 38.412	30
381	37 5.221	120 36.974	32
382	37 4.861	120 35.897	32
383	37 4.699	120 34.280	33
384	37 3.681	120 34.280	33
385	37 3.194	120 33.195	35
386	37 2.387	120 32.564	35
387	37 1.259	120 31.674	36
388	37 0.461	120 29.507	39
389	36 58.895	120 27.841	39
390	36 58.402	120 27.857	39
391	36 57.180	120 27.833	39
392	36 56.739	120 27.599	39
393	36 54.822	120 26.587	42
394	36 54.044	120 26.038	41
395	36 52.500	120 26.102	42
396	36 52.095	120 23.926	44
397	36 51.966	120 22.763	44
398	36 51.511	120 21.499	47
399	36 50.597	120 21.483	47
400	36 50.182	120 21.798	47

SEISMIC RECORDER STATION LOCATIONS

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
401	37 12.748	120 17.586	68
402	37 11.950	120 16.181	71
403	37 11.144	120 15.870	73
404	37 10.498	120 15.012	76
405	37 11.286	120 13.435	80
406	37 10.448	120 12.062	85
407	37 10.022	120 10.502	86
408	37 8.935	120 9.875	89
409	37 8.055	120 9.318	89
410	37 7.295	120 8.747	91
411	37 6.312	120 8.053	89
412	37 5.441	120 6.531	89
413	37 4.560	120 6.605	88
414	37 3.485	120 6.568	85
415	37 2.843	120 5.504	85
416	37 2.264	120 4.426	85
417	37 1.482	120 3.307	89
418	37 0.546	120 3.326	88
419	36 59.615	120 1.672	92
420	36 59.104	120 0.981	89
421	37 57.552	121 1.730	30
422	37 56.628	121 0.747	32
423	37 55.843	120 59.967	33
424	37 54.913	120 59.959	33
425	37 54.284	120 59.361	33
426	37 53.668	120 58.821	36
427	37 52.915	120 57.782	42
428	37 52.225	120 57.725	39
429	37 51.395	120 56.820	41
430	37 50.747	120 55.888	45
431	37 50.137	120 55.143	45
432	37 49.458	120 54.313	47
433	37 48.772	120 53.618	50
434	37 48.065	120 53.137	50
435	37 46.940	120 52.353	48
436	37 45.688	120 52.402	45
437	37 45.266	120 50.874	54
438	37 44.304	120 50.343	57
439	37 43.525	120 49.870	57
440	37 42.870	120 49.461	56
441	37 13.979	120 18.353	68
442	37 15.071	120 19.440	67
443	37 15.931	120 20.511	64
444	37 16.667	120 21.619	62
445	37 17.329	120 22.662	62
446	37 18.188	120 23.749	29
447	37 19.047	120 24.817	28
448	37 19.518	120 25.928	54
449	37 19.907	120 26.988	55
450	37 20.788	120 28.058	53

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
451	37 21.657	120 28.862	53
452	37 22.539	120 29.577	57
453	37 23.317	120 30.114	59
454	37 24.381	120 30.206	66
455	37 25.182	120 30.987	67
456	37 25.707	120 32.166	65
457	37 26.249	120 33.414	66
458	37 26.836	120 34.476	60
459	37 26.962	120 36.048	41
460	37 27.643	120 36.918	35
461	37 42.085	120 48.947	53
462	37 41.229	120 48.409	50
463	37 40.284	120 47.674	46
464	37 39.617	120 46.845	45
465	37 38.932	120 46.133	49
466	37 37.974	120 45.390	48
467	37 37.050	120 44.972	50
468	37 36.099	120 44.749	48
469	37 35.205	120 44.162	50
470	37 34.521	120 43.689	54
471	37 33.648	120 43.167	55
472	37 32.791	120 42.442	65
473	37 32.060	120 41.754	58
474	37 32.195	120 39.780	71
475	37 32.119	120 38.229	72
476	37 31.242	120 37.768	68
477	37 30.366	120 37.778	69
478	37 29.509	120 37.787	67
479	37 28.616	120 37.761	62
481	38 15.306	121 14.615	19
482	38 13.114	121 12.987	24
483	38 10.445	121 10.674	27
484	38 8.341	121 9.538	27
485	38 3.543	121 6.099	28
486	37 58.289	121 2.292	32
487	38 0.131	121 2.916	33
488	38 4.454	121 6.279	28
489	38 5.328	121 6.290	33
490	38 7.478	121 8.990	25
491	38 0.974	121 3.916	30
492	38 1.836	121 4.866	28
493	38 2.669	121 5.430	29
494	38 6.589	121 7.931	27
495	37 59.267	121 2.883	335
496	38 14.050	121 13.553	21
497	38 9.317	121 10.095	25
498	38 11.401	121 11.293	27
499	38 12.107	121 12.399	25
500	38 5.530	121 7.377	27

SEISMIC RECORDER STATION LOCATIONS

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
701	37 21.349	121 0.411	21
702	37 20.201	121 0.199	22
703	37 19.628	120 59.790	21
704	37 18.966	121 0.495	24
705	37 18.230	120 59.748	22
706	37 17.344	120 58.944	22
707	37 17.941	120 59.222	22
708	37 16.436	120 59.393	25
709	37 16.174	120 57.545	22
710	37 15.694	120 57.188	22
711	37 15.122	120 56.805	22
712	37 14.596	120 56.464	22
713	37 14.115	120 56.136	22
714	37 13.642	120 55.820	22
715	37 13.162	120 55.501	22
716	37 12.782	120 55.237	22
717	37 12.201	120 54.849	22
718	37 11.739	120 54.534	22
719	37 11.335	120 54.262	22
720	37 10.856	120 53.941	22
721	37 10.409	120 53.630	24
722	37 9.956	120 53.354	24
723	37 9.264	120 52.865	24
724	37 8.801	120 52.497	25
725	37 8.389	120 52.119	25
726	37 7.870	120 51.600	25
727	37 7.332	120 51.090	27
728	37 6.916	120 50.690	27
729	37 6.278	120 50.038	28
730	37 5.830	120 49.644	29
731	37 4.144	120 47.927	29
732	37 1.998	120 45.865	30
733	37 0.030	120 43.361	32
734	36 58.317	120 40.025	34
735	36 56.946	120 37.435	36
736	36 55.354	120 34.281	39
737	36 54.128	120 31.571	42
738	36 52.342	120 28.390	43
739	36 49.515	120 26.313	49
740	36 47.108	120 24.246	50
741	37 31.090	121 7.109	18
742	37 30.532	121 6.694	18
743	37 29.974	121 6.280	18
744	37 29.420	121 5.855	18
745	37 28.843	121 5.449	18
746	37 28.272	121 5.055	18
747	37 27.695	121 4.642	18
748	37 27.134	121 4.227	18
749	37 26.570	121 3.853	19
750	37 26.090	121 3.427	19

LOCATION NUMBER	LATITUDE (deg,min)	LONGITUDE (deg,min)	ELEV (m)
751	37 25.571	121 3.194	21
752	37 24.985	121 2.500	21
753	37 24.297	121 2.196	23
754	37 23.943	121 1.923	24
755	37 23.673	121 1.458	24
756	37 23.376	121 1.004	22
757	37 22.980	121 0.830	0
758	37 22.280	121 0.985	24
759	37 21.674	121 0.728	23
760	37 21.291	121 0.192	21
761	37 40.184	121 15.874	11
762	37 40.637	121 16.617	14
763	37 40.968	121 16.979	12
764	37 41.287	121 17.361	12
765	37 41.887	121 17.886	11
766	37 42.255	121 18.194	10
767	37 43.119	121 19.000	11
768	37 43.439	121 19.411	10
769	37 43.756	121 19.727	8
770	37 44.292	121 20.081	7
771	37 44.733	121 20.283	6
772	37 45.547	121 21.020	3
773	37 46.350	121 21.727	4
774	37 46.466	121 22.425	3
775	37 47.211	121 22.589	1
776	37 47.871	121 23.324	1
777	37 49.193	121 24.218	1
778	37 49.602	121 24.632	0
781	37 40.205	121 15.909	11
782	37 39.715	121 15.553	15
783	37 39.222	121 15.419	15
784	37 38.921	121 15.216	15
785	37 38.350	121 14.772	15
786	37 37.872	121 14.506	15
787	37 37.128	121 14.129	16
788	37 36.881	121 13.956	16
789	37 36.427	121 13.671	16
790	37 35.960	121 13.467	16
791	37 35.466	121 12.872	15
792	37 34.972	121 12.482	15
793	37 34.615	121 12.101	16
794	37 34.271	121 11.505	16
795	37 33.564	121 10.464	16
796	37 33.412	121 10.197	16
797	37 33.136	121 9.829	17
798	37 32.381	121 8.908	19
799	37 31.985	121 8.403	21
800	37 31.849	121 7.672	18

Appendix B: Data Tables

SHOT 4 SHOT POINT 14 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
302	160.725	141.5	84	-203
303	155.992	142.7	66	2
304	153.961	142.7	66	23
305	151.506	143.0	66	-12
306	150.211	142.6	66	9
308	146.364	142.7	66	48
309	143.178	142.7	84	88
315	134.974	142.0	84	1
317	131.091	141.9	84	43
319	127.549	141.4	66	25
320	125.246	141.7	66	-10
322	47.214	138.2	66	5
323	45.472	137.6	66	0
324	43.757	137.0	66	-5
325	42.608	135.6	66	-13
326	40.894	136.2	66	4
327	39.155	135.8	66	-6
328	37.430	136.2	66	9
329	36.136	136.1	66	5
330	34.881	135.8	66	3
332	31.118	135.5	66	-10
333	29.674	135.9	66	4
334	28.909	135.5	66	-13
335	27.602	135.8	84	-11
338	22.882	133.2	66	3
340	19.176	133.7	28	3
341	17.518	135.5	28	14
342	15.825	133.6	28	2
343	14.124	131.2	28	-19
344	11.837	130.4	28	-14
345	9.545	129.6	28	0
346	7.271	128.3	8	-46
348	3.886	122.8	8	21
349	2.386	127.2	8	2
350	0.956	119.5	8	1
351	0.075	176.4	8	8
352	-1.092	312.7	8	0
353	-2.576	319.9	8	2
354	-4.294	325.3	8	-12
355	-5.457	323.3	8	9
357	-9.445	323.1	28	0
359	-12.030	321.7	28	0
360	-14.180	320.7	28	-6
361	50.730	139.3	66	5
362	52.788	139.1	66	3
363	54.594	138.5	66	3
365	58.129	139.8	66	0
366	60.194	140.2	84	0
369	65.382	138.5	84	2
370	67.938	139.4	84	6
371	69.248	139.9	84	-14
372	72.303	139.1	84	4
373	74.078	141.3	84	0
375	75.324	142.1	84	5
376	76.756	142.7	66	-10
378	78.409	143.7	66	2
379	80.600	142.9	66	-5
381	86.376	142.9	66	-23
382	87.868	142.3	66	-6
383	89.574	141.2	66	13
384	91.060	142.0	66	12
386	94.509	141.6	66	2
387	96.968	141.8	66	6
388	100.119	140.9	66	16
389	103.925	140.8	66	8
390	104.623	141.1	66	17
391	106.426	141.9	84	8
392	107.284	142.0	66	14
394	112.658	142.6	66	10
395	114.900	143.5	66	14
397	118.666	141.9	66	7
398	120.482	141.4	66	-14
399	121.833	141.9	66	9

SHOT 5 SHOT POINT 15 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
302	131.134	142.8	66	-205
303	126.488	144.4	66	2
304	124.457	144.4	66	23
305	122.022	144.7	66	-12
306	120.698	144.3	84	9
308	116.860	144.4	84	48
309	113.679	144.5	84	89
312	110.820	142.8	84	0
317	101.537	143.6	84	44
318	99.773	143.6	84	3
319	97.965	143.0	84	26
320	95.687	143.6	84	-10
322	17.525	142.3	48	5
323	15.756	141.0	48	0
324	14.017	139.3	48	-5
325	12.854	134.9	48	-14
326	11.139	137.0	48	4
327	9.398	135.5	48	-6
328	7.676	137.8	28	9
329	6.381	137.1	28	5
330	5.125	135.6	28	3
332	1.379	126.8	8	-10
333	0.091	291.6	8	4
334	-0.865	327.2	8	-14
335	-2.155	317.2	8	-11
338	-6.976	324.5	28	4
340	-10.618	319.8	28	4
341	-12.239	316.3	28	14
342	-13.958	318.5	28	2
343	-15.720	320.1	28	-20
344	-18.007	319.4	28	-14
345	-20.292	318.8	66	0
346	-22.568	318.3	66	-46
348	-25.985	317.8	66	21
349	-27.400	316.6	66	2
350	-28.840	316.4	66	1
352	-30.846	315.7	66	0
353	-32.326	316.2	66	2
354	-33.999	317.0	66	-12
355	-35.174	317.0	66	9
356	-37.283	317.6	66	-2
357	-39.144	317.6	66	0
359	-41.740	317.5	66	0
360	-43.901	317.4	66	-7
361	21.104	144.3	66	5
362	23.134	143.2	66	3
363	24.905	141.7	66	3
364	26.223	144.0	66	2
365	28.515	144.0	66	0
366	30.599	144.4	66	0
369	35.682	140.8	66	2
370	38.280	142.2	66	6
371	39.619	143.0	66	-14
372	42.622	141.3	66	4
373	44.541	145.0	84	0
375	45.850	146.2	84	5
376	47.333	147.0	66	-10
378	49.092	148.5	66	2
379	51.166	147.0	66	-5
381	56.922	146.5	66	-23
382	58.362	145.6	66	-6
383	59.987	143.9	84	13
384	61.521	144.9	84	12
387	67.409	144.4	66	6
388	70.498	143.0	66	16
389	74.298	142.8	84	9
391	76.860	144.2	84	8
394	83.178	145.1	84	10
395	85.494	146.2	84	15
397	89.124	143.9	84	7
398	90.908	143.3	84	-14
399	92.291	143.9	84	9
400	92.646	144.4	84	4

SHOT 6 SHOT POINT 16 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
302	82.481	139.3	66	-6
303	77.620	141.7	66	13
304	75.591	141.6	66	12
305	73.121	142.1	66	-15
306	71.852	141.3	66	2
308	68.002	141.4	66	17
309	64.814	141.4	66	9
312	62.207	138.2	84	15
315	56.686	139.5	66	15
317	52.824	139.0	66	7
318	51.072	138.8	66	-14
319	49.362	137.5	66	10
320	47.006	138.3	66	4
322	-31.676	332.0	66	5
323	-33.483	332.1	66	0
324	-35.273	332.2	66	-5
325	-36.675	333.3	66	-14
326	-38.189	331.9	66	4
327	-39.937	331.6	66	-6
328	-41.523	330.5	66	9
329	-42.803	330.3	66	5
330	-44.060	330.1	84	3
332	-47.762	329.2	84	-10
333	-49.113	328.5	84	4
334	-49.905	328.5	84	-14
335	-51.155	328.1	84	-11
338	-56.001	328.0	66	4
340	-59.558	327.0	84	4
341	-61.061	326.1	84	15
342	-62.834	326.3	84	2
343	-64.634	326.5	84	-20
345	-69.130	325.7	66	0
346	-71.369	325.3	84	-47
348	-74.735	324.8	84	22
349	-76.069	324.3	66	2
350	-77.483	324.0	66	1
351	-78.292	323.7	66	8
352	-79.427	323.6	84	0
353	-80.954	323.6	84	2
354	-82.677	323.8	84	-12
355	-83.842	323.7	84	9
356	-85.979	323.8	84	-2
357	-87.831	323.7	66	0
359	-90.410	323.5	66	0
360	-92.549	323.3	66	-7
361	-28.038	331.8	66	5
362	-26.095	333.3	66	3
363	-24.490	335.5	66	3
364	-22.993	333.8	66	3
365	-20.736	334.8	66	0
366	-18.653	335.4	66	0
369	-14.502	348.0	28	2
370	-11.774	349.6	28	6
371	-10.337	350.3	28	-14
372	-8.625	7.1	66	4
373	-5.352	359.7	66	0
375	-3.753	359.2	8	5
376	-2.164	5.7	8	-11
378	0.070	105.8	8	2
381	8.099	134.3	48	-24
382	9.726	130.5	48	-6
383	11.817	124.1	48	13
384	12.967	131.0	48	12
385	14.776	129.5	48	-15
386	16.457	131.5	48	2
387	18.841	133.6	48	6
388	22.217	130.6	48	17
389	25.985	131.9	48	9
390	26.586	133.4	48	18
391	28.213	136.7	48	8
394	34.325	140.1	66	10
395	36.506	143.1	66	15
397	40.414	138.3	66	7
398	42.298	137.2	84	-14
399	43.571	138.6	66	10

SHOT 7 SHOT POINT 17 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
402	123.249	143.2	84	-207
404	126.439	143.3	84	999
405	126.669	142.1	84	8
406	129.137	141.8	84	12
407	131.178	141.3	84	-11
410	136.754	141.7	84	4
411	138.824	141.9	84	46
412	141.478	141.5	84	9
414	144.318	142.4	84	33
415	146.217	142.2	84	7
417	150.197	141.8	66	52
419	154.414	141.9	84	25
420	155.789	141.8	84	2
421	15.851	155.0	84	-6
422	18.017	153.2	84	16
424	21.374	154.3	84	-11
426	24.178	153.1	84	12
427	26.118	151.5	84	-15
428	27.286	152.6	84	22
429	29.263	151.7	48	13
431	32.496	149.8	84	13
432	34.195	149.1	84	13
433	35.809	148.7	84	-17
434	37.293	148.9	84	14
436	41.639	150.7	84	3
437	43.443	148.6	84	19
438	45.370	149.0	84	8
439	46.963	149.1	84	10
440	48.312	149.3	84	11
441	118.321	143.4	84	7
442	115.740	143.4	84	4
443	113.522	143.6	84	-7
444	111.459	143.9	84	-4
445	109.567	144.1	84	2
446	107.341	144.3	84	-24
447	105.131	144.5	84	10
448	103.480	145.0	84	20
449	102.002	145.5	84	5
450	99.765	145.7	84	2
452	95.824	145.7	84	6
454	92.482	145.0	84	-4
455	90.609	145.1	84	6
456	88.825	145.6	84	4
457	86.970	146.2	84	5
458	85.204	146.7	84	0
459	83.767	147.9	66	3
460	82.020	148.2	84	-2
461	49.947	149.4	84	18
462	51.713	149.5	84	13
463	53.766	149.5	84	13
464	55.449	149.0	84	15
465	57.075	148.8	84	9
466	59.157	148.8	84	11
467	60.939	149.1	84	-32
469	64.486	149.8	84	11
471	67.712	149.9	84	0
472	69.619	149.8	84	18
473	71.297	149.6	84	2
475	73.956	146.1	84	17
476	75.682	146.4	84	-20
477	77.031	147.1	84	11
478	78.362	147.7	84	0
474	72.592	147.6	84	16
481	-22.107	326.7	66	-25
482	-17.415	325.9	84	1
483	-11.434	326.0	66	27
484	-7.323	319.7	66	25
485	3.301	174.9	66	1
486	14.269	155.7	84	9
487	10.801	152.7	66	14
488	1.603	178.9	66	27
489	0.021	45.6	8	18
490	-5.602	315.4	66	33
493	5.068	165.4	66	29
494	-3.346	314.5	66	17
495	12.264	155.9	66	23
496	-19.314	326.7	84	-13
497	-9.243	323.1	66	14
498	-13.407	327.0	84	-10
499	-15.395	324.6	84	14
500	-1.621	283.9	66	11

SHOT 8 SHOT POINT 18 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
402	49.478	138.9	84	-209
403	50.908	139.6	84	8
405	53.119	136.5	84	8
406	55.643	136.0	84	12
409	61.649	136.2	84	112
410	63.251	136.5	84	4
411	65.282	136.9	84	46
412	67.998	136.5	84	9
414	70.637	138.5	84	34
415	72.571	138.2	84	7
418	77.893	138.5	84	4
421	-58.387	323.7	84	-6
422	-56.157	323.9	84	16
423	-54.311	324.0	84	6
424	-52.924	322.9	84	-11
426	-50.080	322.8	84	12
427	-48.051	323.2	84	-15
428	-46.984	322.4	84	23
429	-44.958	322.5	84	14
431	-41.617	323.3	84	13
432	-39.883	323.6	84	13
433	-38.256	323.7	84	-17
434	-36.785	323.4	84	14
436	-32.661	320.3	48	3
437	-30.651	322.6	84	19
439	-27.208	321.0	84	10
440	-25.891	320.3	84	11
441	44.537	138.8	84	8
442	41.958	138.7	84	4
443	39.719	138.9	84	-7
444	37.618	139.4	84	-4
445	35.688	140.0	84	2
446	33.439	140.3	84	-24
447	31.209	140.7	84	11
448	29.506	142.1	84	20
449	27.988	143.7	84	5
450	25.740	144.4	84	2
452	21.801	144.2	84	6
453	20.171	143.7	84	5
454	18.534	140.4	84	-5
455	16.659	140.2	84	6
456	14.817	143.0	48	4
458	11.195	150.5	66	0
459	10.031	161.4	84	3
460	8.467	166.9	84	-2
461	-24.294	319.5	84	18
462	-22.580	318.4	84	13
463	-20.560	317.4	84	13
464	-18.827	317.6	84	15
465	-17.185	317.3	84	9
466	-15.147	315.8	84	11
467	-13.514	312.6	84	-32
469	-10.466	303.3	66	11
470	-9.216	299.1	66	25
471	-7.828	291.4	66	0
472	-6.350	281.6	66	19
473	-5.207	269.2	66	2
475	0.034	335.4	8	18
476	1.724	157.3	66	-21
479	6.483	174.0	66	8
474	-2.306	274.3	8	17
483	-85.464	326.1	84	27
484	-81.308	325.6	84	25
485	-71.117	324.9	84	1
488	-72.648	325.5	84	27
489	-73.993	326.2	84	19
490	-79.503	325.4	84	33
496	-93.348	326.3	84	-13

SHOT 9 SHOT POINT 19 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
402	-4.252	287.1	66	-210
403	-3.612	266.2	66	9
404	-2.739	238.5	66	999
405	-0.024	360.0	8	8
406	2.541	126.9	66	12
409	8.519	134.3	66	113
410	10.114	136.7	66	4
411	12.154	139.0	66	46
412	14.862	136.5	84	9
414	17.634	144.8	84	34
415	19.523	143.0	84	8
417	23.518	140.4	84	53
418	24.859	142.9	84	4
419	27.727	141.0	66	25
421	-111.296	320.3	84	-6
422	-109.061	320.3	84	17
424	-105.888	319.7	84	-11
426	-103.053	319.6	84	12
427	-101.006	319.7	84	-16
428	-99.980	319.3	84	23
429	-97.951	319.3	84	14
431	-94.582	319.5	84	13
432	-92.837	319.5	84	13
433	-91.209	319.5	84	-17
434	-89.757	319.3	84	14
436	-85.742	317.9	48	3
437	-83.668	318.7	84	19
438	-81.818	318.3	84	8
439	-80.281	318.0	84	10
440	-78.985	317.7	84	11
441	-8.832	304.5	84	8
442	-11.326	308.3	84	4
443	-13.557	309.5	84	-7
444	-15.687	309.5	84	-4
445	-17.654	309.4	84	2
446	-19.905	310.0	84	-24
447	-22.137	310.5	84	11
448	-23.953	309.5	84	20
449	-25.623	308.6	84	6
450	-27.877	309.1	84	2
451	-29.816	310.1	84	12
452	-31.679	311.1	84	6
453	-33.226	312.1	84	5
454	-34.672	314.4	84	-5
455	-36.531	314.8	84	6
456	-38.455	314.0	84	5
457	-40.480	313.2	84	5
458	-42.367	312.8	84	0
459	-44.251	311.0	84	3
460	-46.047	311.1	84	-2
461	-77.405	317.4	84	18
462	-75.706	317.0	84	13
463	-73.694	316.7	84	13
464	-71.960	316.8	84	15
466	-68.283	316.3	84	11
467	-66.628	315.7	84	-32
469	-63.376	314.3	84	11
471	-60.327	313.3	84	0
472	-58.466	312.9	84	19
473	-56.804	312.6	84	2
475	-53.168	316.5	84	18
476	-51.530	315.8	84	-21
477	-50.395	314.5	84	11
474	-54.871	314.9	84	17
481	-148.738	322.8	84	-26
482	-144.073	322.6	84	1
483	-138.099	322.4	48	27
484	-134.006	322.0	84	25
485	-123.926	321.3	84	1
486	-112.870	320.4	84	9
487	-116.088	321.1	84	14
488	-125.408	321.7	84	27
489	-126.691	322.1	84	19
490	-132.255	321.8	84	33
492	-120.334	321.0	84	24
493	-122.052	321.2	84	30
494	-130.007	321.9	84	17
496	-145.950	322.7	84	-13
497	-135.931	322.2	84	14
498	-140.053	322.6	84	-10
499	-142.073	322.4	84	14
500	-127.967	321.7	84	11

SHOT 12 SHOT POINT 10 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
701	-32.744	331.3	60	19
702	-30.741	329.9	60	63
703	-29.521	329.9	78	-29
704	-29.026	326.9	60	-5
705	-27.284	327.3	60	3
706	-25.263	327.5	60	21
707	-26.416	328.0	60	11
709	-22.334	329.0	60	17
711	-20.102	328.8	60	-8
712	-19.008	328.6	60	9
713	-17.998	328.4	60	5
715	-16.004	328.0	60	16
716	-15.200	327.9	60	5
717	-13.985	327.5	60	-8
718	-13.015	327.2	60	-12
719	-12.169	326.9	60	18
720	-11.168	326.5	60	15
721	-10.224	326.0	40	86
722	-9.303	325.2	40	19
723	-7.840	324.3	40	17
724	-6.827	323.8	40	13
725	-5.880	323.8	40	12
726	-4.652	324.4	20	8
727	-3.403	325.0	20	19
729	-0.927	335.0	20	8
730	-0.192	86.5	8	10
731	4.140	138.6	20	15
732	9.145	140.7	40	13
733	14.326	138.4	40	15
734	20.043	133.8	60	26
736	30.052	130.1	60	29
737	34.600	128.7	60	14
738	40.357	128.2	60	3
739	46.070	130.9	60	-30
740	51.329	132.4	60	19
741	-53.293	331.3	78	14
742	-52.094	331.3	78	-8
743	-50.896	331.4	40	11
744	-49.697	331.4	78	-36
745	-48.472	331.4	78	9
746	-47.267	331.5	78	-16
747	-46.038	331.5	78	3
749	-43.654	331.5	78	13
750	-42.574	331.7	40	-13
751	-41.567	331.5	40	10
752	-40.126	332.0	40	1
753	-38.793	331.7	40	13
754	-38.025	331.8	40	6
755	-37.262	332.4	60	8
756	-36.466	332.9	60	17
758	-34.661	331.4	60	-6
759	-33.496	331.1	60	13
760	-32.495	331.7	60	-19
761	-74.322	328.8	60	-3
762	-75.607	328.4	60	-15
763	-76.407	328.3	60	6
764	-77.206	328.2	60	46
765	-78.555	328.1	60	5
766	-79.373	328.1	60	16
767	-81.410	328.0	60	27
769	-82.977	327.8	60	23
770	-84.093	327.9	60	17
771	-84.943	328.0	60	10
772	-86.795	327.9	78	23
773	-88.606	327.8	78	1
774	-89.336	327.4	78	6
775	-90.628	327.7	78	14
778	-95.973	327.6	78	51
781	-74.381	328.8	60	7
782	-73.334	328.7	60	7
783	-72.454	328.5	60	10
784	-71.823	328.5	60	22
786	-69.624	328.4	60	1
787	-68.161	328.2	60	0
789	-66.705	328.1	60	0
790	-65.814	327.9	60	24
791	-64.574	328.1	60	22
793	-62.637	328.2	60	10
794	-61.636	328.6	60	-40
795	-59.723	329.2	40	14
797	-58.564	329.6	40	7
798	-56.675	330.1	40	1
799	-55.670	330.4	40	13
800	-54.922	331.2	40	9

SHOT 13 SHOT POINT 7 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
701	15.090	166.6	60	19
702	17.230	167.3	60	63
703	18.401	166.2	78	-29
704	19.384	170.0	60	-5
705	20.933	167.7	60	3
706	22.801	165.6	60	21
707	21.631	166.0	60	11
709	25.453	162.3	60	17
711	27.643	161.4	60	-8
712	28.727	161.1	60	9
713	29.724	160.7	60	5
715	31.701	160.2	60	16
716	32.495	160.0	60	5
717	33.702	159.7	60	-8
718	34.665	159.4	60	-12
719	35.505	159.3	60	18
720	36.502	159.1	60	15
721	37.439	158.9	78	87
722	38.368	158.7	78	19
723	39.823	158.4	78	17
724	40.820	158.2	78	13
725	41.737	157.8	78	12
726	42.917	157.4	78	8
727	44.127	157.0	78	19
728	45.066	156.7	78	15
729	46.535	156.1	78	8
730	47.528	155.9	78	10
731	51.424	154.7	78	15
732	56.326	153.7	78	13
733	61.258	152.1	78	15
734	66.433	149.6	78	26
736	75.607	146.1	78	29
737	79.755	144.6	78	14
738	85.234	143.3	78	3
739	91.280	143.7	78	-30
740	96.691	143.8	78	19
741	-7.206	297.6	40	14
742	-6.219	291.7	40	-8
743	-5.321	283.8	40	11
744	-4.548	273.1	20	-37
745	-4.027	258.2	20	9
746	3.850	240.8	20	-16
747	4.031	223.1	20	3
748	4.520	208.3	20	29
749	5.271	197.6	40	13
750	5.991	189.2	40	-13
751	6.901	185.1	40	10
752	7.968	177.1	40	1
753	9.269	174.7	40	13
754	9.964	172.8	40	6
755	10.564	169.4	60	8
756	11.241	166.6	60	18
758	13.227	168.5	60	-6
759	14.402	167.9	60	14
760	15.273	165.6	60	-20
761	-27.898	316.3	60	-3
762	-29.259	315.9	60	-15
763	-30.069	315.9	60	6
764	-30.884	316.0	60	46
765	-32.218	316.3	60	5
766	-33.024	316.6	60	16
767	-35.000	317.0	60	28
769	-36.590	317.0	60	23
770	-37.669	317.5	60	17
771	-38.473	318.0	60	10
772	-40.316	318.3	78	23
773	-42.116	318.5	78	1
774	-42.961	317.7	78	6
775	-44.147	318.7	78	14
777	-48.483	319.4	78	7
778	-49.452	319.5	78	51
781	-27.961	316.2	60	7
782	-26.945	315.7	60	7
783	-26.160	314.6	60	11
784	-25.557	314.2	60	22
786	-23.466	312.6	60	1
787	-22.136	310.9	60	0
789	-20.785	309.5	60	0
790	-20.011	308.1	60	24
791	-18.759	307.5	60	22
793	-16.908	305.7	60	10
794	-15.826	305.6	60	-40
795	-13.818	304.9	40	14
797	-12.598	304.4	40	7
798	-10.698	302.3	40	1
799	-9.680	301.0	40	13
800	-8.634	303.3	40	9

SHOT 14 SHOT POINT 11 DATA TABLE

LOCATION NUMBER	DISTANCE (km)	AZMUTH (deg)	AMPLIFICATION (dB)	CLOCK CORRECTION (msec)
701	63.263	145.7	60	19
702	65.203	146.5	60	63
703	66.421	146.6	78	-29
704	66.890	147.9	60	-5
705	68.629	147.7	60	3
706	70.649	147.6	60	21
707	69.497	147.4	60	11
709	73.585	147.2	78	17
711	75.815	147.3	60	-8
712	76.906	147.3	78	9
713	77.916	147.4	78	5
715	79.909	147.5	78	16
716	80.762	147.5	78	5
717	81.978	147.6	78	-8
718	82.950	147.7	60	-12
719	83.797	147.7	60	18
720	84.801	147.7	78	15
721	85.748	147.8	78	87
722	86.675	147.8	78	20
723	88.145	147.9	78	17
724	89.161	147.9	78	14
725	90.105	147.8	78	12
726	91.326	147.8	78	8
727	92.572	147.7	78	19
728	93.537	147.6	78	15
729	95.052	147.5	78	8
730	96.064	147.5	78	10
731	100.062	147.2	78	15
732	105.056	147.0	78	13
733	110.132	146.4	78	15
734	115.518	145.2	78	26
736	124.916	143.5	78	30
737	129.133	142.6	78	14
738	134.626	141.9	78	3
739	140.656	142.2	78	-30
740	146.062	142.3	78	19
741	42.854	143.0	78	14
742	44.047	143.2	78	-8
743	45.238	143.4	40	12
744	46.434	143.5	78	-37
745	47.650	143.7	78	9
746	48.845	143.9	78	-16
747	50.067	144.0	78	3
749	52.436	144.3	40	13
750	53.524	144.3	40	-13
751	54.505	144.6	40	10
752	55.982	144.4	40	1
753	57.280	144.8	40	13
754	58.048	144.9	40	6
755	58.851	144.6	60	8
756	59.687	144.4	60	18
758	61.365	145.4	60	-6
759	62.504	145.7	60	14
760	63.535	145.5	60	-20
761	21.655	143.6	60	-3
762	20.337	144.6	60	-15
763	19.530	144.9	60	6
764	18.724	145.2	60	47
765	17.373	145.2	60	5
766	16.555	145.2	60	16
767	14.566	145.4	60	28
768	13.737	146.1	60	9
769	12.992	146.3	60	23
770	11.880	145.8	60	17
771	11.040	144.7	60	10
772	9.185	144.7	34	23
773	7.373	144.7	30	1
774	6.644	150.8	10	6
775	5.344	145.9	10	14
776	3.733	149.1	96	12
777	0.969	141.2	10	7
778	0.000	180.0	10	51
781	21.594	143.6	60	7
782	22.635	143.9	60	7
783	23.491	144.8	60	11
784	24.119	145.0	60	22
786	26.308	145.6	60	1
787	27.760	146.2	60	0
789	29.212	146.5	60	0
790	30.100	147.0	60	24
791	31.344	146.5	60	22
793	33.284	146.4	60	10
794	34.300	145.8	60	-40
795	36.247	144.9	78	14
797	37.434	144.5	78	7
798	39.359	144.0	78	1
799	40.388	143.8	78	13
800	41.234	142.8	78	9

Appendix C: SEG-Y Tape Format

Archive Tape Data Format

Archive data tapes are written in SEGY standard format (Barry et al, 1975). Recording density is 1600 bpi, phase encoded (PE). In order to accomodate seismic refraction data, some minor changes have been made to the tape header fields. A complete list of header fields is provided in the card image portion of the reel identification header, shown below:

```
C 1   REEL IDENTIFICATION HEADER BYTES :
C 2   3217 -3218     SAMPLING INTERVAL (MICROSECS).
C 3   3221 -3222     NUMBER OF SAMPLES PER TRACE.
C 4   3225 -3226     DATA SAMPLE FORMAT CODE.
C 5   3255 -3256     MEASUREMENT SYSTEM (1 = METERS; 2 = FEET)
C 6
C 7
C 8   TRACE IDENTIFICATION HEADER BYTES :
C 9      1 -   4     TRACE SEQUENCE NUMBER WITHIN REEL.
C10      5 -   8     TRACE SEQUENCE NUMBER WITHIN REEL.
C11      9 -  12     STATION LOCATION NUMBER.
C12     29 -  30     TRACE ID CODE (1 = SEISMIC DATA).
C13     37 -  40     SHOTPOINT-RECEIVER DISTANCE (M).
C14     41 -  44     STATION ELEVATION (M).
C15     45 -  48     SHOTPOINT ELEVATION (M).
C16     49 -  52     SOURCE DEPTH (M).
C17     69 -  70     SCALAR TO BE APPLIED TO ALL ELEVATIONS.
C18     71 -  72     SCALAR TO BE APPLIED TO ALL COORDINATES.
C19     73 -  76     SHOTPOINT COORDINATE - X.
C20     77 -  80     SHOTPOINT COORDINATE - Y.
C21     81 -  84     RECEIVER COORDINATE - X.
C22     85 -  88     RECEIVER COORDINATE - Y.
C23     89 -  90     COORDINATE UNITS (1 = METERS; 2 = SECONDS OF ARC).
C24    115 - 116     NUMBER OF SAMPLES IN THIS TRACE.
C25    117 - 118     SAMPLE INTERVAL IN MICROSECONDS FOR THIS TRACE.
C26    121 - 122     INSTRUMENT ATTENUATION IN DB.
C27    157 - 158     SHOT TIME - YEAR.
C28    159 - 160     SHOT TIME - DAY OF YEAR.
C29    161 - 162     SHOT TIME - HOUR OF DAY (24 HOUR CLOCK).
C30    163 - 164     SHOT TIME - MINUTE OF HOUR.
C31    165 - 166     SHOT TIME - SECOND OF MINUTE.
C32    167 - 168     TIME BASIS CODE (2 = GMT).
C33    181 - 182     SHOT TIME - MILLISECONDS.
C34    183 - 184     SHOTPOINT LOCATION NUMBER.
C35    185 - 186     RECORDING INSTRUMENT UNIT NUMBER.
C36    191 - 192     DISTANCE WEIGHTING EXPONENT (HUNDREDTHS).
C37    193 - 194     SHOT SEQUENCE NUMBER (SHOT NUMBER).
C38    195 - 196     SHOT SIZE (KG).
C39    197 - 200     SHOTPOINT - STATION AZIMUTH (SEC OF ARC).
C40    201 - 204     TIME OF FIRST POINT MINUS SHOT TIME (MSEC)
```

The data point format is "32 bit floating point", and the appropriate bytes (3225-3226) of the binary reel id header contain a value of 1. The trace amplitudes have not been adjusted for instrument gain, but the gain correction factor can be estimated from the instrument attenuation value (att) specified in bytes 121-122. To correct for gain, the data should be demeaned and then multiplied by

$$10^{(att/20)}.$$

The measurement system (bytes 3255-3256 of the binary reel header) is set to 1, meters.

Shotpoint and receiver coordinates are in seconds of arc (byte field 89-90). The coordinate scalar multiplier (bytes 71-72) is set to -100, so the coordinates (bytes 73-88) are in hundredths of a second of arc.

Bytes 157-166 and bytes 181-182 refer to the shot detonation time. The time of the first data sample is found by adding the shot detonation time to the time specified in bytes 201-204.

Since there is no weighting of amplitudes with distance for archive tapes, the distance weighting exponent (bytes 191-192) is not used.

Shot sequence number (bytes 193-194) refers to the order in which shots were fired during the field campaign.

REFERENCE

Barry, K.M., D.A. Cavers, and C.W. Kneale (1975). Recommended Standards for Digital Tape Formats, Geophysics 40, 344-352.