

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

DATA REPORT FOR A SEISMIC REFRACTION/
WIDE-ANGLE REFLECTION INVESTIGATION
OF THE PUGET BASIN AND WILLAMETTE VALLEY
IN WESTERN WASHINGTON AND OREGON

By

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Introduction

In September, 1991, the U.S. Geological Survey (USGS), in collaboration with Oregon State University (OSU), the University of Texas at El Paso (UTEP), the Geological Survey of Canada (GSC), the Incorporated Research Institutions for Seismology (IRIS), the University of British Columbia (UBC), and the University of Wyoming (WYO), conducted a seismic refraction/wide angle reflection experiment in the Puget Basin of western Washington and the Willamette Valley of western Oregon. The experiment was designed to image the structure of the Cascadia subduction zone to provide a basis for understanding the seismic and volcanic hazards associated with the subduction zone. Two north-south profiles and one east-west profile were shot (figure 1). This report presents data collected along the north-south profiles. Data from the east-west profile are presented in Tréhu *et al.* (1993).

Description of the Survey

The first profile line extended south from the U.S.-Canadian border to Randle, Washington. Portable seismic recorders were laid out in a linear array at a nominal spacing of 600 meters along the 284-km-long north-south profile along the east flank of the Puget Basin. Ten shots were fired at 10 locations at intervals of ~30 km along the profile (shotpoints 1-10; Table 1, Figure 2). The second profile line extended south from near Centralia, Washington to Eugene, Oregon. The seismic recorders were then laid out in a linear array at a nominal spacing of 700 meters along the 333-km-long north-south profile in the Willamette Valley (Figures 1,2). Ten shots were fired at 10 locations at intervals of ~33 km along the profile (shotpoints 11-20) (Table 1, Figure 2).

Shotpoints were sited in 20 cm by 50 m drill holes (Table 1). Ammonium nitrate explosive was detonated by electric detonators (caps), detonating cord, and boosters. Shot depth is considered to be at the center of the explosive column at 30 m. All shots were fired automatically by portable master clocks calibrated to time obtained from the GOES satellite. The reported shot times are accurate to within ± 2 milliseconds, assuming that the explosives detonated at the time of the cap break.

The positions and elevations of recording instruments and shot points were determined using the satellite-based Global Positioning System (GPS). All the positions (Appendix A) are estimated to be accurate to within 2 meters; elevations to within 5 meters.

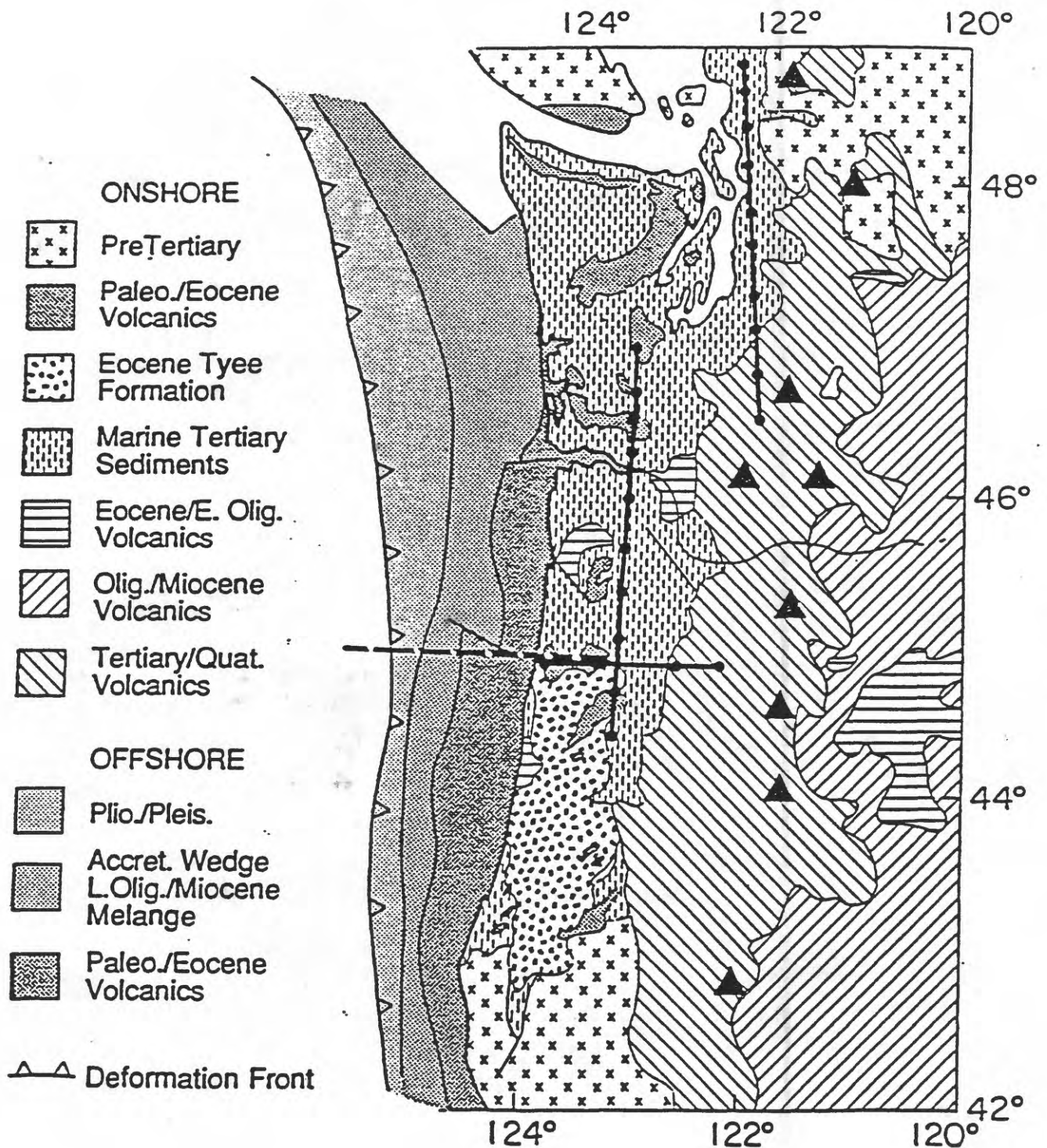


FIGURE 1. Simplified geologic map (onshore geology after Wells et al., 1984; offshore geology after Snavely, 1987) showing the location of the seismic reflection and refraction profiles collected in 1989 (Brocher et al., 1993, Tréhu and Nakamura, 1993; heavy dashed line) and 1991 (heavy solid lines). Filled triangles show the locations of Cascade volcanoes. Dots along profiles show the approximate locations of large explosive shots (Table 1).

Table 1

SHOT LIST

Shot No.	Shot Point	Shot Year	Shot Date	Time UTC Day:Hr:Mn:Sec	Size (kg)	Latitude (deg)	Longitude (deg)	Elev. (m)	Depth (m) *
1	9	1991	9/24	267:06:00:00.000	1364	46.77634N	121.95531W	1147	30
2	7	1991	9/24	267:06:02:00.000	909	47.33746N	121.98857W	256	30
3	5	1991	9/24	267:06:04:00.000	909	47.89902N	122.06177W	42	30
4	3	1991	9/24	267:06:06:00.000	909	48.47834N	122.21106W	279	30
5	1	1991	9/24	267:06:08:00.000	1818	48.94640N	122.17978W	606	30
6	10	1991	9/24	267:09:00:00.000	1818	46.49186N	121.90090W	411	30
7	8	1991	9/24	267:09:02:00.000	909	47.08868N	122.02650W	430	30
8	6	1991	9/24	267:09:04:00.000	909	47.69011N	122.03147W	67	30
9	4	1991	9/24	267:09:06:00.000	909	48.24211N	122.10647W	114	30
10	2	1991	9/24	267:09:08:00.000	1364	48.72761N	122.16451W	219	30
11	13	1991	9/28	271:07:00:00.000	909	46.28102N	123.13479W	332	30
12	11	1991	9/28	271:07:02:00.000	1818	46.71530N	123.11958W	122	30
13	15	1991	9/28	271:07:04:00.000	909	45.64276N	123.18259W	276	30
14	17	1991	9/28	271:07:06:00.000	909	44.99615N	123.21644W	58	30
15	19	1991	9/28	271:07:08:00.000	1364	44.37606N	123.31846W	81	30
16	14	1991	9/28	271:09:00:00.000	909	45.96819N	123.14380W	305	30
17	12	1991	9/28	271:09:02:00.000	1364	46.49464N	123.14212W	343	30
18	16	1991	9/28	271:09:04:00.000	909	45.32990N	123.24969W	179	30
19	18	1991	9/28	271:09:06:00.000	909	44.68893N	123.20181W	76	30
20	20	1991	9/28	271:09:08:00.000	1818	44.03289N	123.39594W	290	30

*Assumed from depth to center of explosive charge.

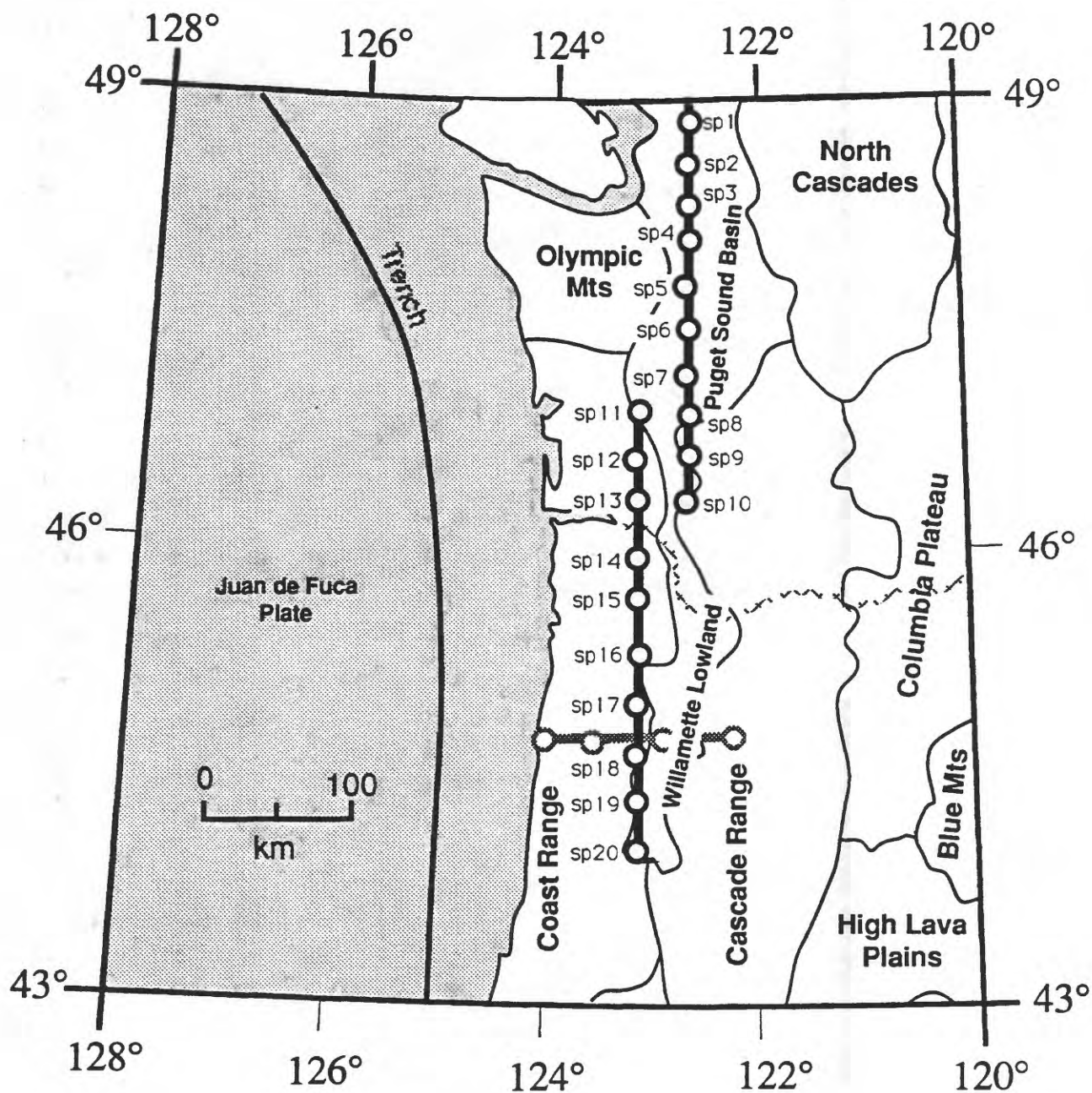


Figure 2. Approximate location of 1991 seismic refraction profiles in Washington and Oregon.

INSTRUMENTATION AND DATA REDUCTION

Seismic Recorders

Four different types of instruments were used in this experiment. The seismic group recorders used in this seismic-refraction survey were 185 modified single-component SGR IIIs. The SGR-III recorders were designed by Amoco Production Company, built by Globe Universal Sciences, Inc., and modified by the USGS. The SGR-III is a single channel, digital seismic recorder with a theoretical dynamic range of 156 dB. Data is sampled at 500 samples per second by a 12 bit A/D with gain ranging from 0-90 dB in 6 dB steps. Data from these instruments have been resampled at 200 samples per second for merging with other data. The instruments have been modified to turn on at preset times instead of using the standard radio turn on. A programmable memory board in each unit allows data to be recorded during 99 predetermined time windows. Timing is provided by a temperature compensated internal oscillator that is synchronized to a USGS master clock prior to deployment. The USGS master clocks drift approximately one millisecond per week and are checked periodically against satellite clocks. The digital data and a drift rate are recorded on cartridge tape. The drift rate is used to calculate a chronometer correction at shot time. In this investigation, each SGR III was connected to a single string of 6 modified Mark Products L-10B vertical component 8-Hz geophones connected in series. The total system response is shown in figure 2.

The USGS seismic cassette recorders used in this seismic-refraction survey have been described by *Murphy* (1989). Each instrument is connected to a Mark Products L4A 2-Hz vertical-component geophone. The signal from this geophone passes through three parallel amplifiers, each with an adjustable gain setting. The three seismic signals plus an internally generated time code (IRIG-E) and a fixed reference frequency are recorded as a multiplexed signal on analog cassette tape. A programmable memory board in each unit allows data to be recorded during ten predetermined time windows. Prior to recording the seismic data, the instrument records a geophone pulse, an amplification step, and 10-Hz sine-wave calibration signals at 1, 10, 100, and 1000 mv. The frequency response curve for the system peaks at about 20 Hz (figure 2). Attenuation settings of every instrument have been checked against the calibration signals. Where calibration signals indicated a different dB setting than listed on the field sheets, the correct settings were calculated and entered into the computer. After checking for errors in clock drift

and site locations, the analog data were digitized for 50 seconds, starting at either (X/8-1) or (X/6-4) seconds prior to shot time, where X is the shot point to recorder distance in km. The sampling rate for digitizing was 200 samples per second.

The PRS-1 system used by the GSC uses a Mark Products L4A 2-Hz vertical-component geophone. These digitally recording instruments have a total dynamic range of 126 dB and a sample rate of 125 samples/s. The PRS-4 seismographs are similar to the PRS-1s, except that they record 3 orthogonal geophone components. Only the vertical component data are presented in this report. Curves showing displacement versus frequency for this system peak at approximately 17 Hz (Figure 2) (*I. Asudeh*, pers. comm., 1987). Data from these instruments have been resampled at 200 samples per second for merging with other data.

The REFTEK seismographs are 6-component instruments that can be operated in both pre-programmed and event-detect modes. A wide range of sampling rates is possible. For this experiment, the instruments were programmed to record for 110 s during each shot window and the data were sampled at 100 Hz. Data from these instruments have been resampled at 200 samples per second for merging with other data. The sensors used for this experiment were three-component Mark Products L-22 2 Hz seismometers. The theoretical velocity response is shown in figure 2 (PASSCAL training center manual, unpublished manuscript).

The clocks of each recording unit were initially synchronized to a GOES master clock via a portable base receiver. Each unit was then deployed with programmable timers to initiate recording over the expected shot time window. After the deployment the GOES time signal was compared to the internal clocks for drift measurement. All data were time corrected using the GOES data assuming a linear drift rate.

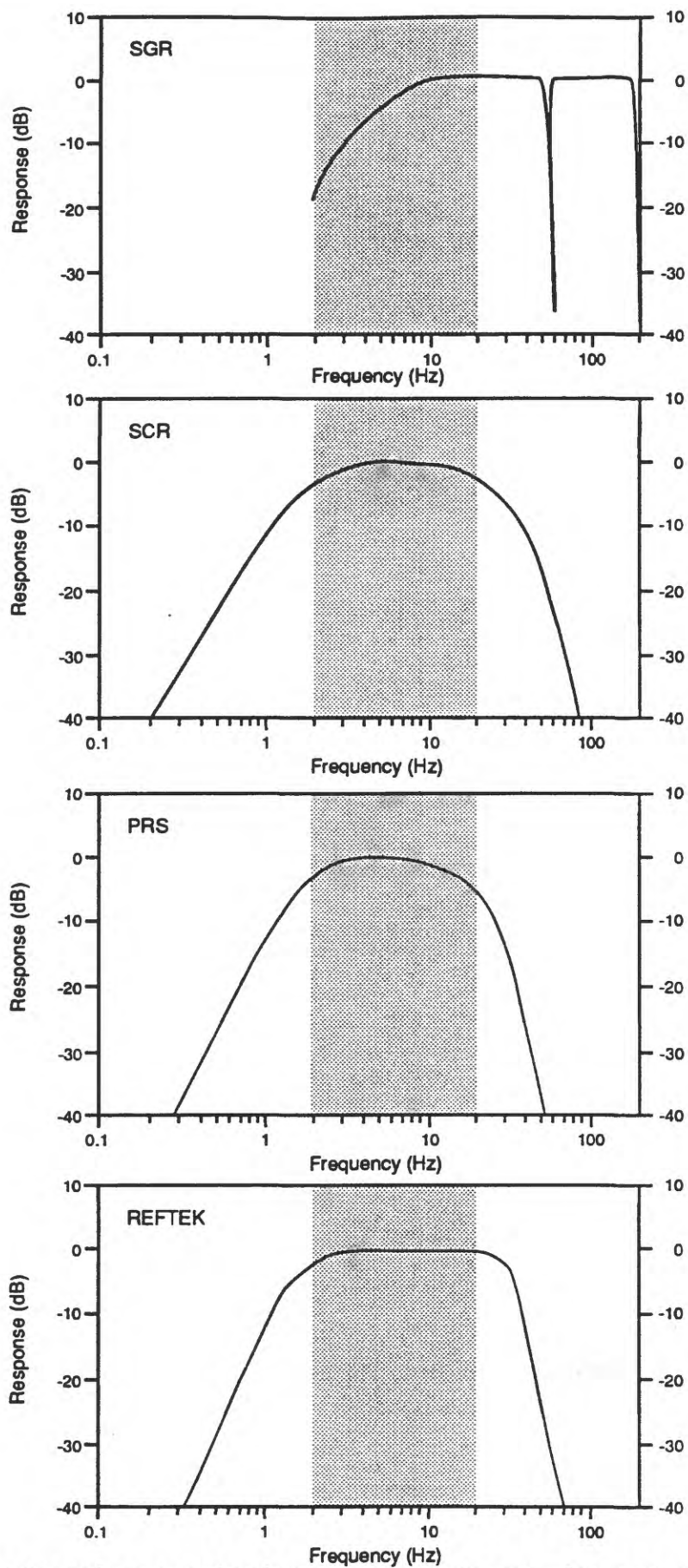


Figure 3 -Approximate velocity response curves for the four groups of instrument used in this experiment. Shaded region from 2-20 Hz is the bandpass of the filtered traces presented in figures 4-21.

Data Reduction

Following the experiment, data from all instruments was written in SEG Y format and merged into shot gathers. All data have been resampled to 200 samples per second, gain corrected to be in units of nanometers/s, and header information has been checked for accuracy and consistency.

The data presented in this report 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
(303) 497-6472

The data have also been archived at the IRIS Data Management Center. Tapes are available from:

IRIS Data Management Center
1408 N.E. 45th Street, Second Floor
Seattle, Washington 08105
(206) 547-0393 Phone
(206) 547-1093 Fax

Appendix B contains a description of the tape format. Interpretation of the data collected during the experiment is continuing.

Record Sections

For each shot-gather which successfully recorded energy a trace-normalized record section is presented (Fig. 3-20). Shotpoint 2 on profile 1 and shotpoint 16 on profile 2 did not provide sufficient energy to be recorded by the instrument arrays. All traces are normalized to their maximum deflection and plotted using reduced time, with a reduction velocity of 7.0 km/s. All traces have been bandpass filtered from 2 to 20 Hz to attenuate high frequency noise bursts and ground roll. A few traces which recorded no data have been removed for clarity. Each shot gather has been split and plotted as two separate record sections which overlap one another by 20 km.

References

- Brocher, T.M., M.J. Moses, and A.M. Tréhu, 1993, Onshore-offshore wide-angle seismic recordings from central Oregon: The five-day recorder data, *USGS Open-file Rept. 93-318*, U.S. Geol. Surv., 24p.
- Murphy, J.M., 1989, USGS FM cassette seismic-refraction recording system, *USGS Open-file Rept. 88-570*, U.S. Geol. Surv., 43p.
- Snively, P.D., Jr., 1987, Tertiary geologic framework, neotectonics, and petroleum potential of the Oregon-Washington continental margin, in Scholl, D.W., Grantz, A., and Vedder, J.G. (eds.), *Geology and resource potential of the continental margin of western North America, Circum Pacific Council for Energy and Mineral Resources Earth Science Series vol. 6*, P. 305-335.
- Tréhu, A., and Y. Nakamura, 1993, Onshore-offshore wide-angle seismic recordings from central Oregon: Ocean bottom seismometer data, *USGS Open-file Rept. 93-317*, U.S. Geol. Surv.
- Tréhu, A., S. Azevedo, J. Nabelek, J. Luetgert, W. Mooney, I. Asudeh, and B. Isbell, 1993, Seismic refraction data across the Coast Range and Willamette Basin in central Oregon: the 1991 Pacific Northwest Experiment, *USGS Open-file Rept. 93-319*, U.S. Geol. Surv., 31p.
- Wells, R.E., D.C. Engebretson, P.D. Snively, Jr., and R.S. Coe, 1984, Cenozoic plate motions and the volcano-tectonic evolution of western Oregon and Washington, *Tectonics*, 3, 275-294.

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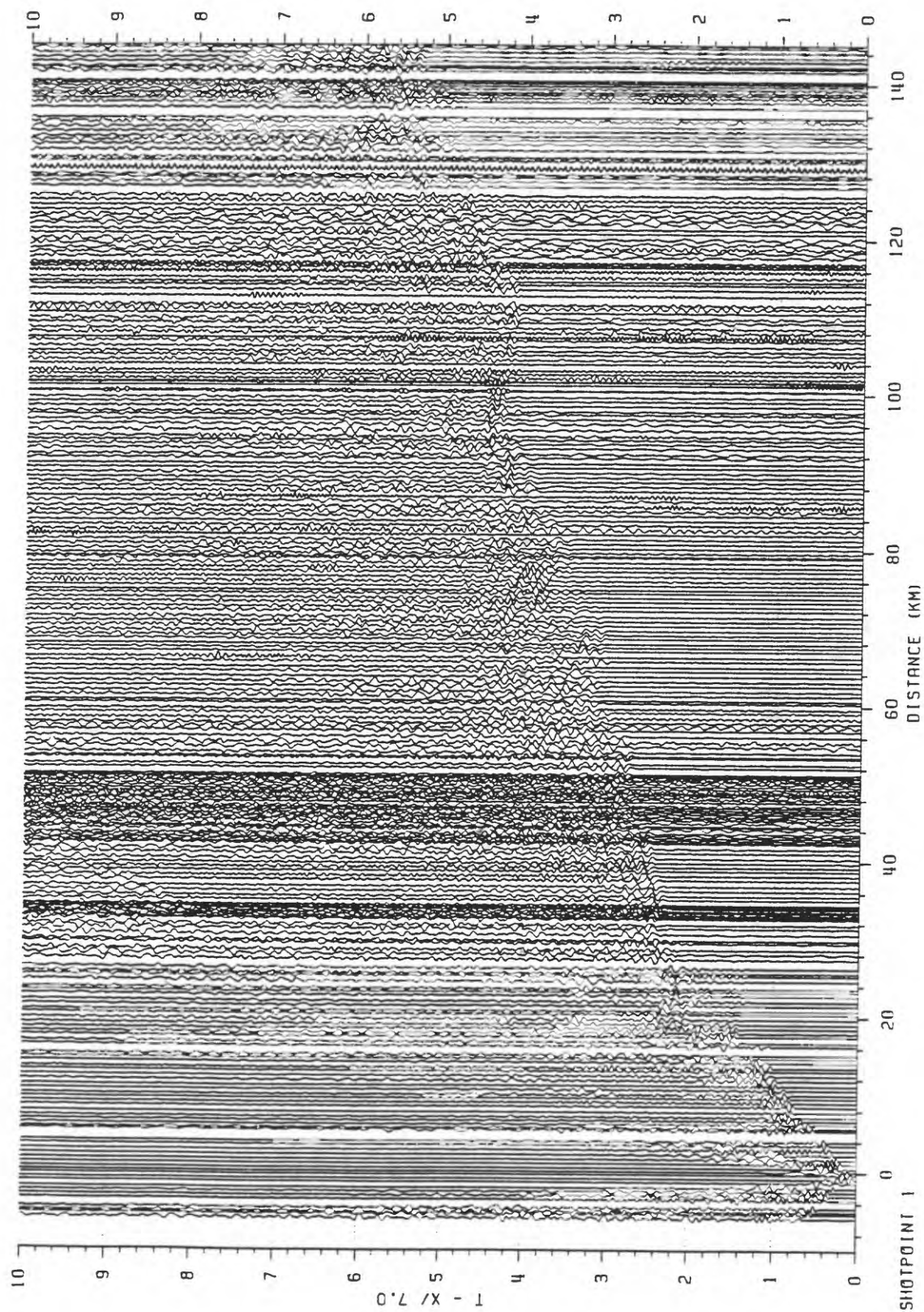


FIGURE 4a. Record section for shotpoint 1 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

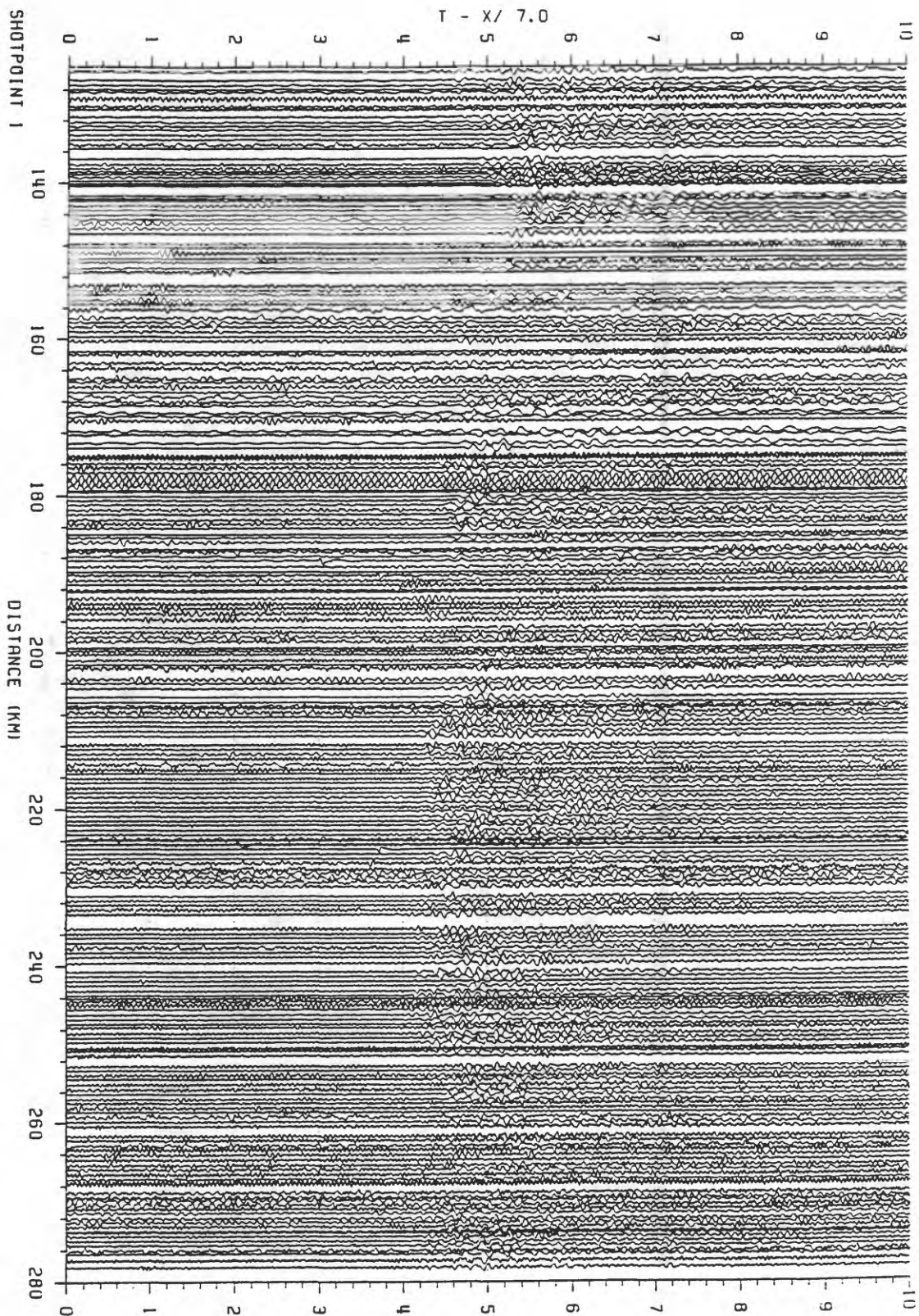


FIGURE 4b. Record section for shotpoint 1 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

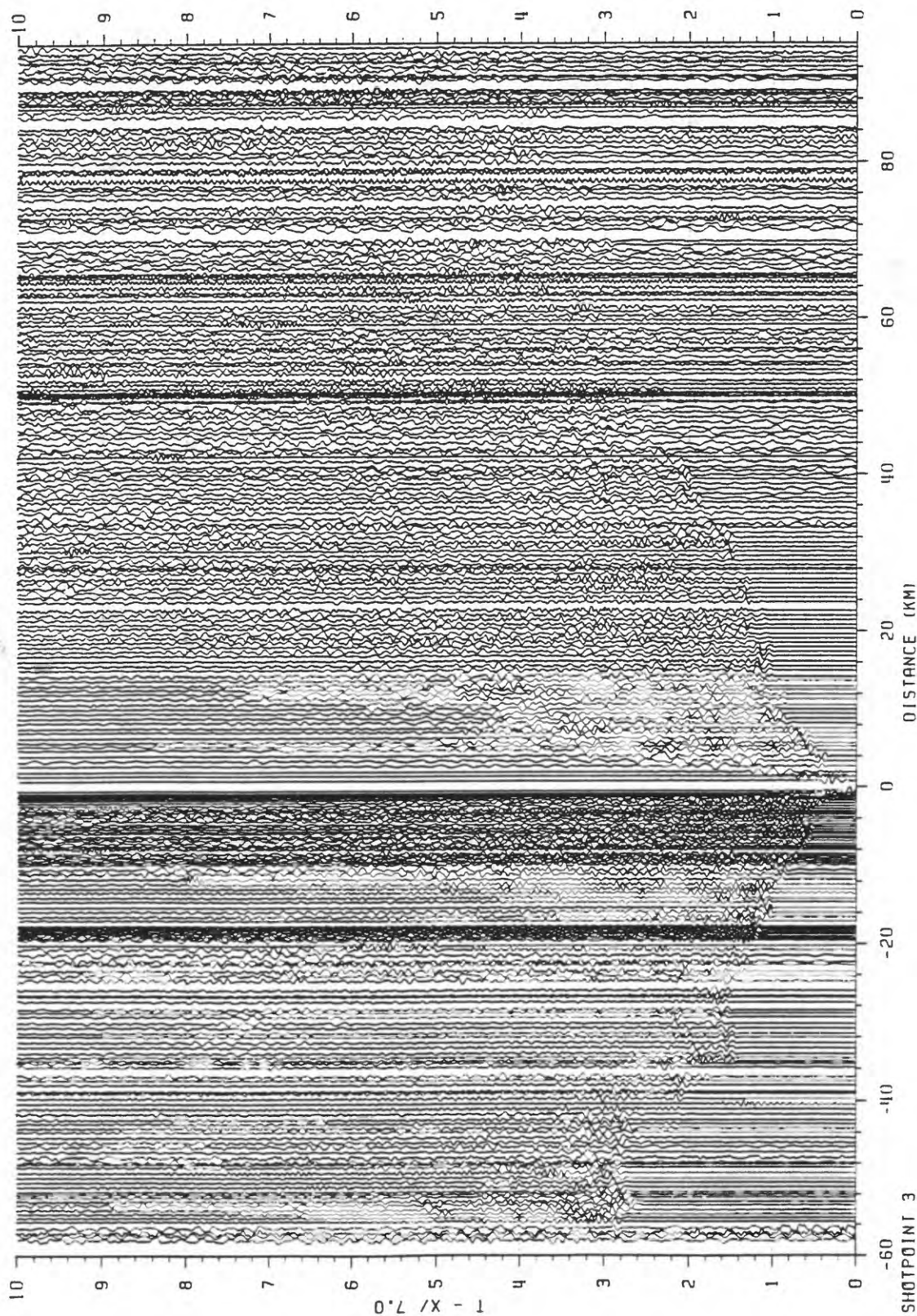


FIGURE 5a. Record section for shotpoint 3 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

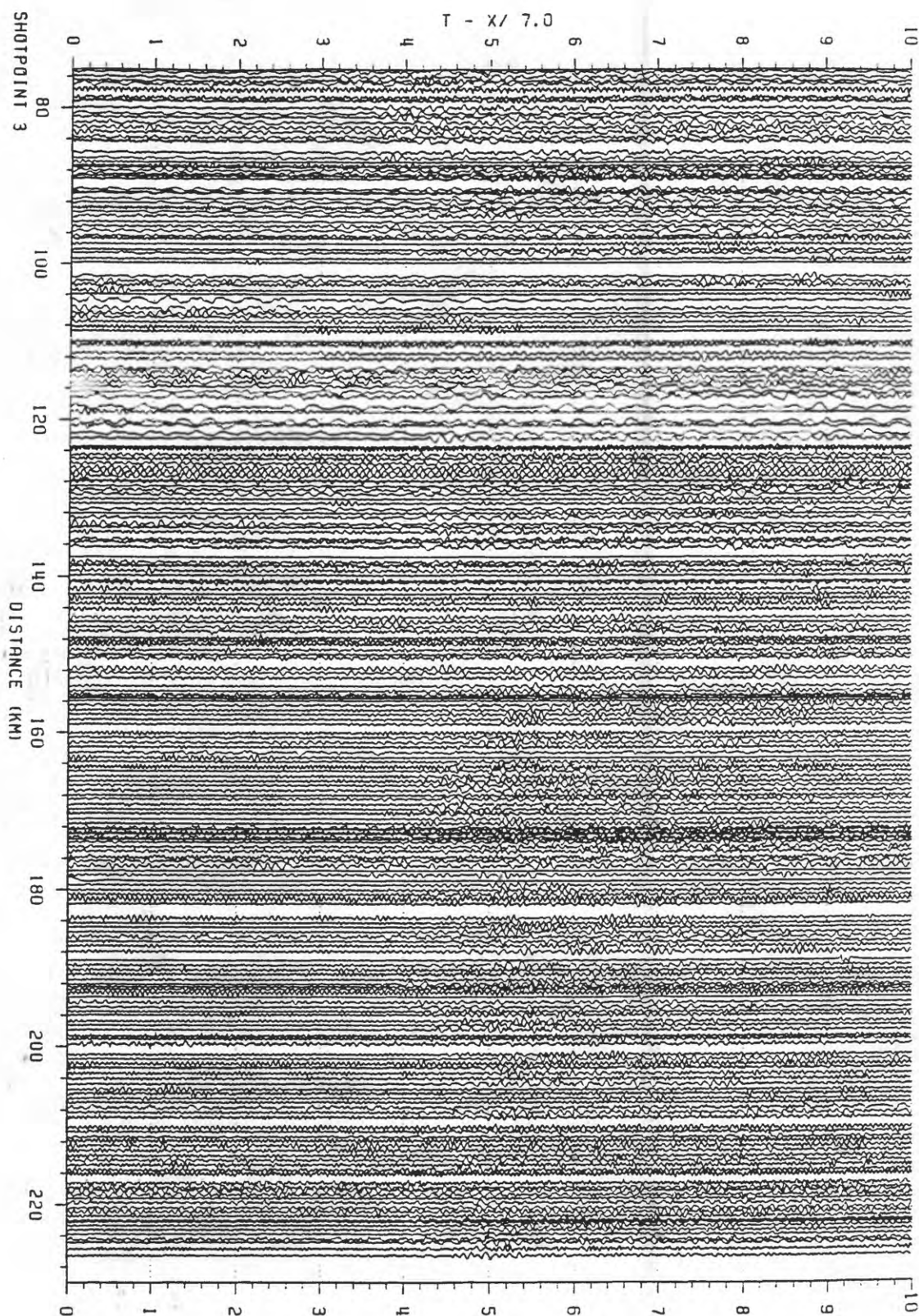


FIGURE 5b. Record section for shotpoint 3 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

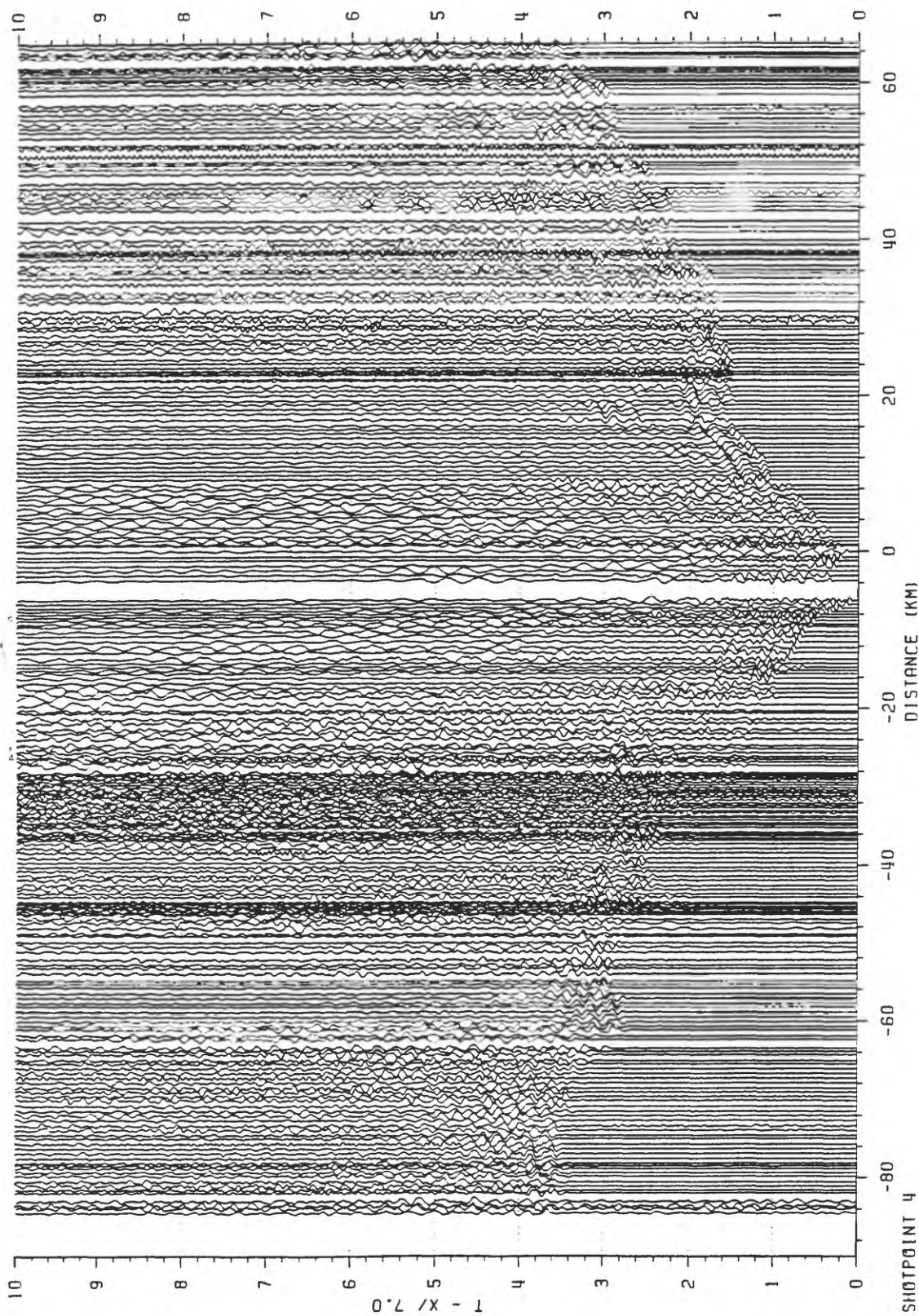


FIGURE 6a. Record section for shotpoint 4 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

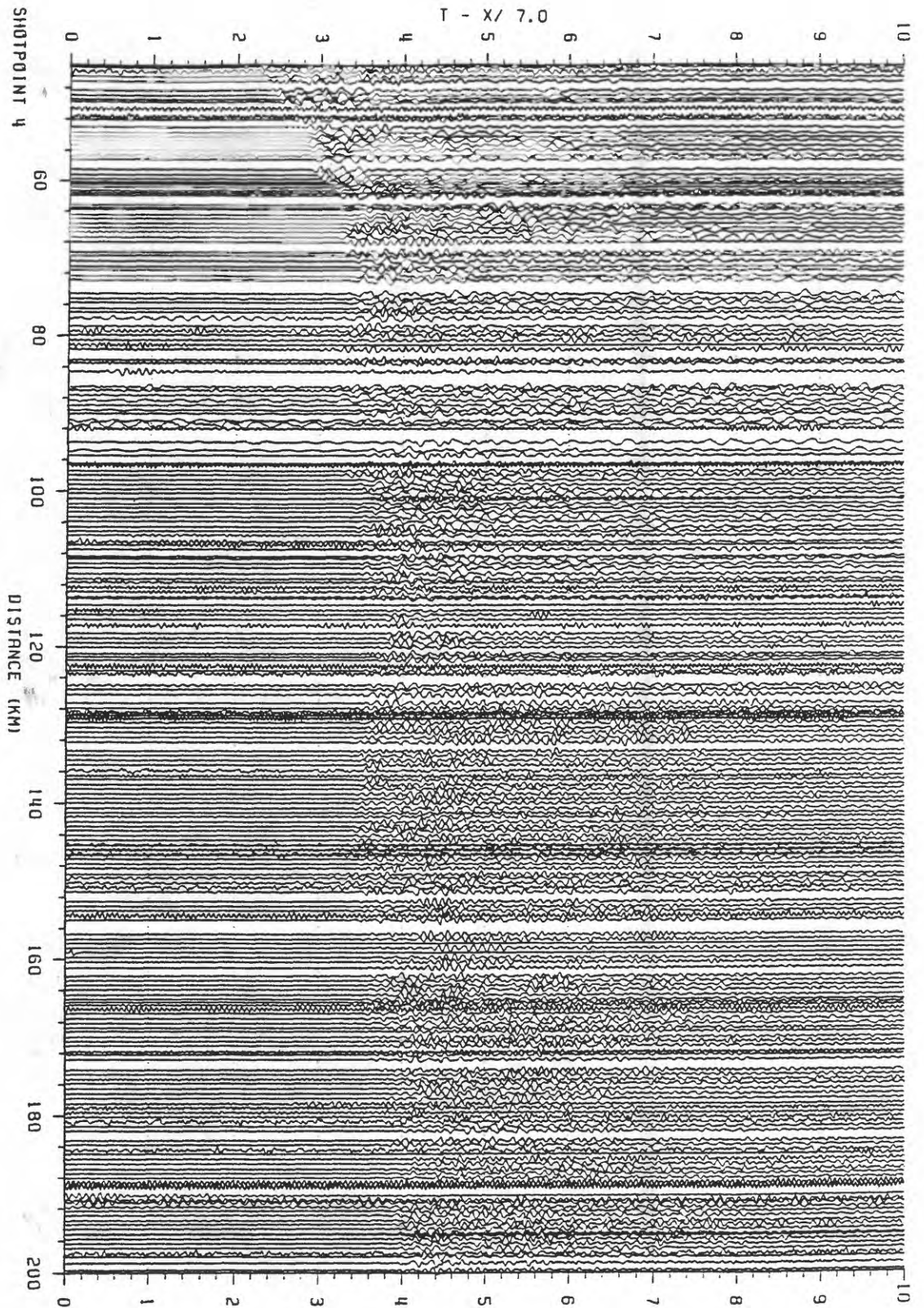


FIGURE 6b. Record section for shotpoint 4 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

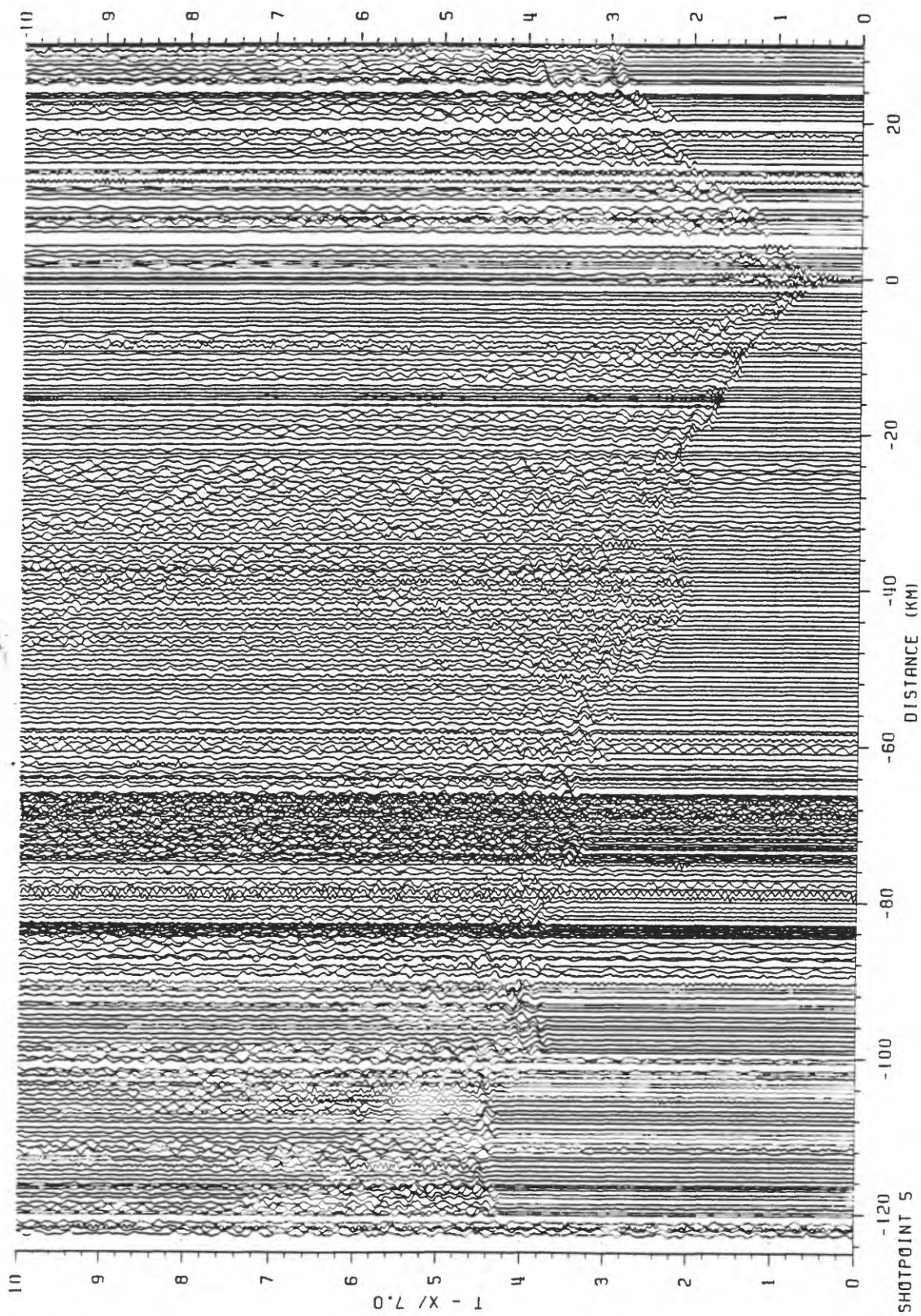


FIGURE 7a. Record section for shotpoint 5 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

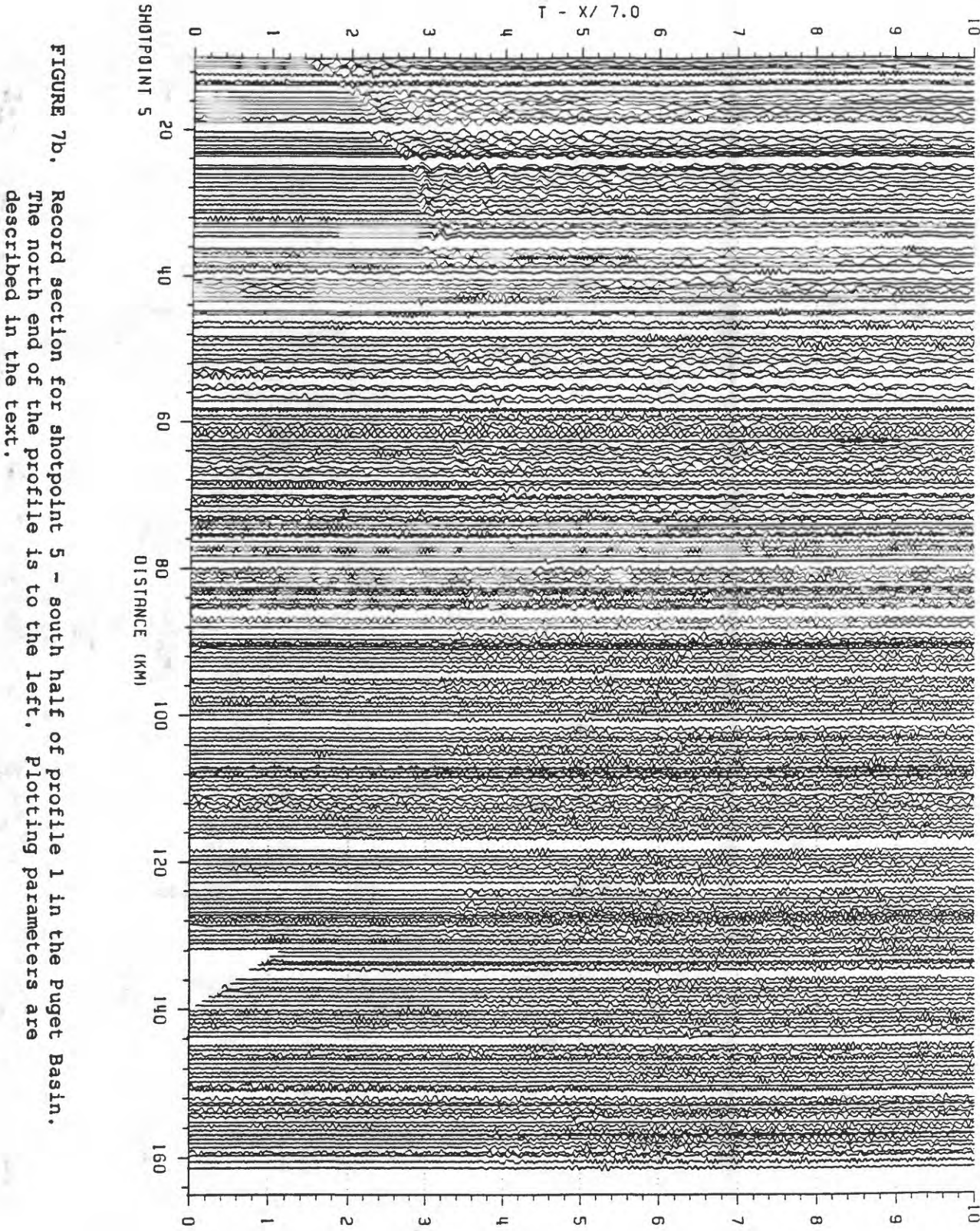


FIGURE 7b. Record section for shotpoint 5 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

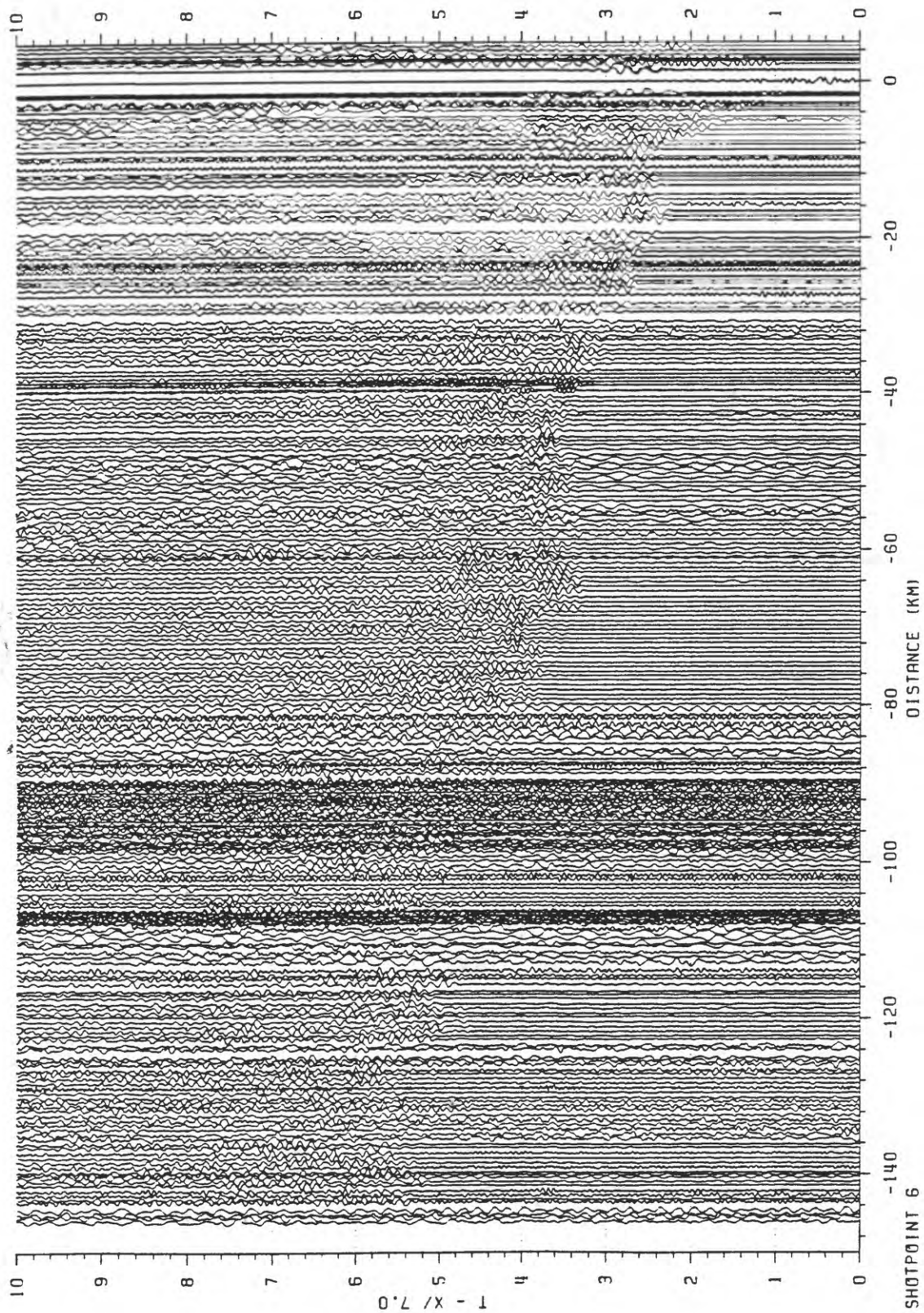


FIGURE 8a. Record section for shotpoint 6 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

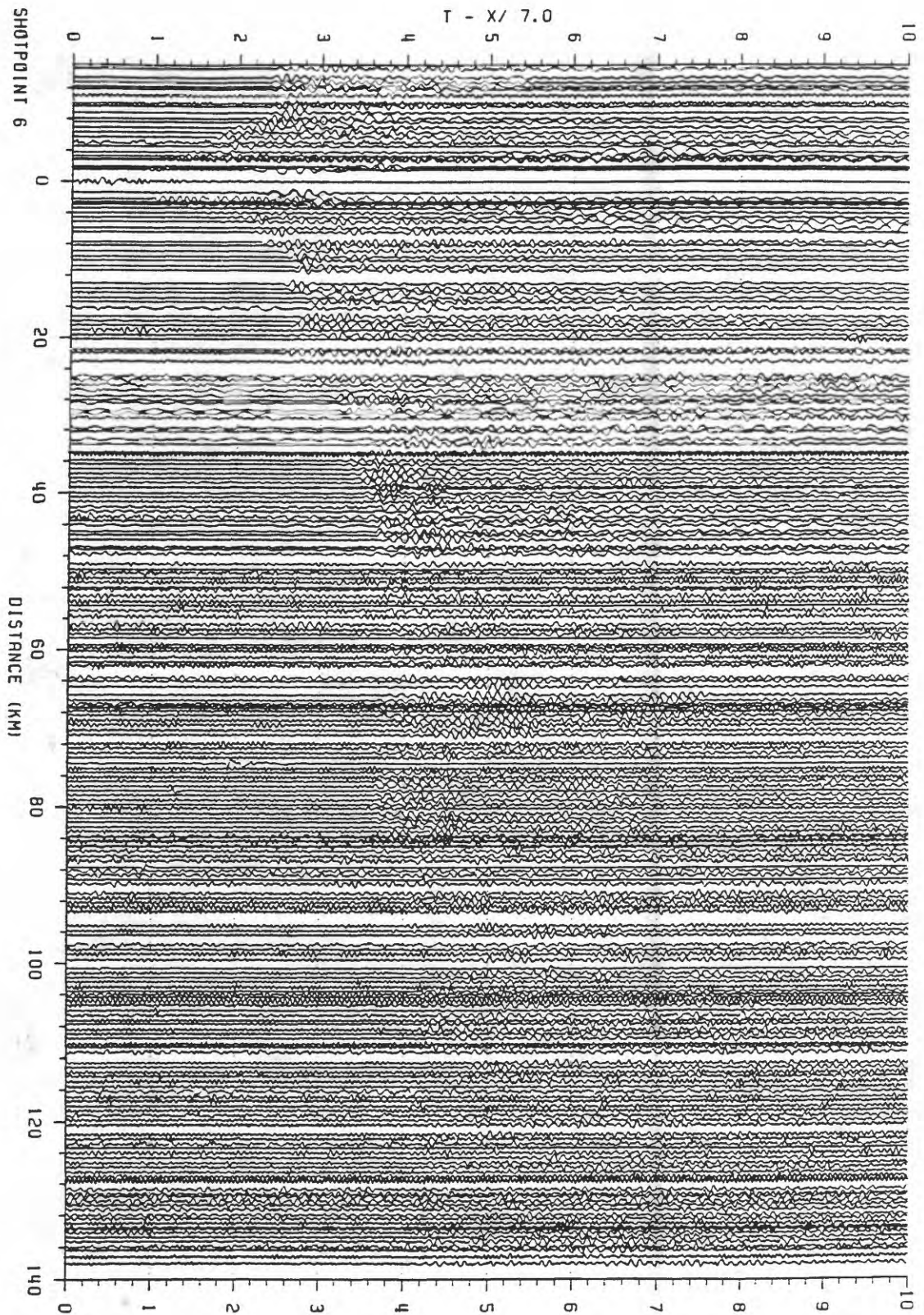


FIGURE 8b. Record section for shotpoint 6 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

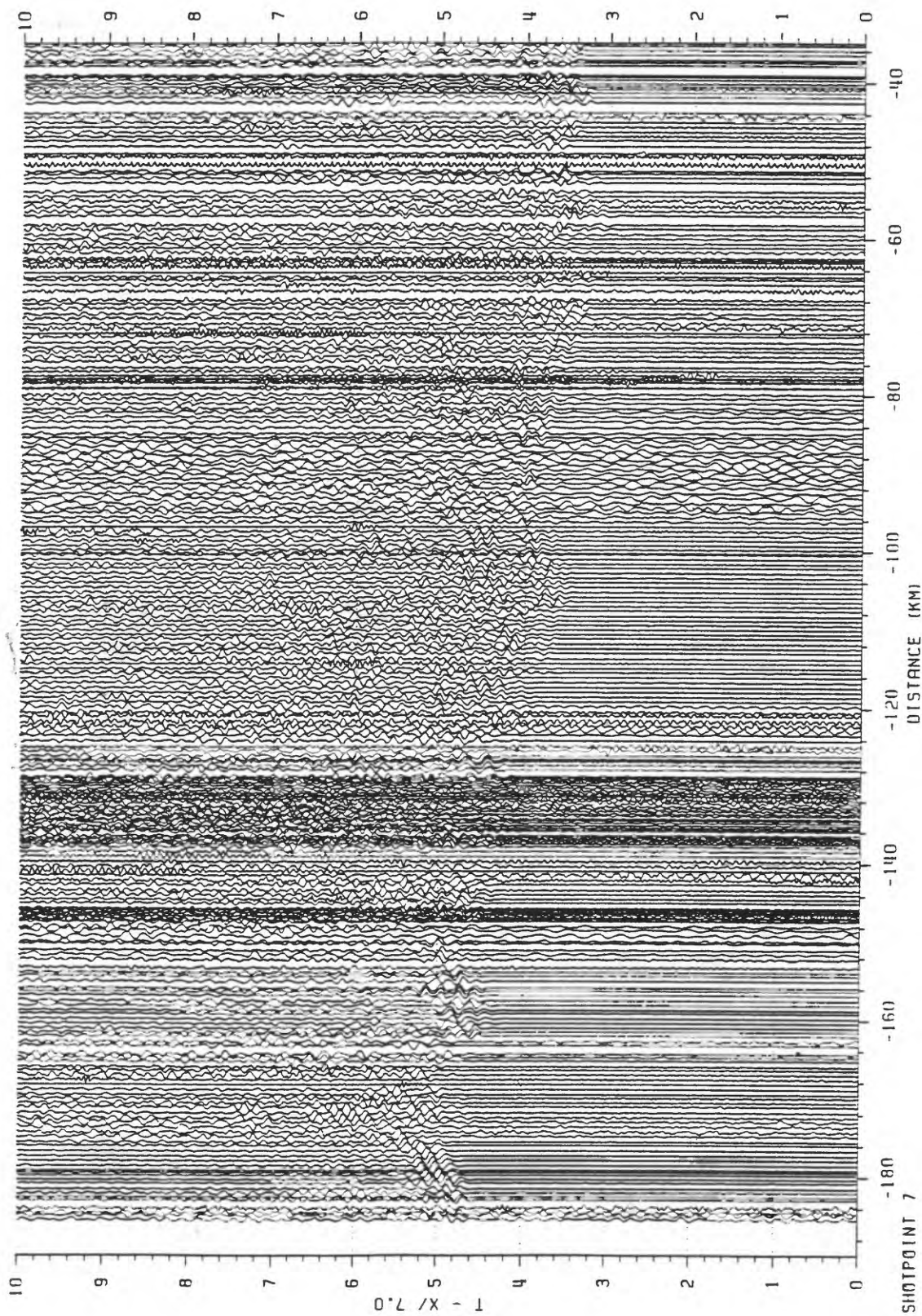


FIGURE 9a. Record section for shotpoint 7 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

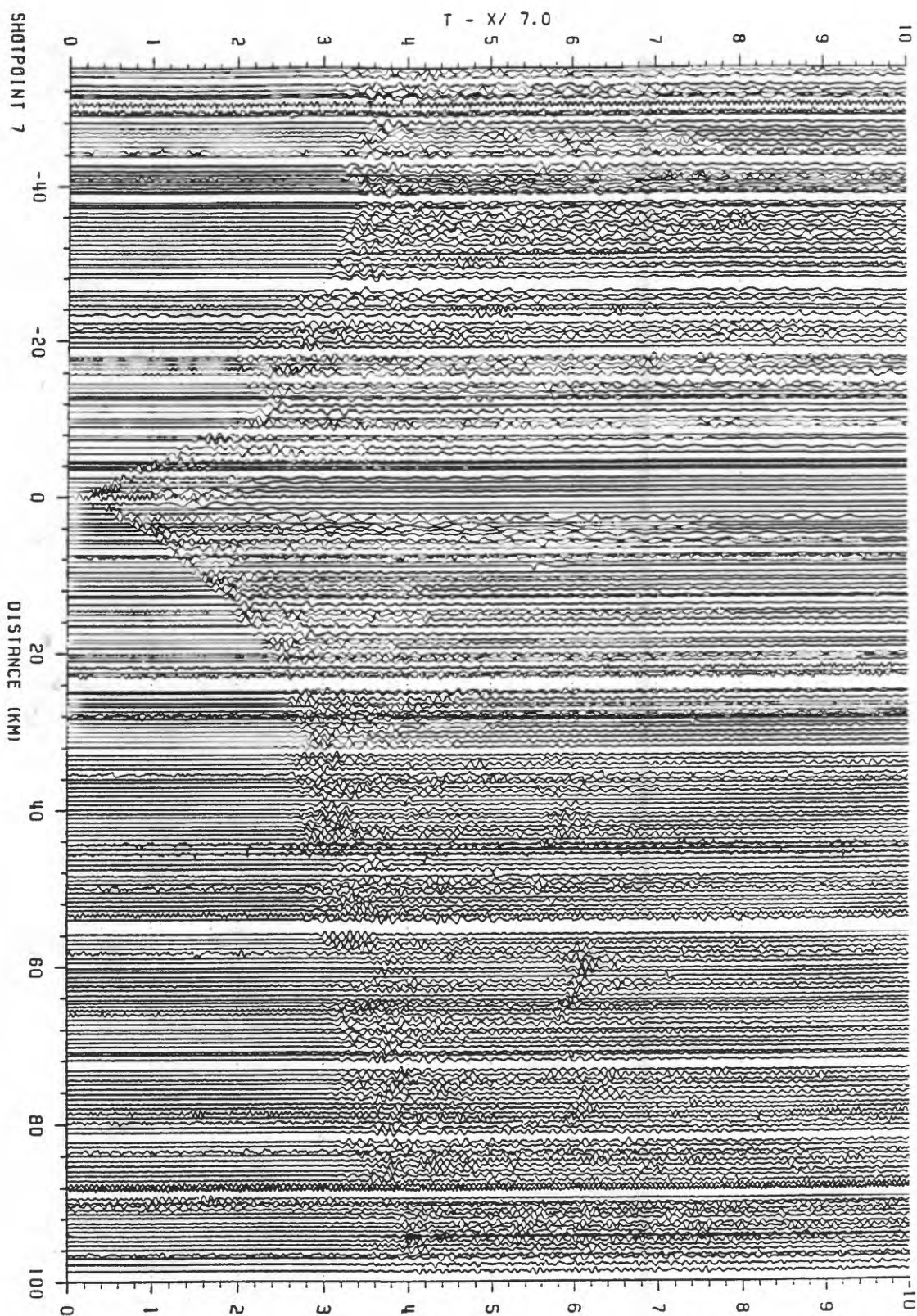


FIGURE 9b. Record section for shotpoint 7 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

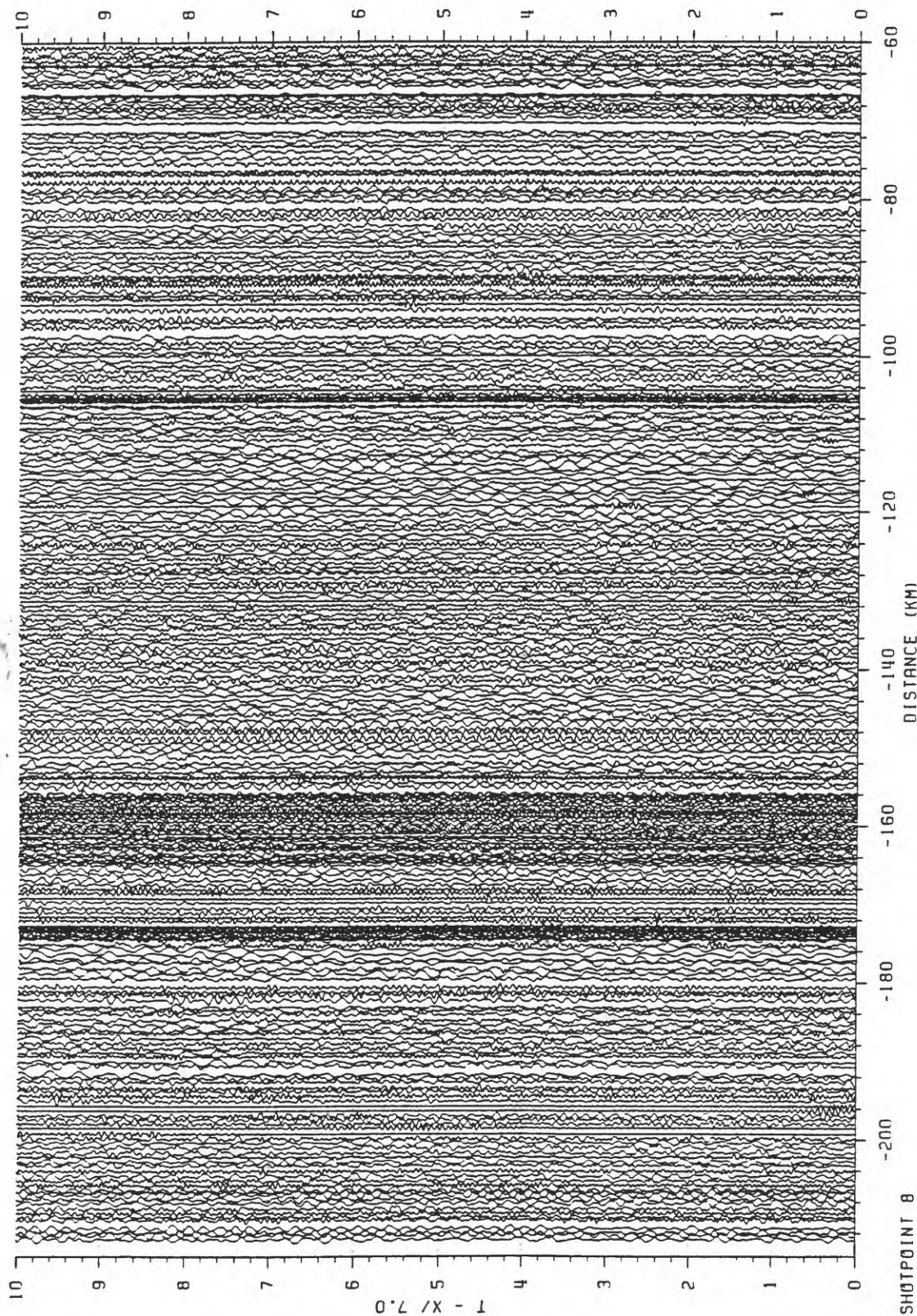


FIGURE 10a. Record section for shotpoint 8 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

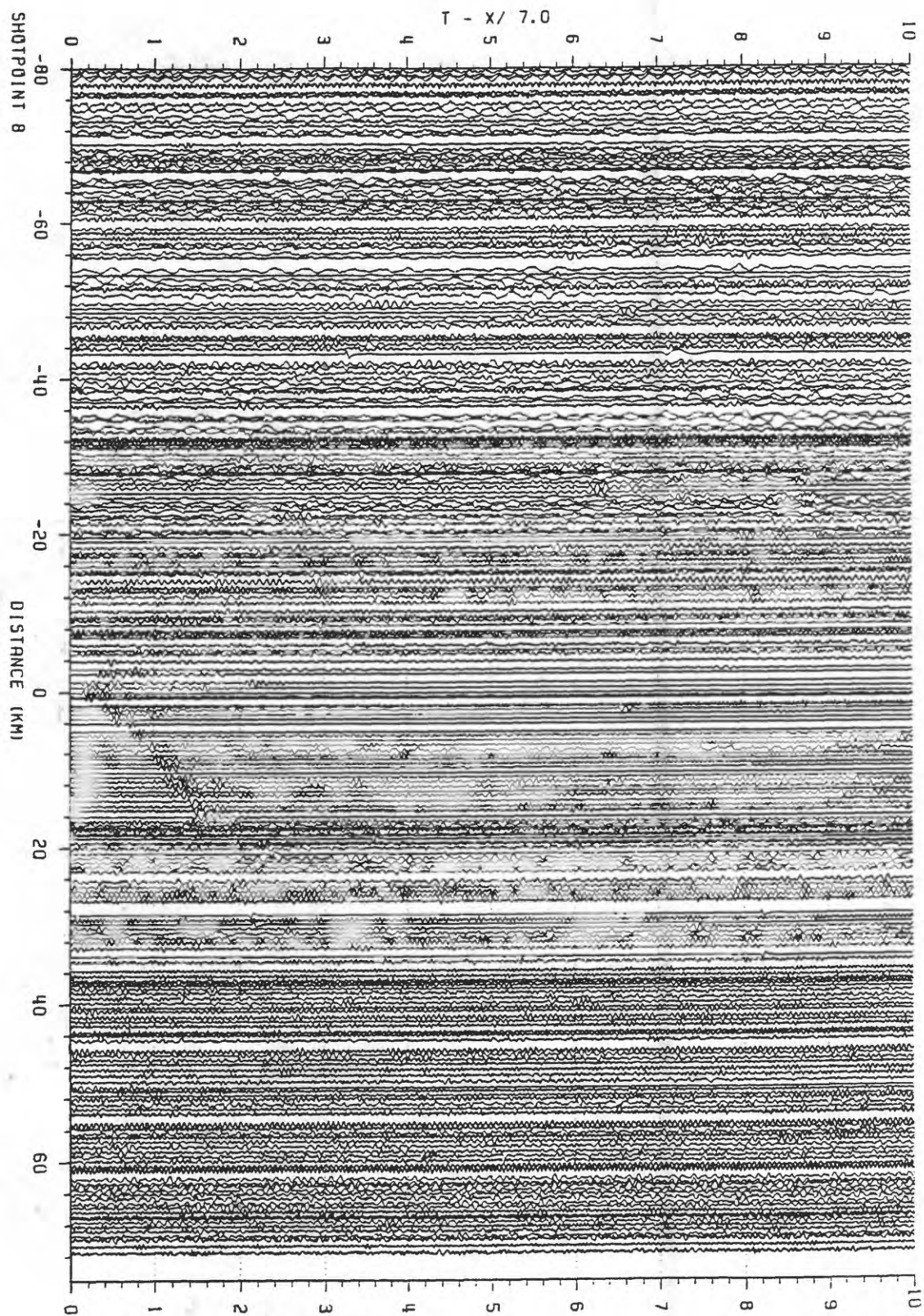


FIGURE 10b. Record section for shotpoint 8 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

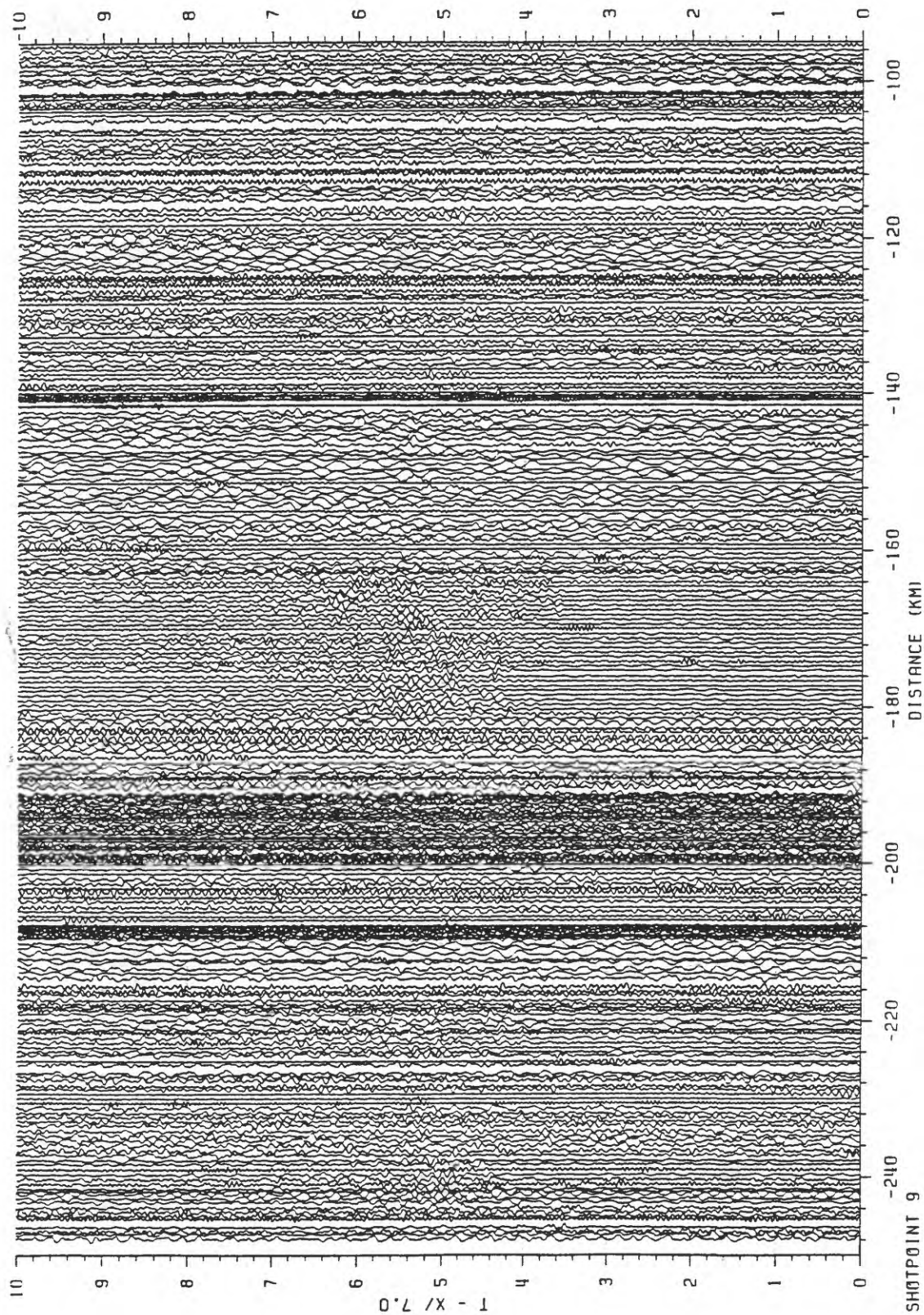


FIGURE 11a. Record section for shotpoint 9 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

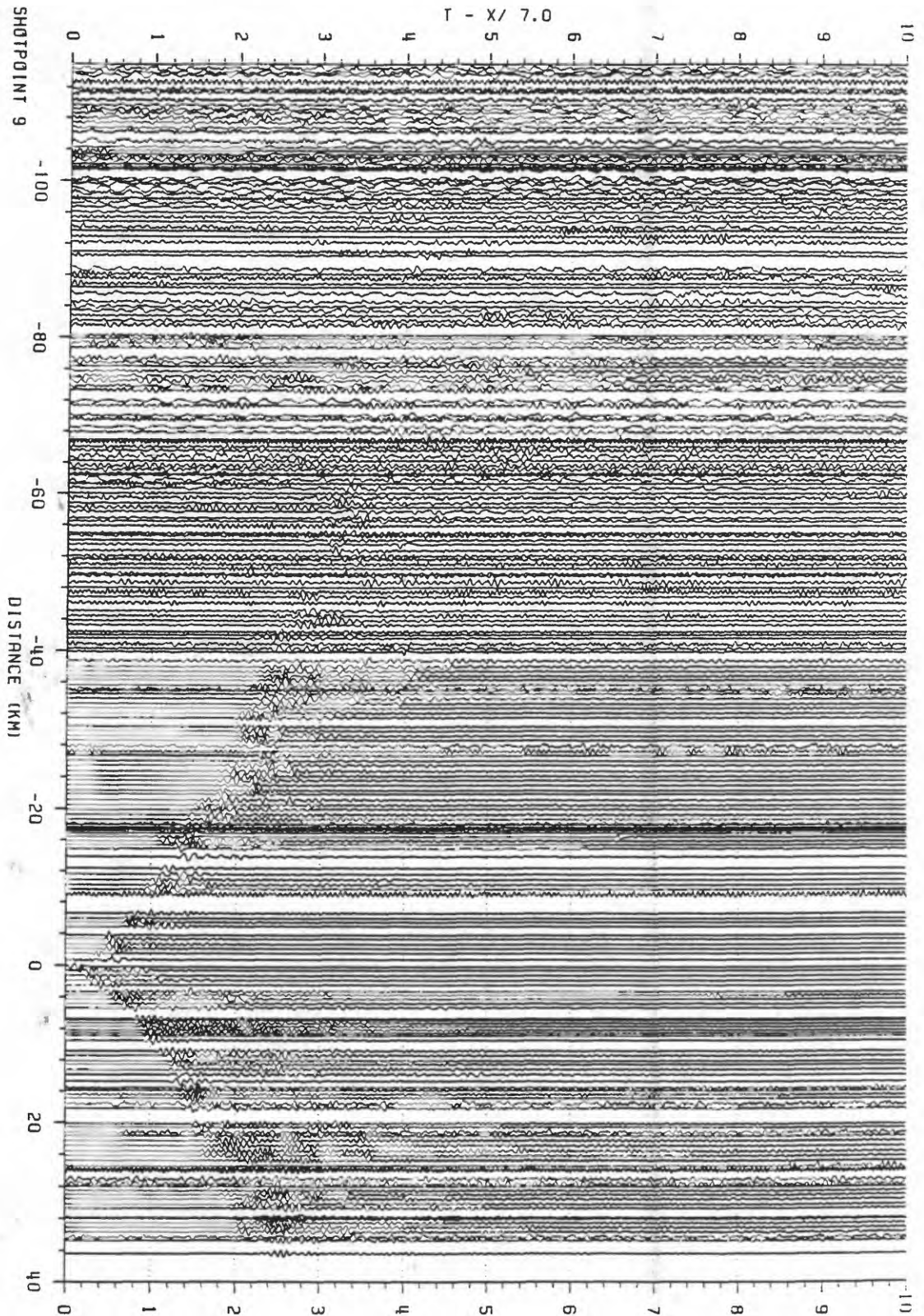


FIGURE 11b. Record section for shotpoint 9 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

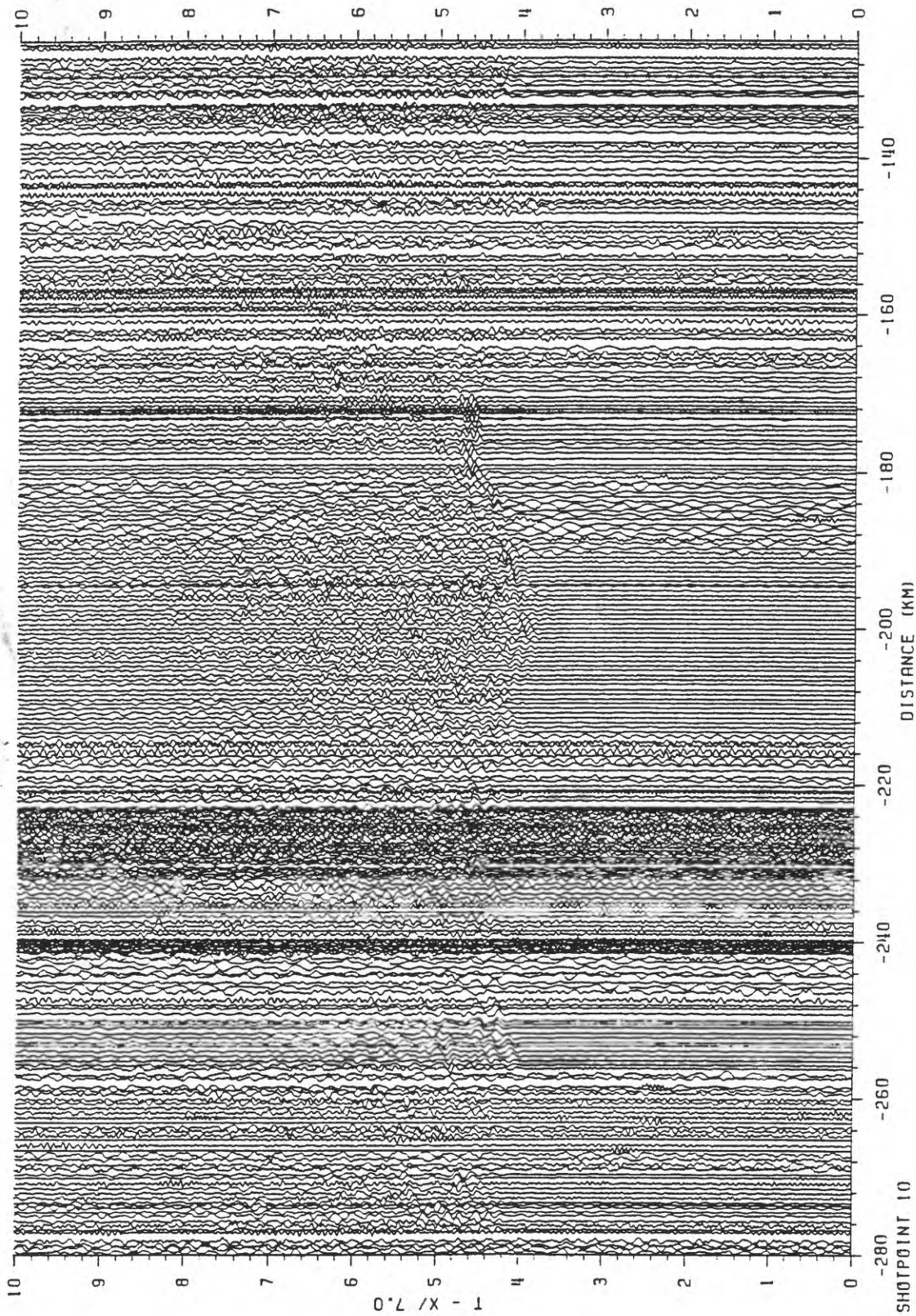


FIGURE 12a. Record section for shotpoint 10 - north half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

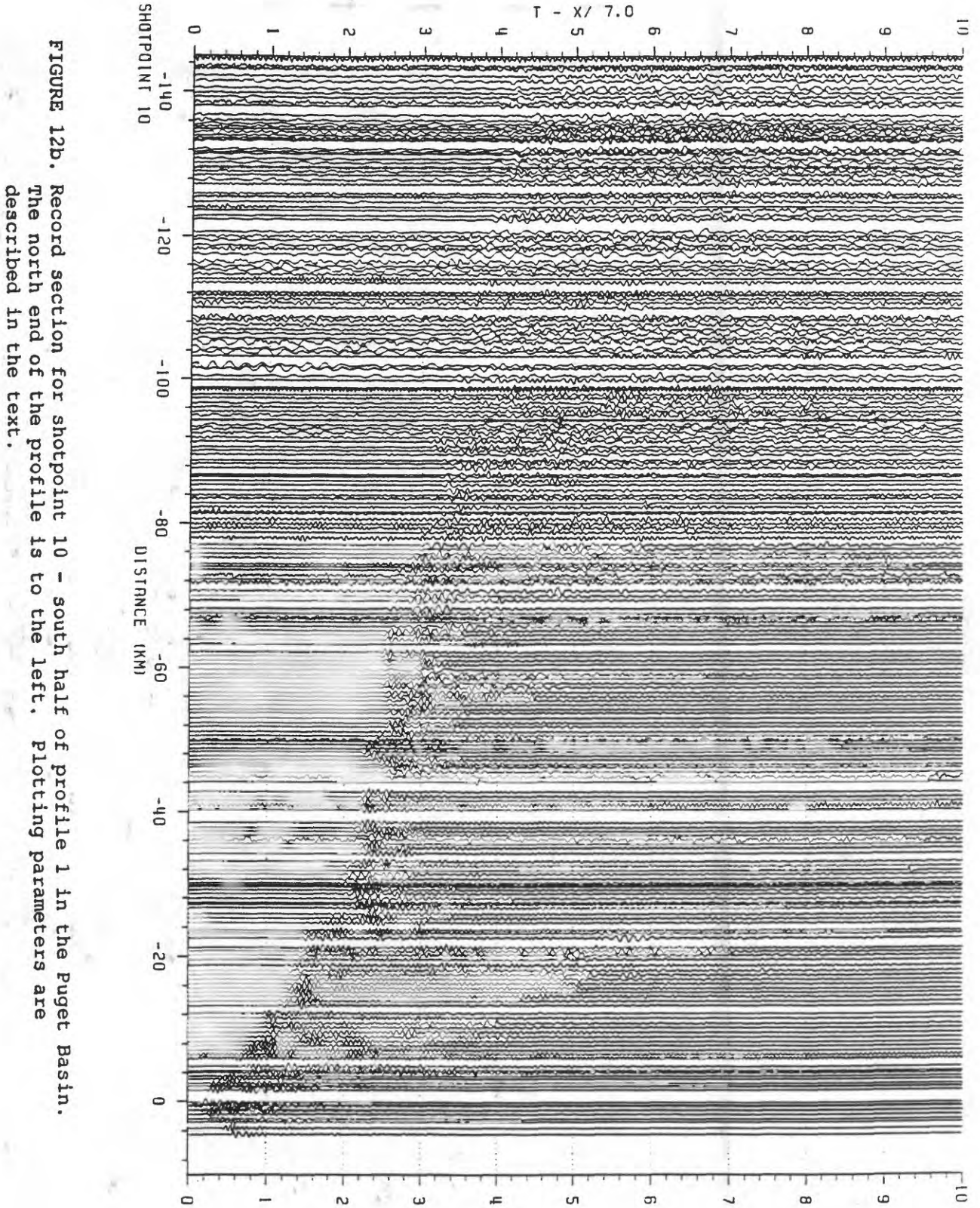


FIGURE 12b. Record section for shotpoint 10 - south half of profile 1 in the Puget Basin. The north end of the profile is to the left. Plotting parameters are described in the text.

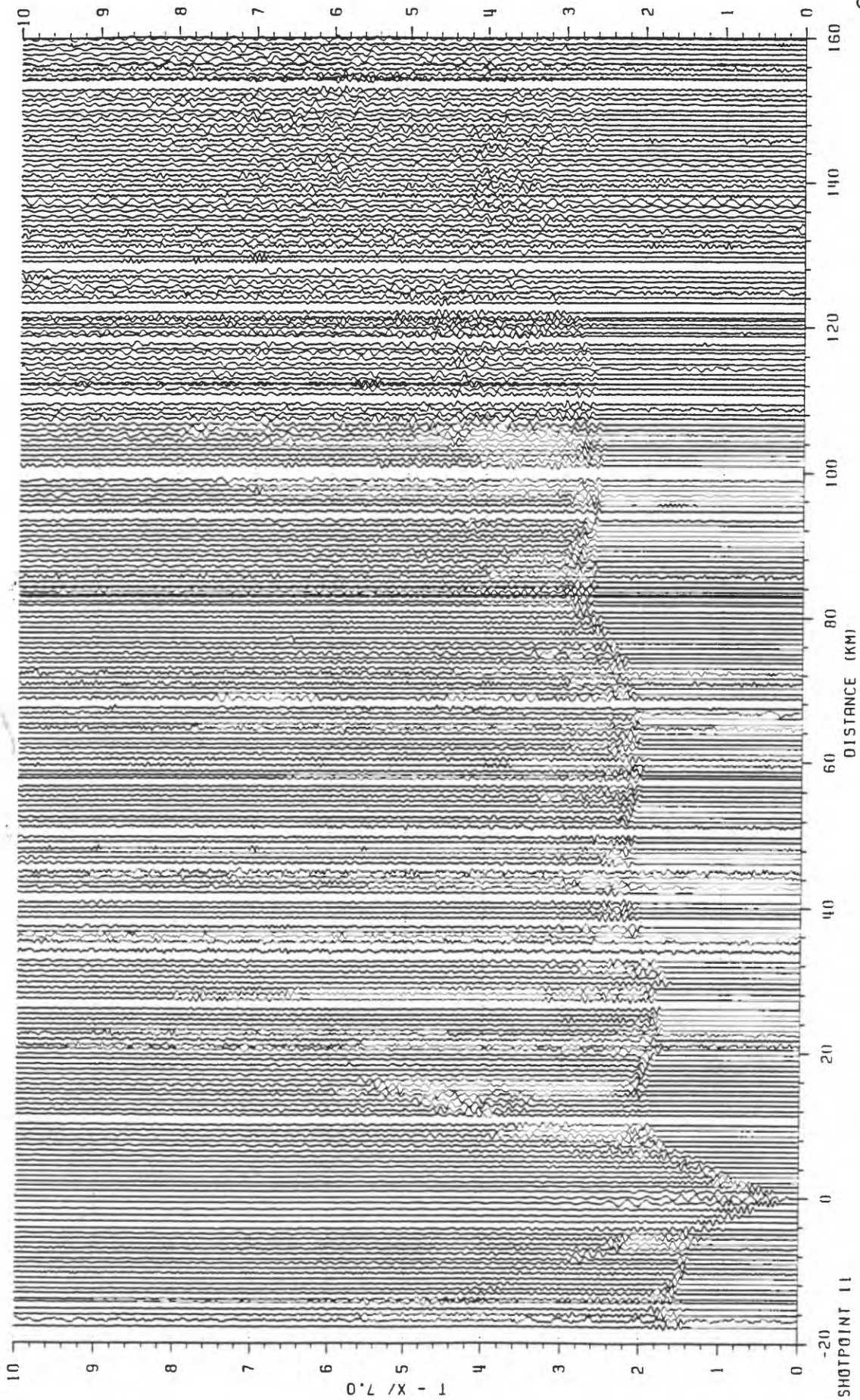


FIGURE 13a. Record section for shotpoint 11 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

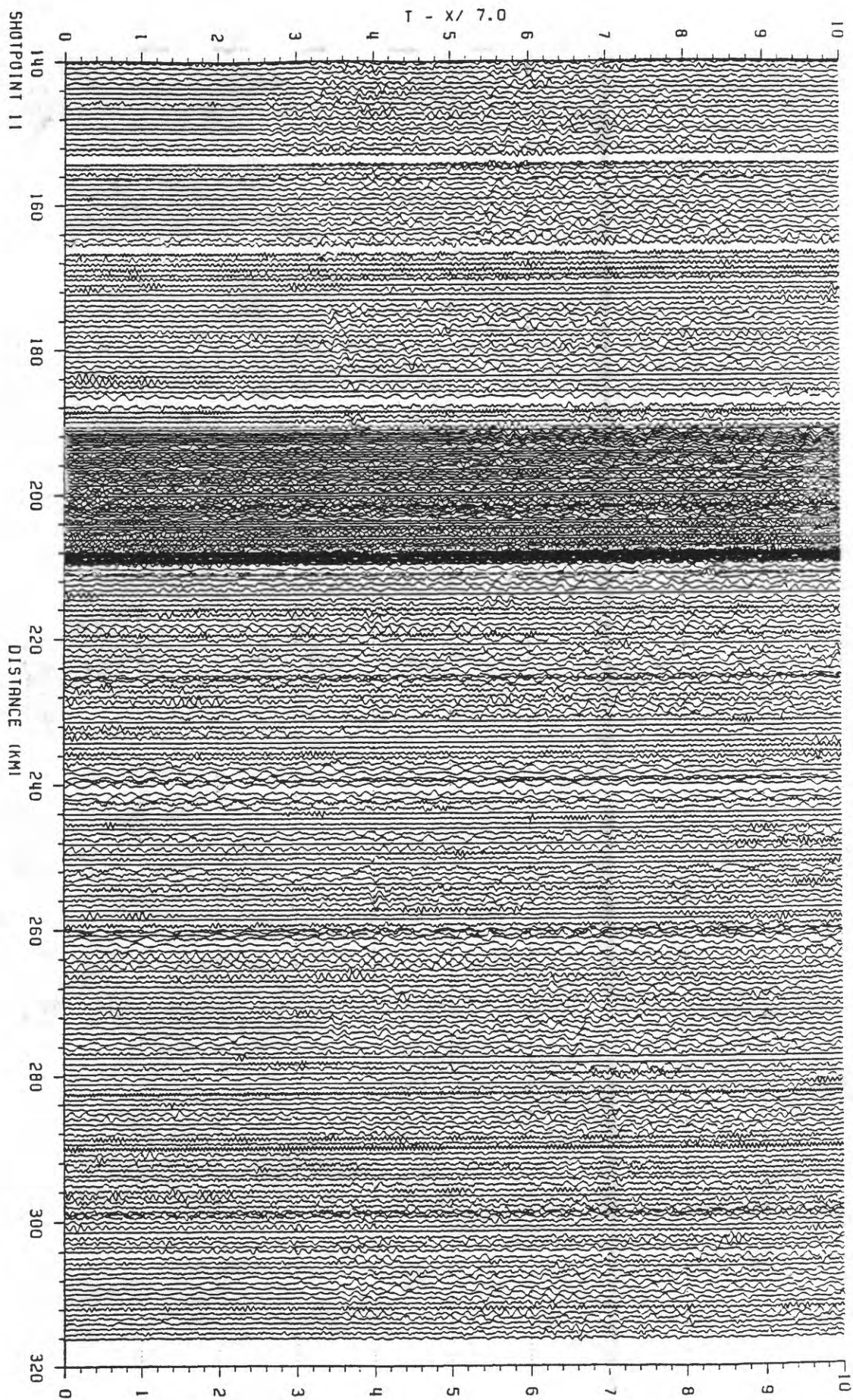


FIGURE 13b. Record section for shotpoint 11 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

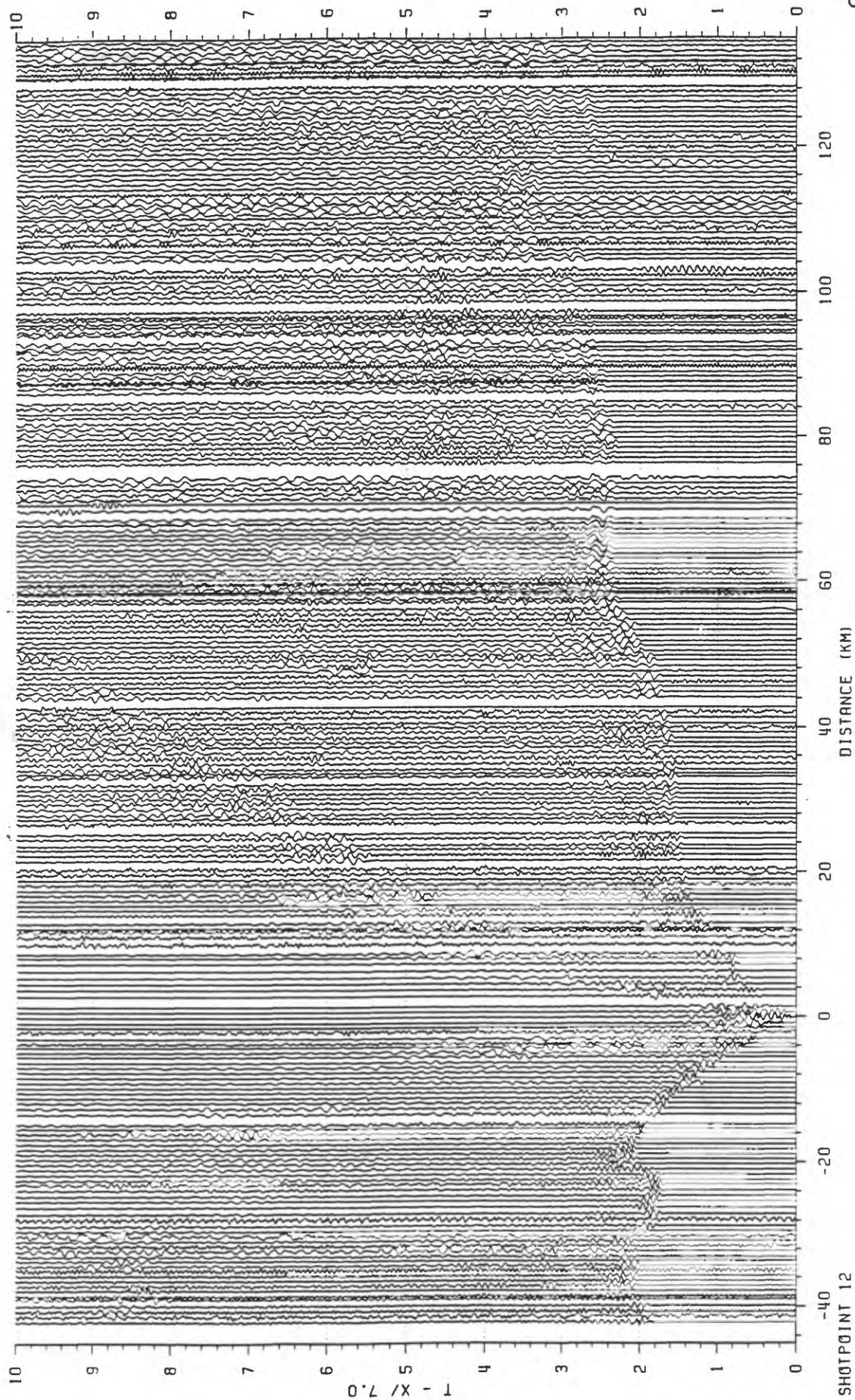


FIGURE 14a. Record section for shotpoint 12 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

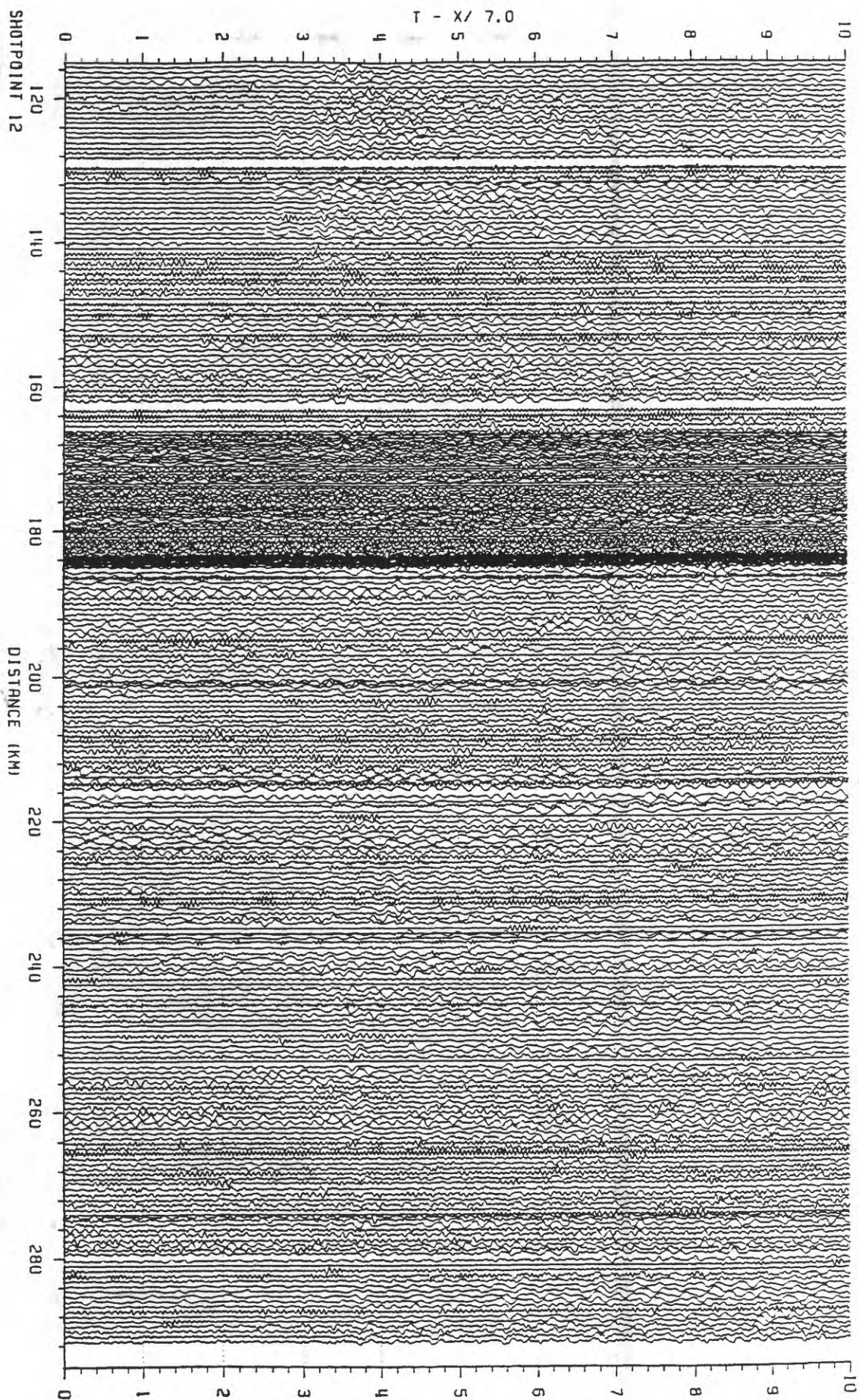


FIGURE 14b. Record section for shotpoint 12 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

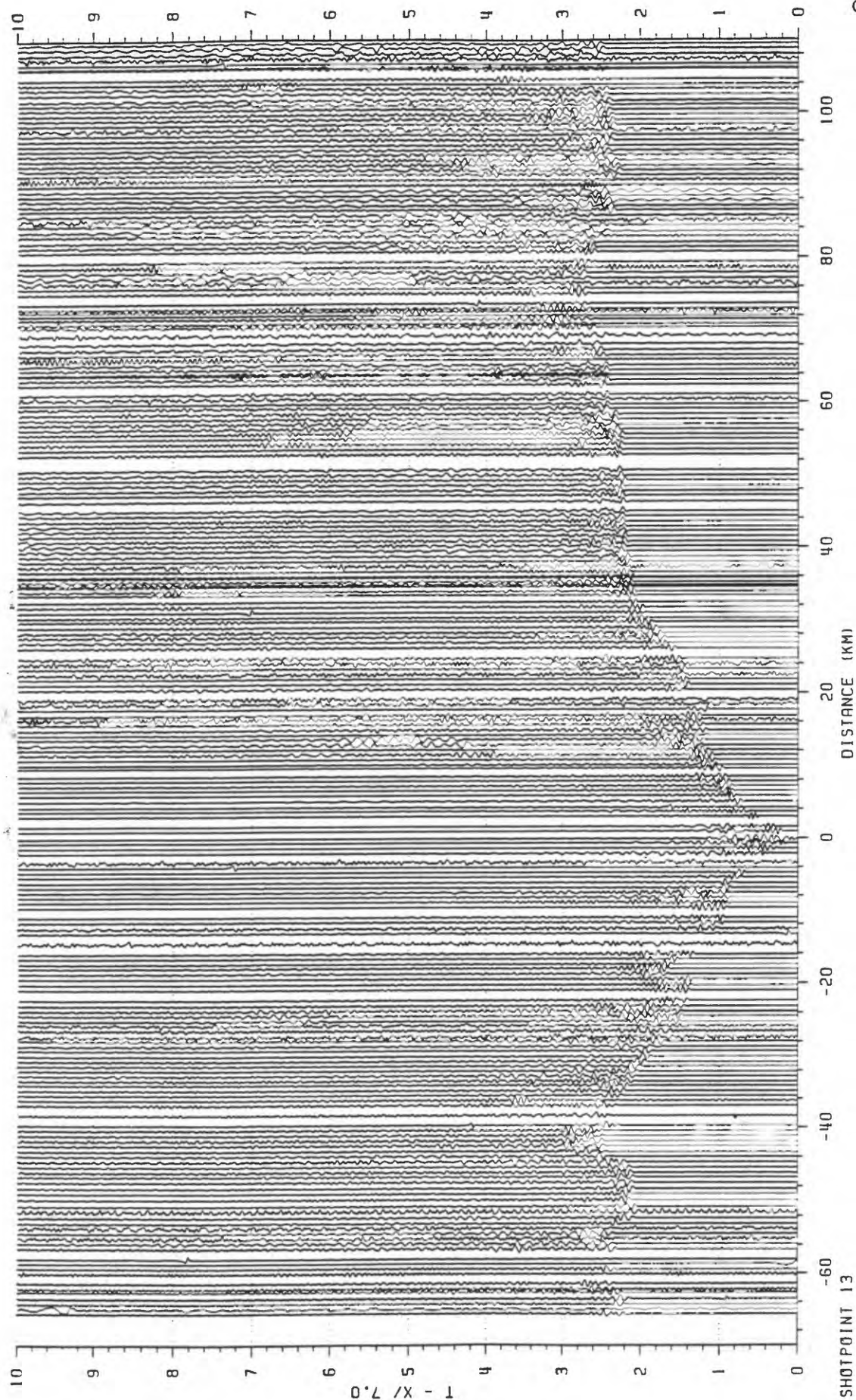


FIGURE 15a. Record section for shotpoint 13 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

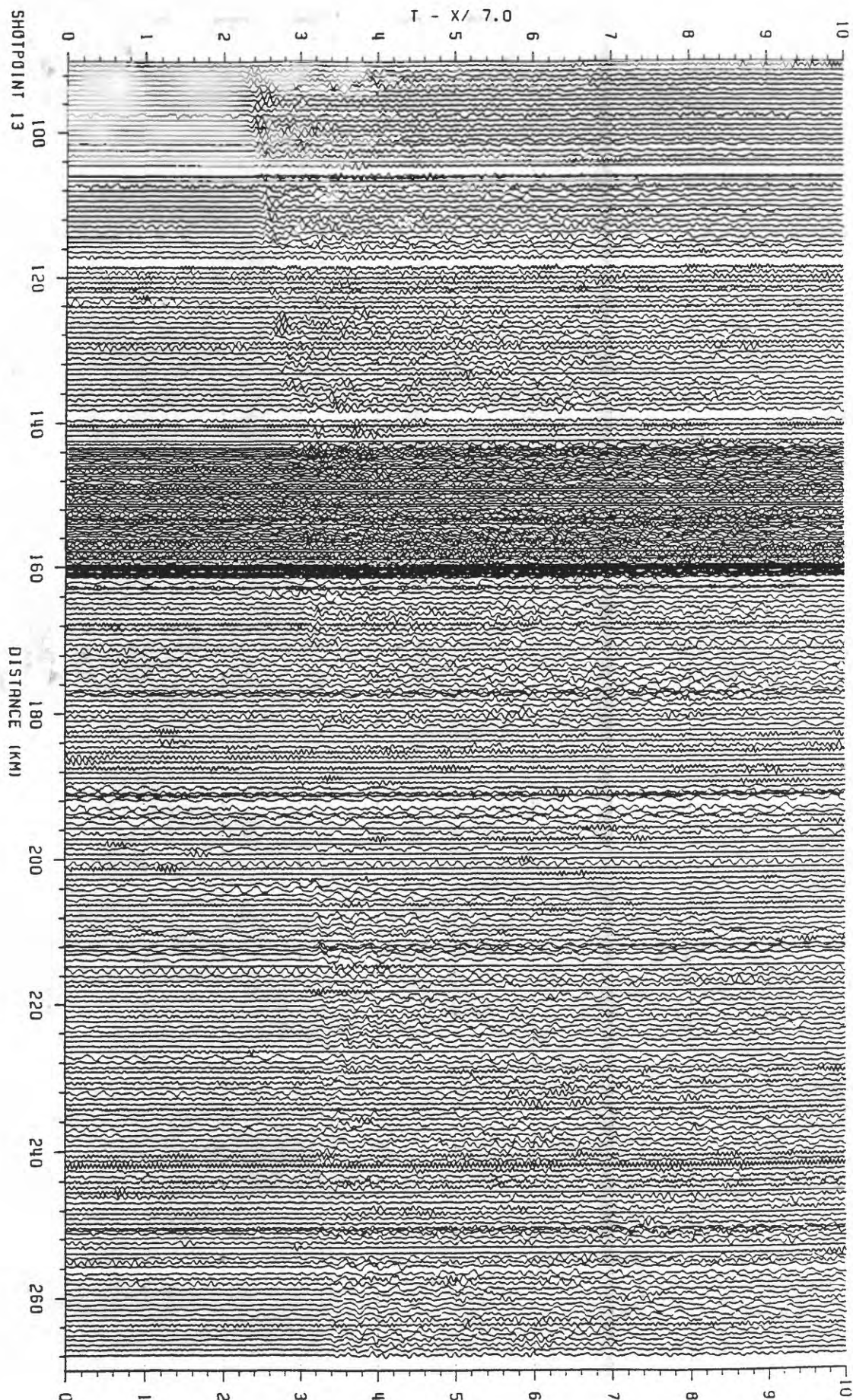


FIGURE 15b. Record section for shotpoint 13 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

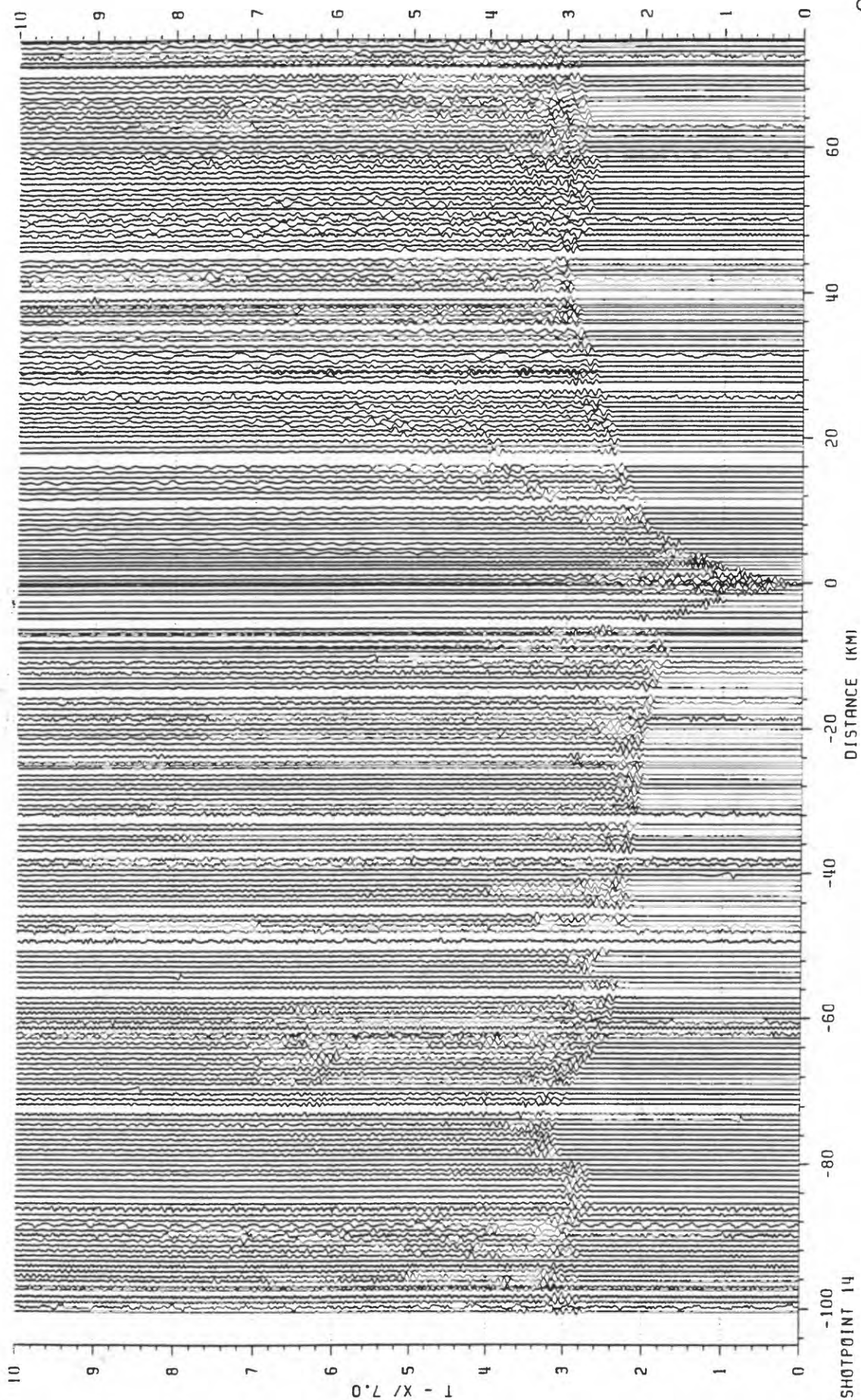


FIGURE 16a. Record section for shotpoint 14 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

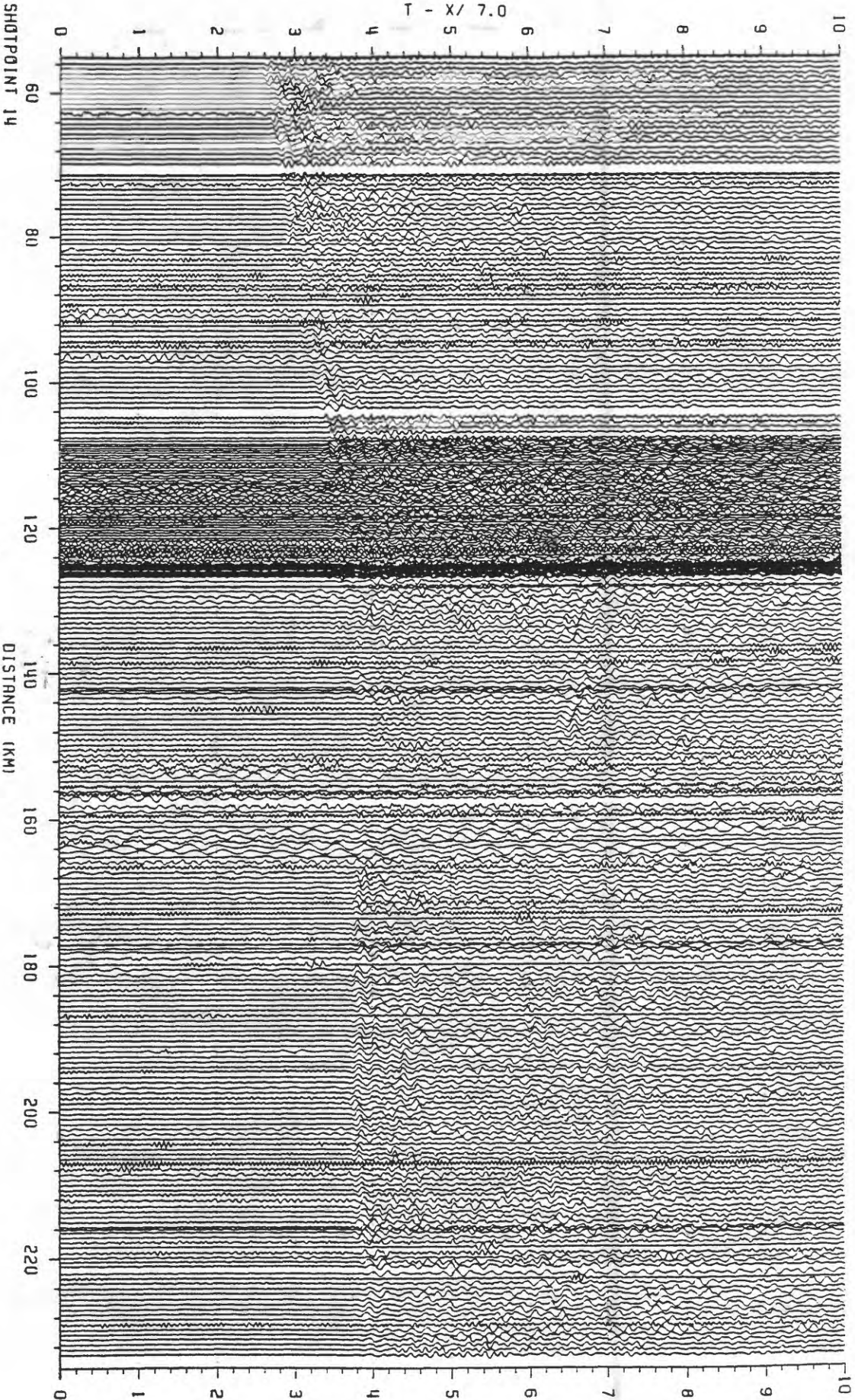


FIGURE 16b. Record section for shotpoint 14 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

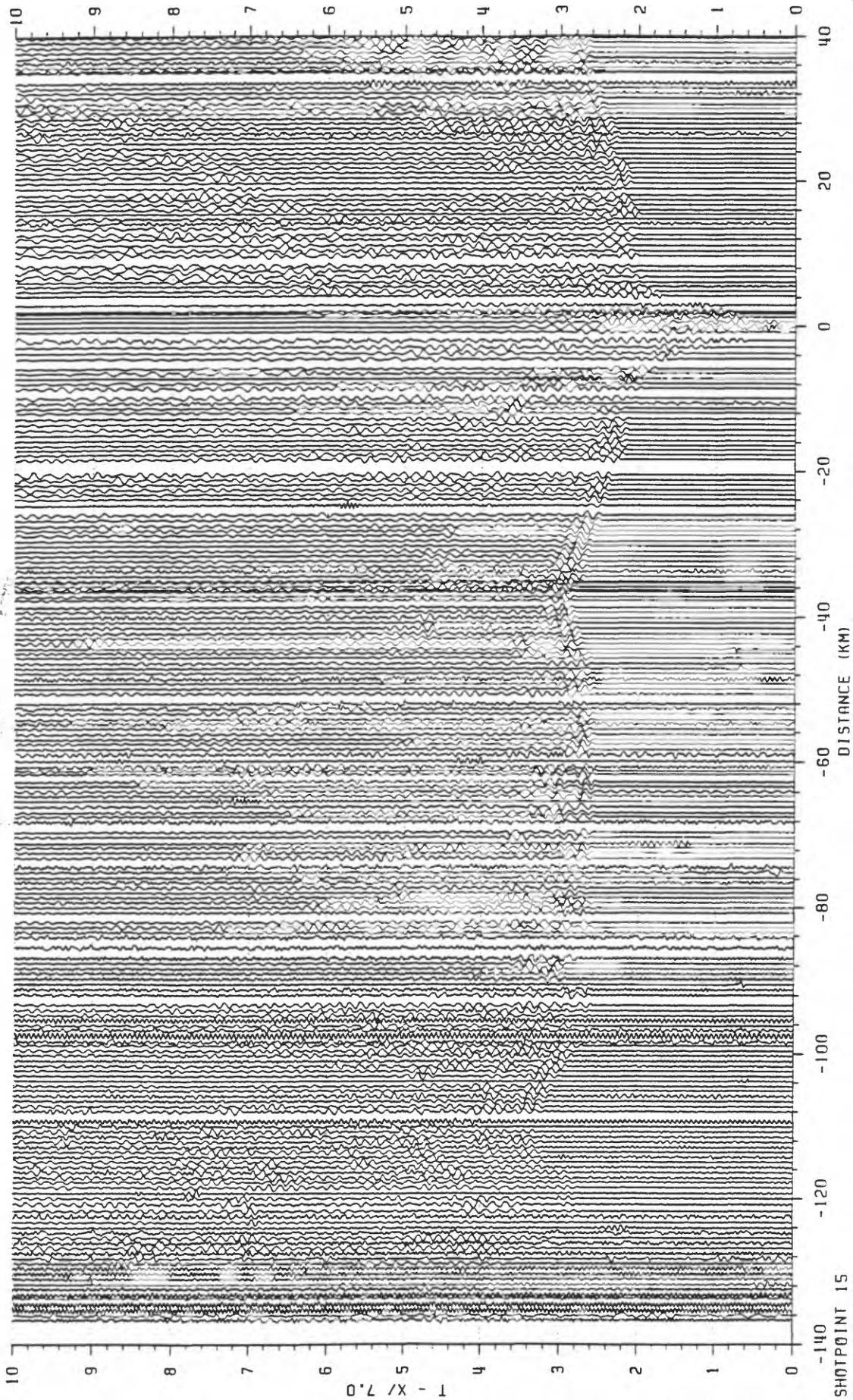


FIGURE 17a. Record section for shotpoint 15 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

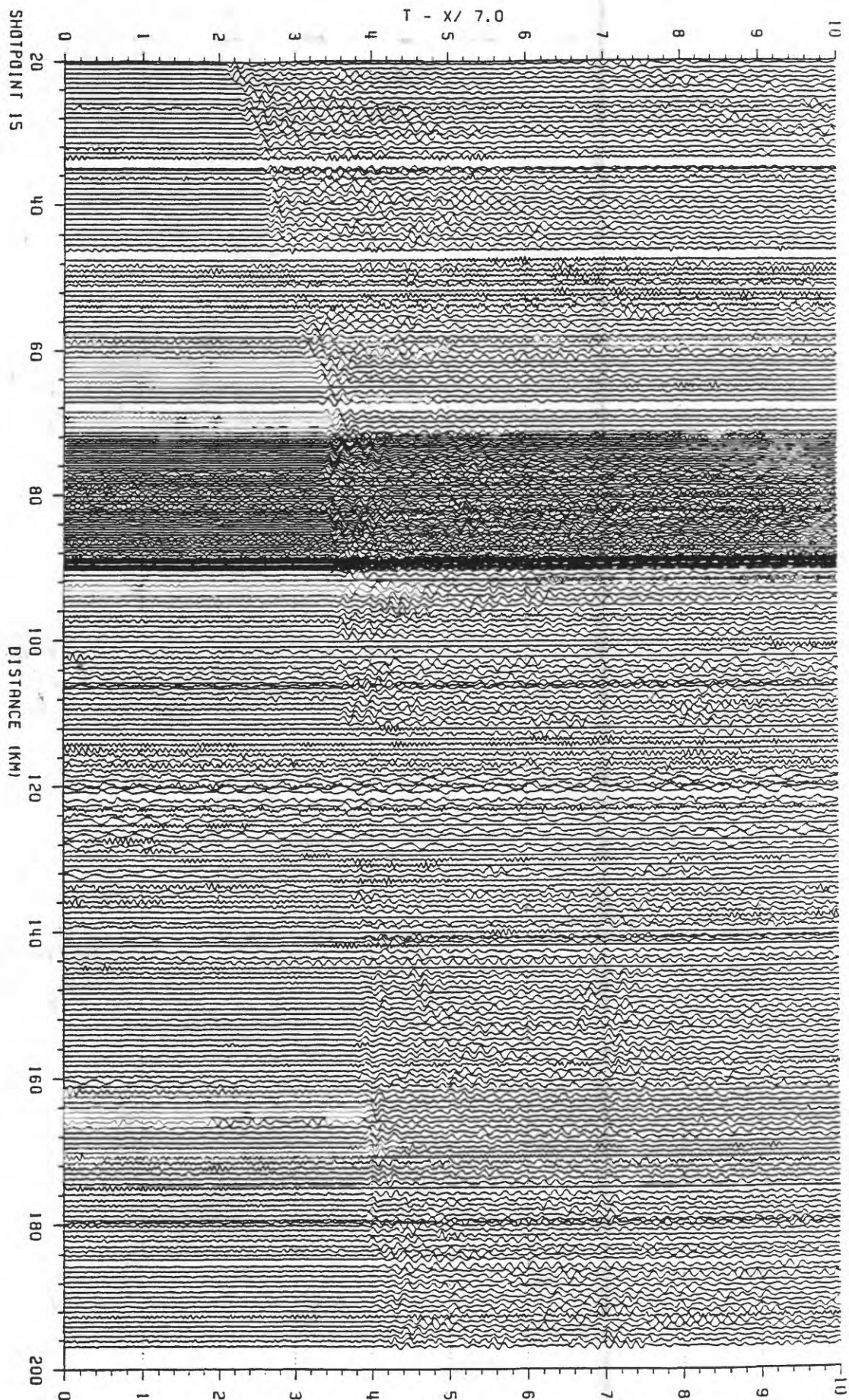


FIGURE 17b. Record section for shotpoint 15 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

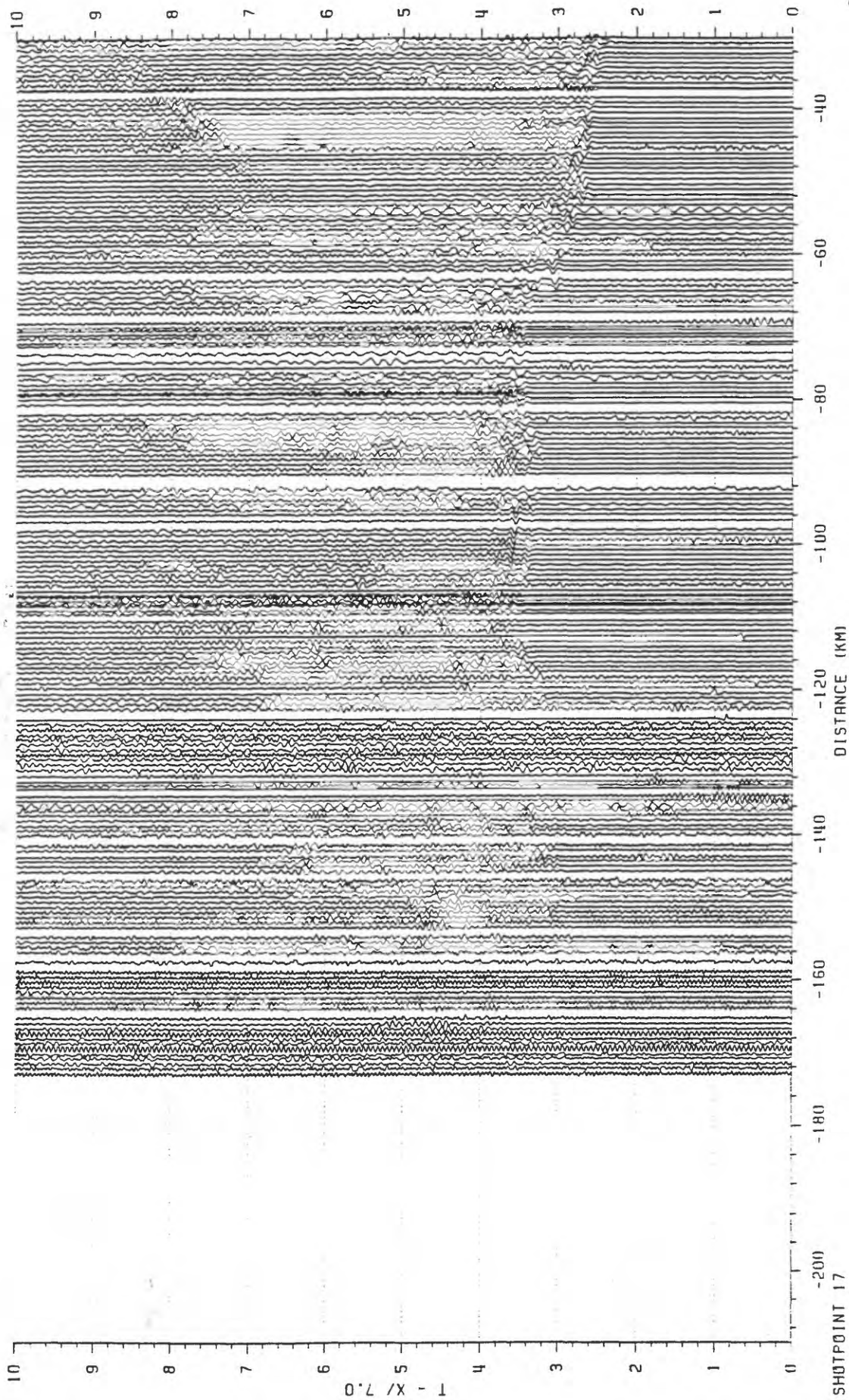


FIGURE 18a. Record section for shotpoint 17 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

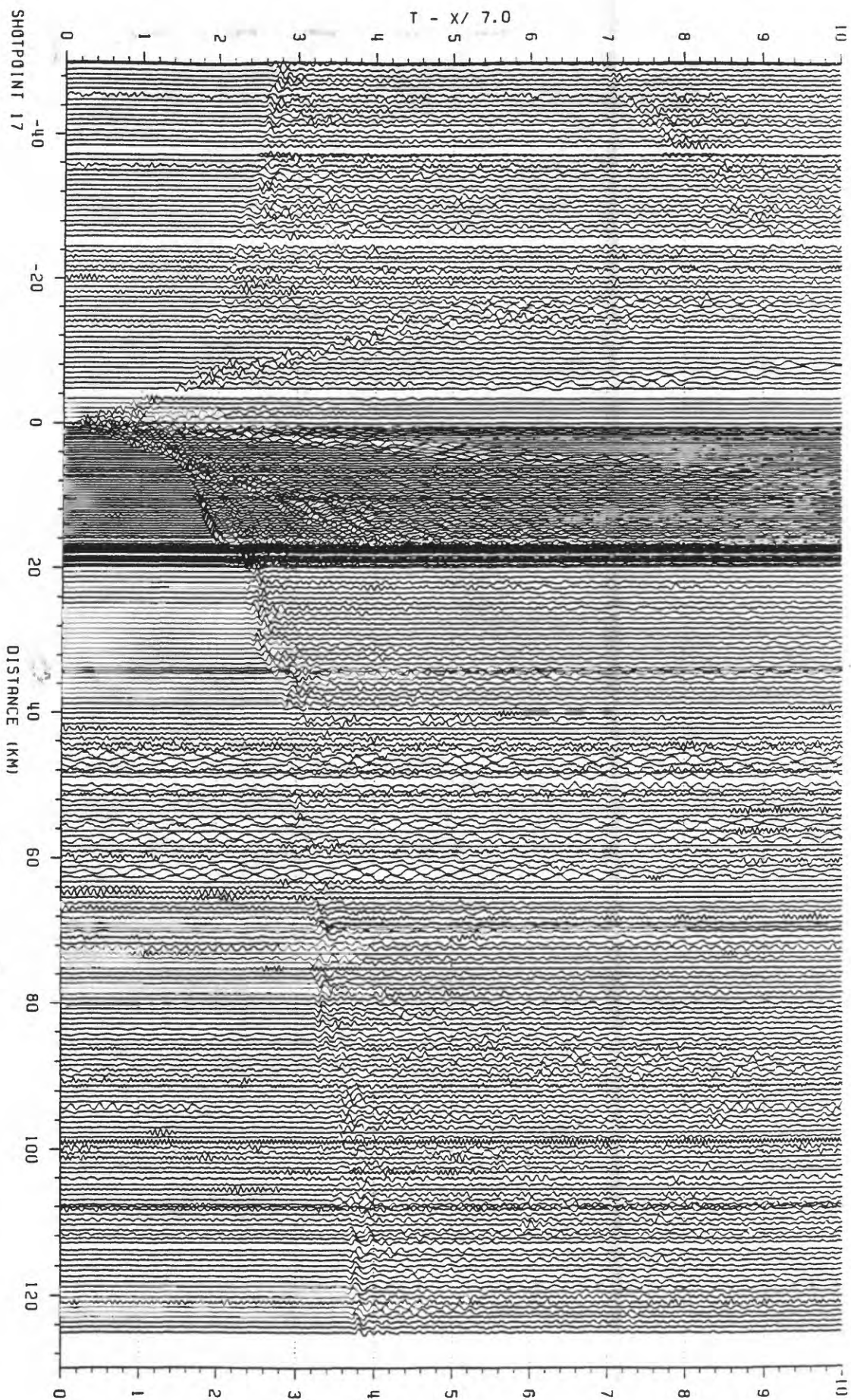


FIGURE 18b. Record section for shotpoint 17 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

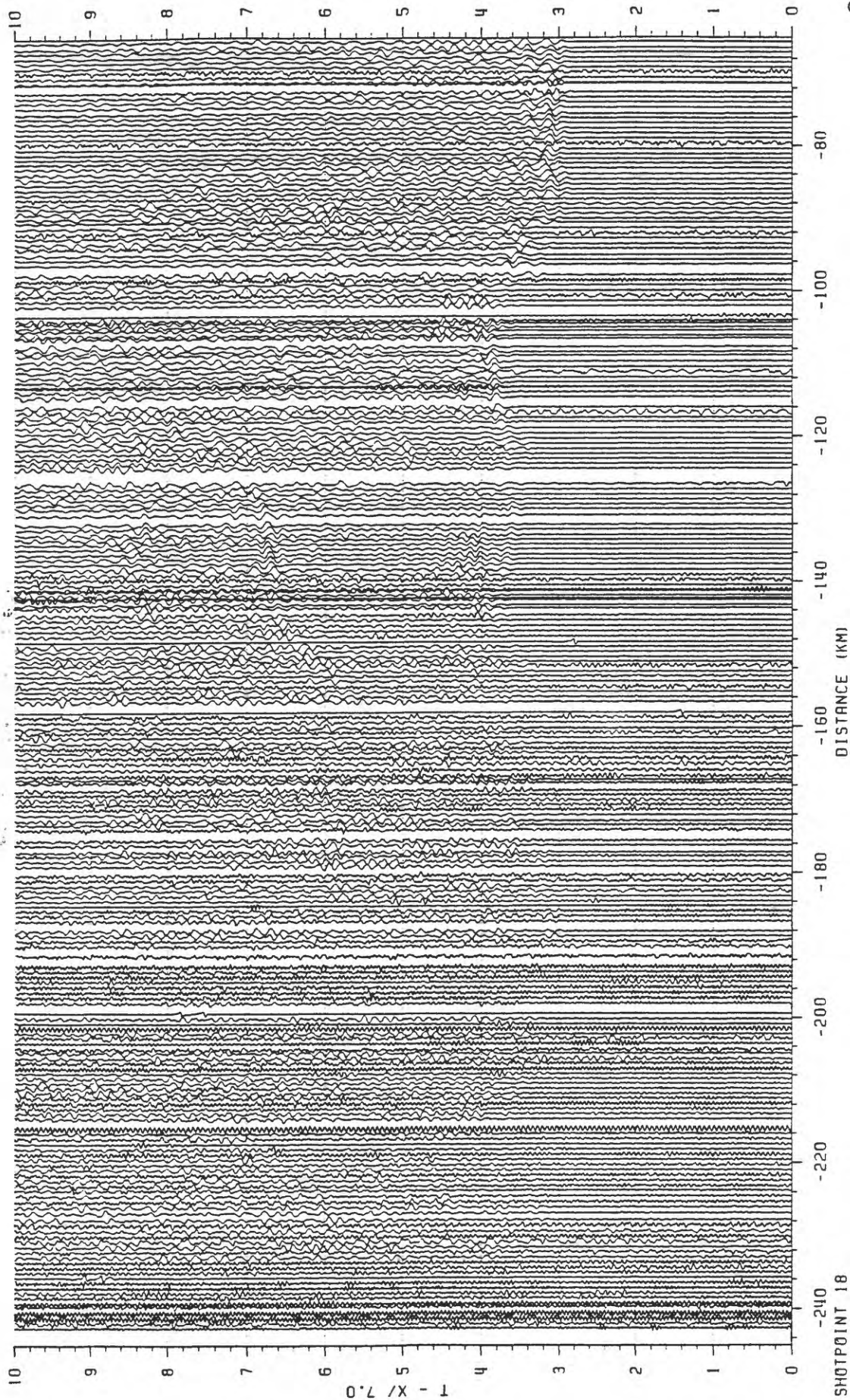


FIGURE 19a. Record section for shotpoint 18 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

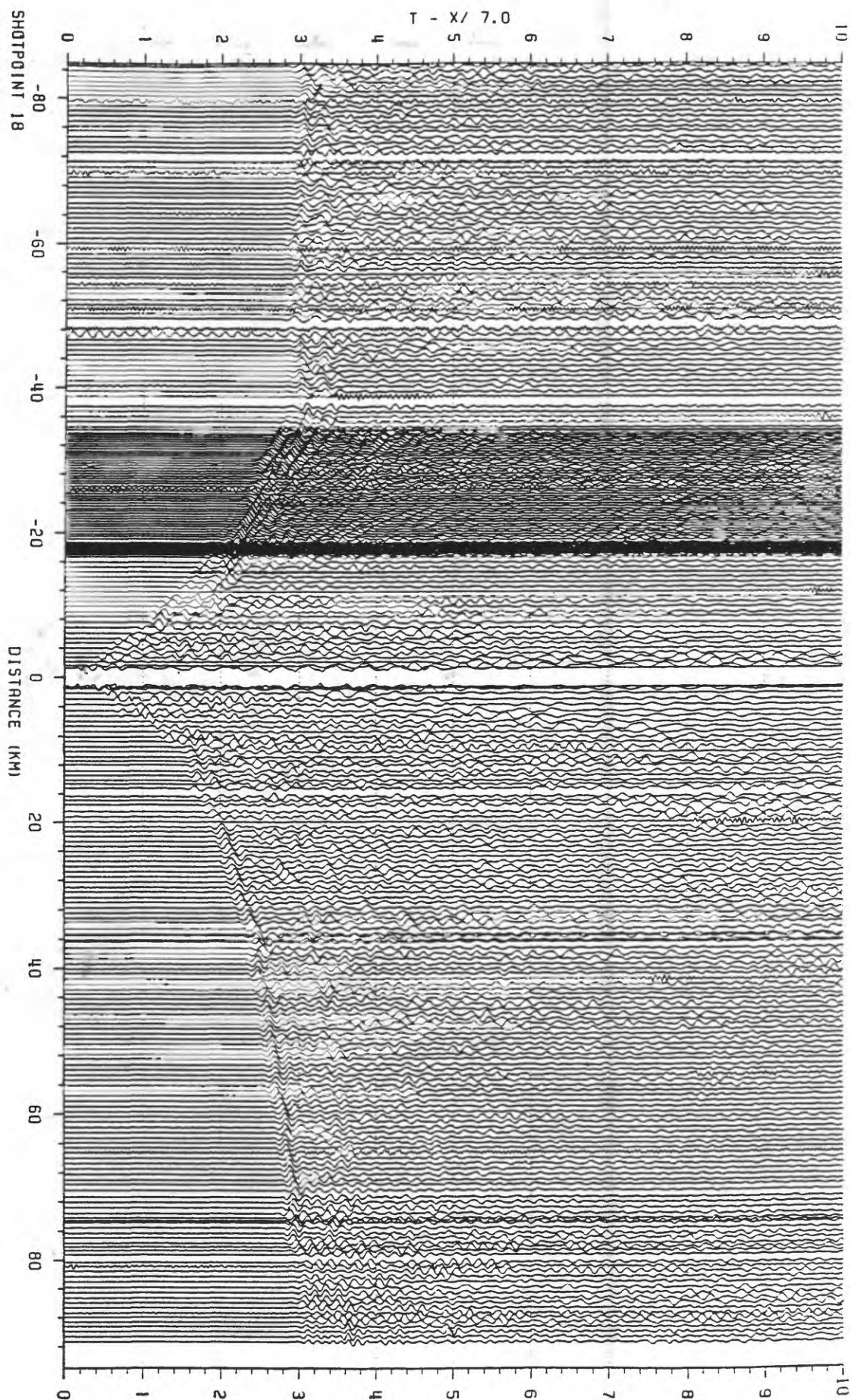


FIGURE 19b. Record section for shotpoint 18 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

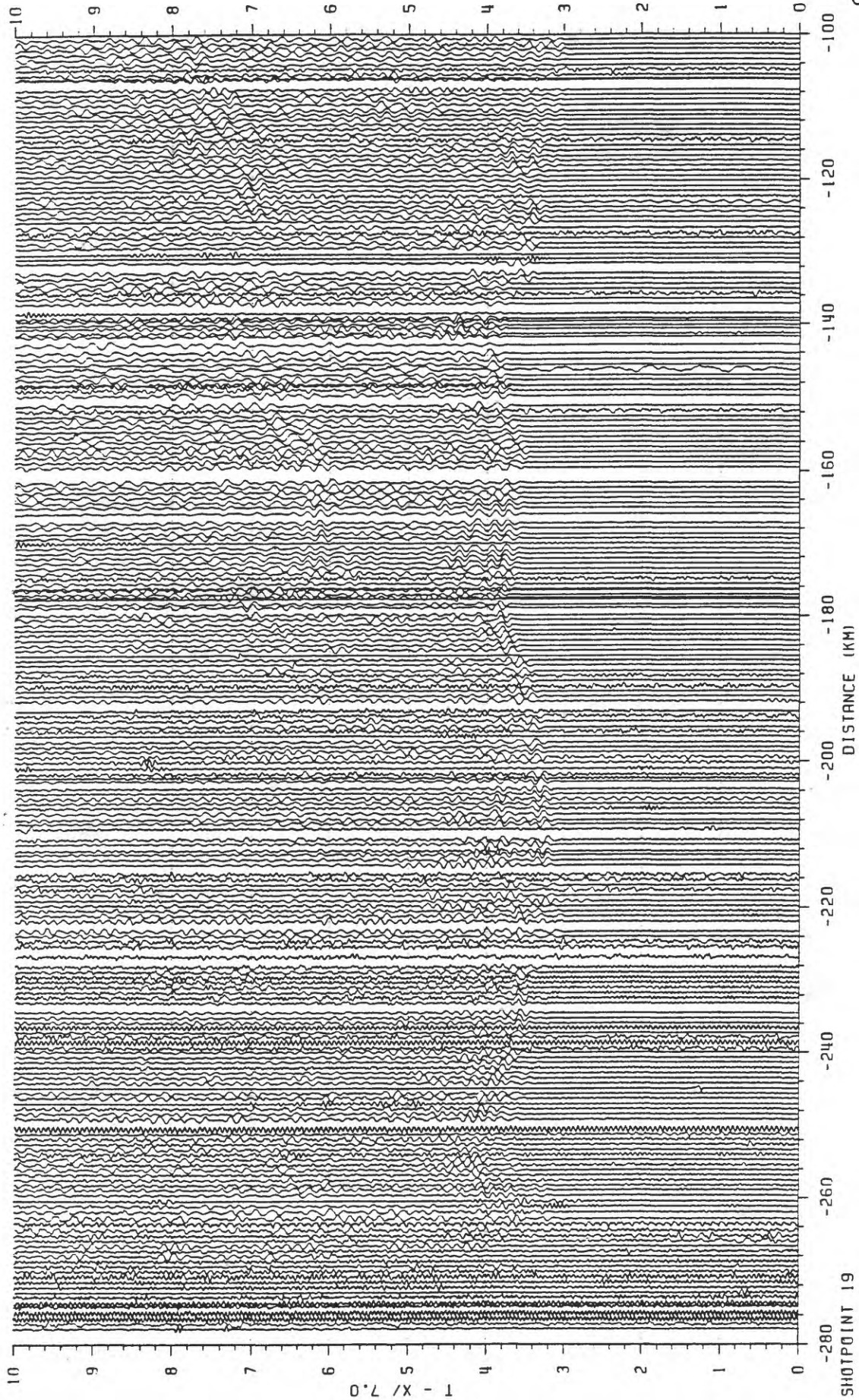


FIGURE 20a. Record section for shotpoint 19 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

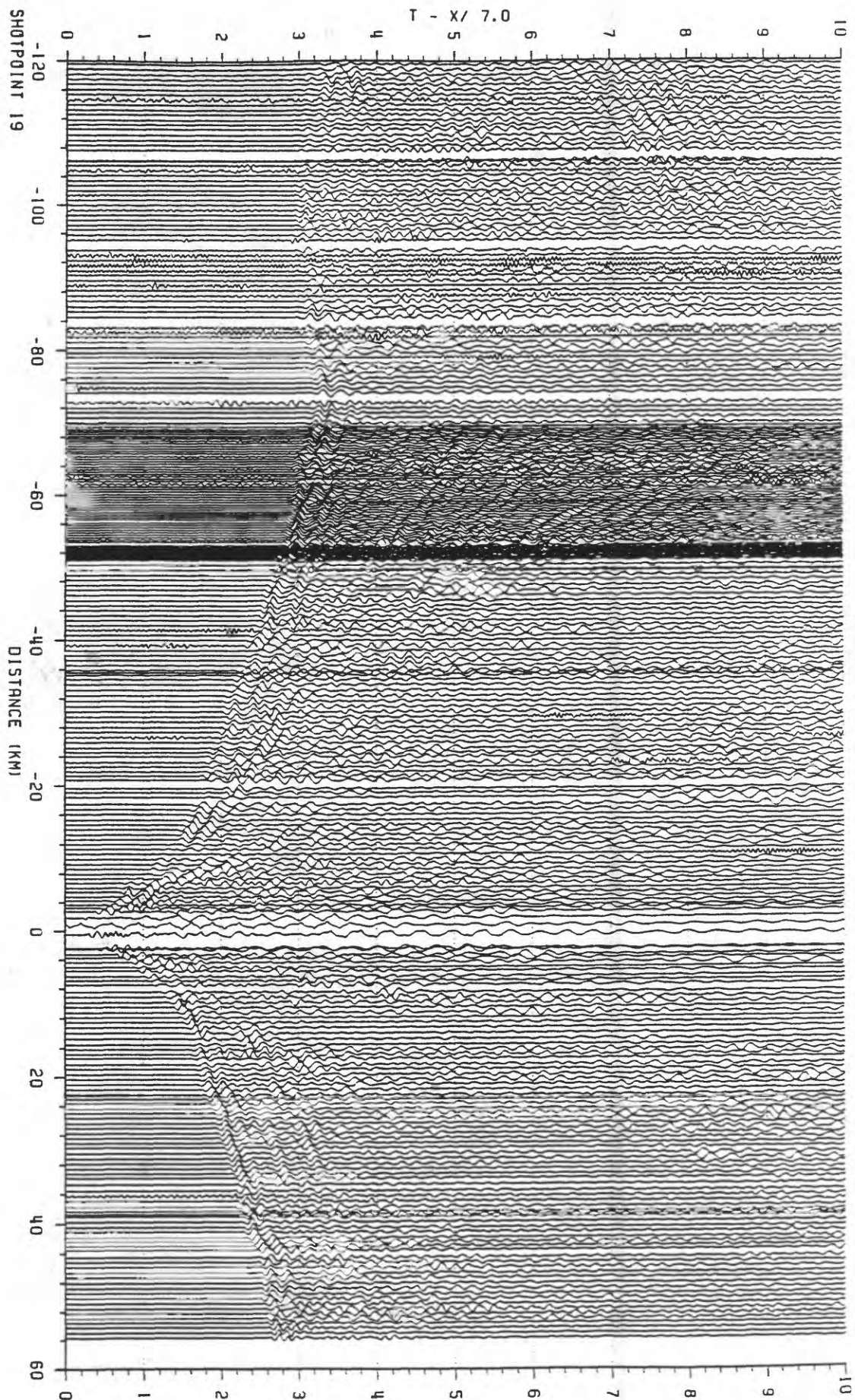


FIGURE 20b. Record section for shotpoint 19 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

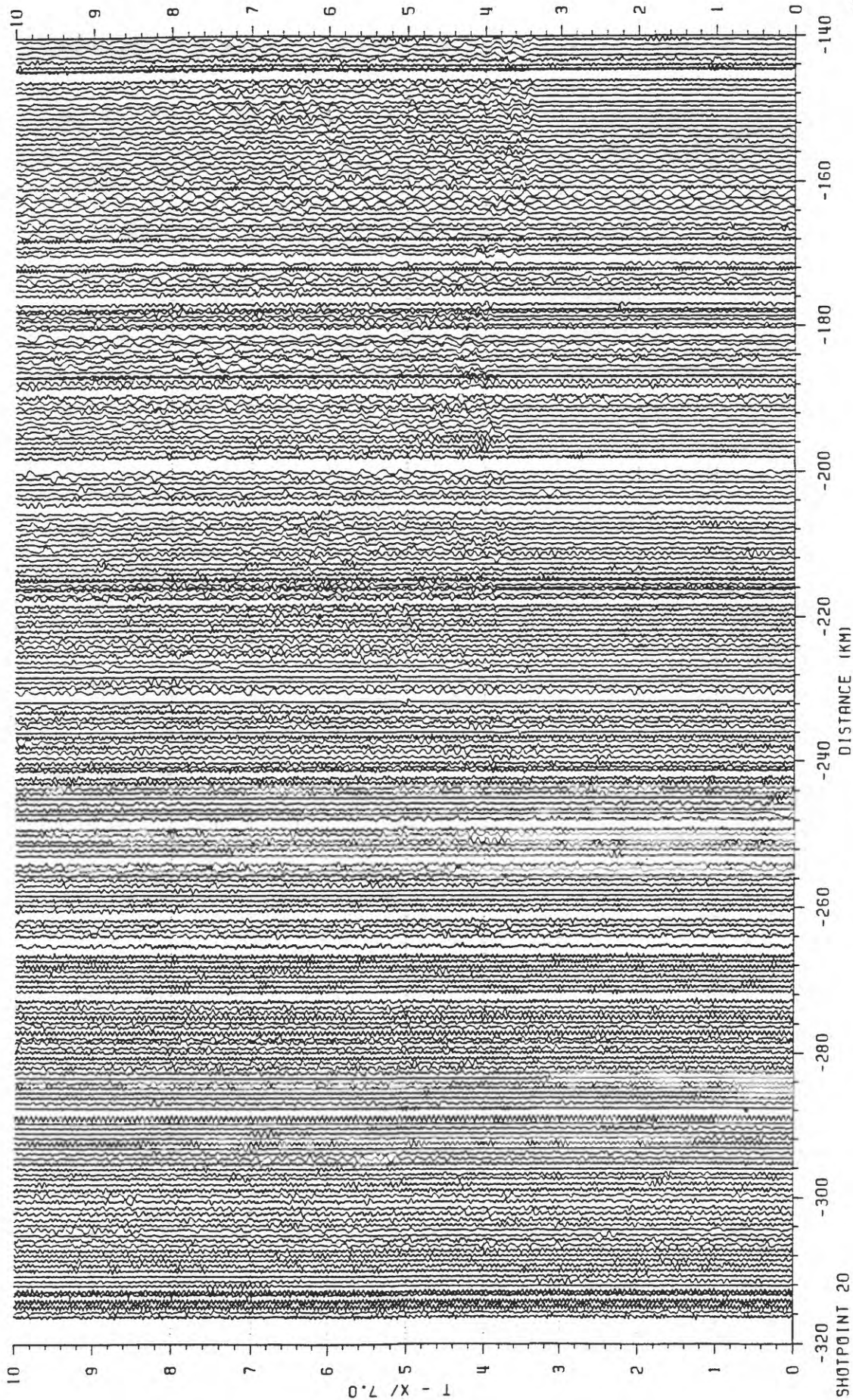


FIGURE 21a. Record section for shotpoint 20 - north half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

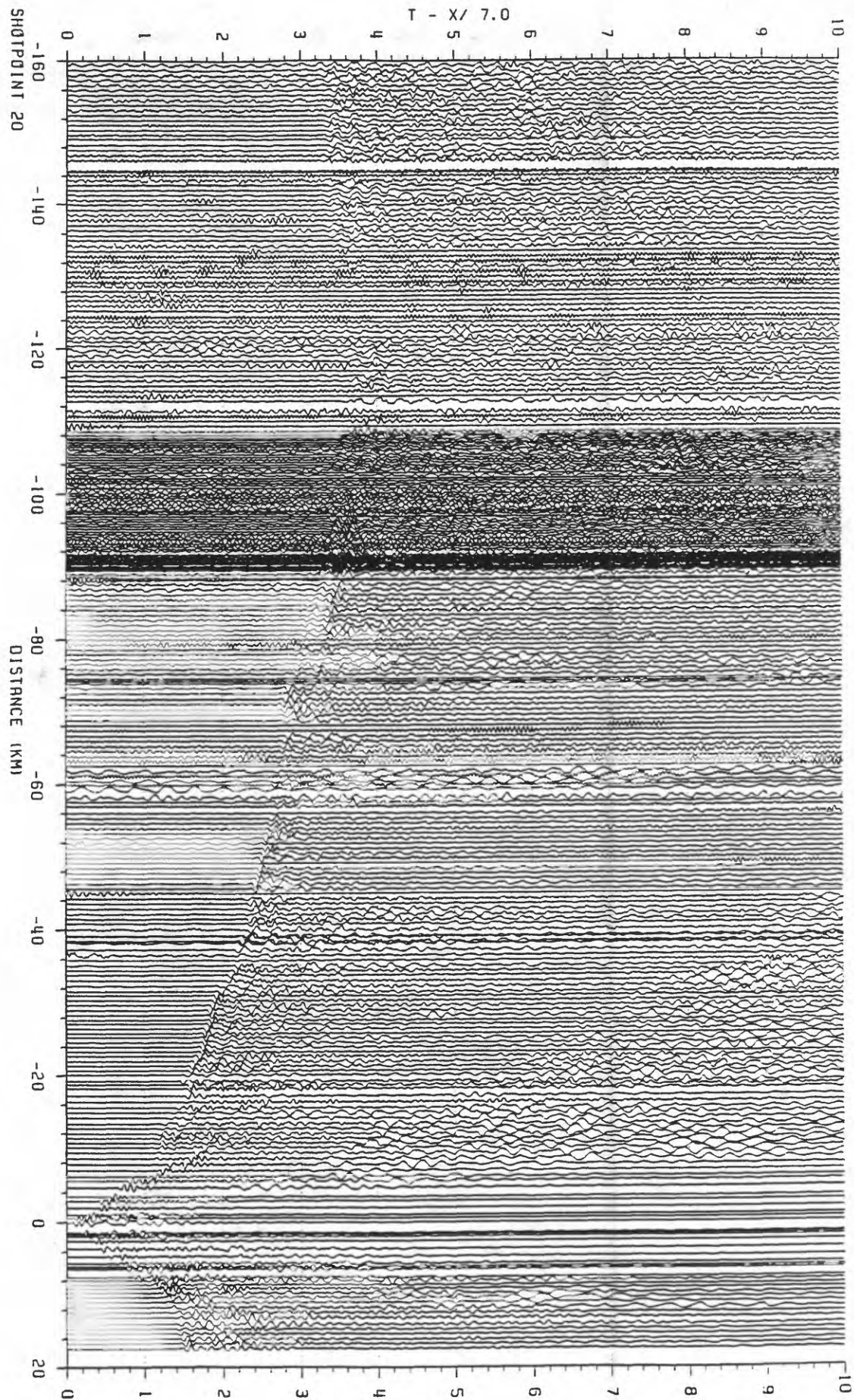


FIGURE 21b. Record section for shotpoint 20 - south half of profile 2 in the Willamette Valley. The north end of the profile is to the left. Plotting parameters are described in the text.

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
1001	49.00000	-122.18256	8	1054	48.72525	-122.18060	226
1002	48.99493	-122.18256	9	1055	48.71909	-122.17908	165
1003	48.99171	-122.19145	9	1056	48.71651	-122.16010	165
1004	48.98627	-122.19783	10	1057	48.71066	-122.16496	155
1005	48.97786	-122.17154	180	1058	48.70027	-122.18124	96
1006	48.97394	-122.18597	178	1059	48.69440	-122.18141	84
1007	48.96931	-122.18622	162	1060	48.68935	-122.18108	98
1008	48.96439	-122.18623	175	1061	48.68145	-122.18203	122
1009	48.95830	-122.17536	390	1062	48.67866	-122.18741	131
1010	48.95409	-122.17759	524	1063	48.67149	-122.19577	79
1011	48.94895	-122.17903	555	1064	48.66481	-122.19549	67
1012	48.94584	-122.17988	604	1065	48.66044	-122.19845	79
1013	48.94290	-122.18444	549	1066	48.65416	-122.20417	73
1014	48.93740	-122.18527	518	1067	48.64934	-122.21033	85
1015	48.93198	-122.18463	549	1068	48.64276	-122.21667	98
1016	48.92652	-122.18463	536	1069	48.63790	-122.21657	98
1017	48.92087	-122.18476	536	1070	48.63175	-122.21613	98
1018	48.91466	-122.18108	553	1071	48.62739	-122.21764	98
1019	48.91068	-122.17959	562	1072	48.62169	-122.22195	79
1020	48.90646	-122.13631	125	1073	48.61659	-122.22530	79
1021	48.90124	-122.14218	125	1074	48.60958	-122.22965	73
1022	48.89490	-122.14685	125	1075	48.60469	-122.23224	76
1023	48.88917	-122.15049	122	1076	48.59881	-122.23156	61
1024	48.88429	-122.15370	116	1077	48.59445	-122.23040	61
1025	48.87854	-122.15609	110	1078	48.58939	-122.22681	85
1026	48.87190	-122.15453	119	1079	48.58409	-122.22438	98
1027	48.86755	-122.15130	107	1080	48.57791	-122.22445	98
1028	48.86238	-122.15216	98	1081	48.57272	-122.22483	98
1029	48.85810	-122.15279	94	1082	48.56709	-122.22485	110
1030	48.85202	-122.15569	94	1083	48.56263	-122.21095	85
1031	48.84631	-122.16182	107	1084	48.55748	-122.21235	107
1032	48.84056	-122.16480	113	1085	48.55012	-122.21291	87
1033	48.83491	-122.16835	114	1086	48.54637	-122.21379	81
1034	48.82912	-122.17498	98	1087	48.53958	-122.22122	66
1035	48.82616	-122.15701	88	1088	48.53506	-122.22232	61
1036	48.81905	-122.16465	86	1089	48.52968	-122.21714	43
1037	48.81426	-122.17578	81	1090	48.52439	-122.21052	30
1038	48.81051	-122.18026	81	1091	48.51810	-122.21023	20
1040	48.79579	-122.18910	72	1092	48.51269	-122.21016	20
1041	48.79069	-122.14622	634	1093	48.50813	-122.21036	18
1042	48.78669	-122.14664	646	1094	48.50310	-122.20970	17
1043	48.78174	-122.14513	640	1095	48.49695	-122.20946	12
1044	48.77584	-122.15387	602	1096	48.49206	-122.20902	12
1045	48.77013	-122.15535	579	1097	48.48843	-122.20890	15
1046	48.76392	-122.15638	549	1099	48.47853	-122.20345	238
1047	48.76014	-122.15828	536	1100	48.47416	-122.20291	67
1048	48.75422	-122.16126	514	1101	48.46746	-122.22057	79
1049	48.74906	-122.16480	411	1102	48.46587	-122.21466	79
1050	48.74199	-122.17109	341	1103	48.46107	-122.21492	14
1051	48.73745	-122.17286	311	1104	48.45481	-122.22042	14
1052	48.73382	-122.17669	274	1105	48.44984	-122.22594	15
1053	48.73012	-122.17742	262	1106	48.44287	-122.22005	12

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
1107	48.43618	-122.22127	13	1159	48.16678	-122.09738	146
1108	48.43156	-122.22108	14	1160	48.16050	-122.09581	152
1109	48.42690	-122.20969	12	1161	48.15538	-122.09595	158
1110	48.42164	-122.21028	24	1162	48.15041	-122.09559	162
1111	48.41511	-122.20674	36	1163	48.14530	-122.09089	162
1112	48.41078	-122.21316	73	1164	48.14036	-122.08582	158
1113	48.40417	-122.20846	140	1165	48.13466	-122.08611	165
1114	48.40081	-122.18634	116	1166	48.12976	-122.08621	113
1115	48.39540	-122.18525	125	1167	48.12301	-122.09803	119
1116	48.39035	-122.18358	116	1168	48.11878	-122.09800	138
1117	48.38480	-122.18307	143	1169	48.11219	-122.09805	134
1118	48.37962	-122.17594	113	1170	48.10667	-122.09800	131
1119	48.37397	-122.17477	91	1171	48.10210	-122.09812	130
1120	48.36781	-122.18443	98	1172	48.09776	-122.09817	127
1121	48.36299	-122.18656	70	1173	48.09059	-122.09821	119
1122	48.35668	-122.19173	114	1174	48.08361	-122.09809	113
1123	48.35160	-122.19020	113	1175	48.07826	-122.09808	115
1124	48.34505	-122.18452	152	1176	48.07279	-122.09806	121
1125	48.34049	-122.17990	168	1177	48.07062	-122.06523	113
1126	48.33624	-122.16990	171	1178	48.06450	-122.06534	104
1127	48.33033	-122.16587	166	1179	48.05906	-122.06525	90
1128	48.32566	-122.16331	174	1180	48.05390	-122.06529	91
1129	48.32055	-122.15952	158	1181	48.04652	-122.06410	91
1130	48.31444	-122.16781	201	1182	48.03983	-122.06372	90
1131	48.30945	-122.16756	166	1183	48.03591	-122.06515	82
1132	48.30393	-122.17063	152	1184	48.03195	-122.05941	76
1133	48.29719	-122.17560	146	1185	48.02730	-122.05676	70
1134	48.29230	-122.17579	134	1186	48.02309	-122.05343	62
1135	48.28681	-122.17628	117	1187	48.01565	-122.05178	69
1136	48.28173	-122.17417	178	1188	48.01040	-122.05310	65
1137	48.27637	-122.17224	189	1189	48.00464	-122.05309	75
1138	48.27394	-122.12007	168	1190	47.99939	-122.06702	79
1139	48.26872	-122.11698	134	1191	47.99379	-122.06416	67
1140	48.26379	-122.11339	111	1192	47.98724	-122.06444	69
1141	48.25833	-122.11326	97	1193	47.98357	-122.06456	78
1142	48.25252	-122.11055	85	1194	47.97823	-122.05963	28
1143	48.24779	-122.11116	96	1195	47.97294	-122.06290	25
1144	48.24248	-122.10645	84	1196	47.96632	-122.06621	25
1145	48.23657	-122.11129	87	1197	47.96136	-122.06842	24
1146	48.23528	-122.11123	91	1198	47.95478	-122.07087	40
1147	48.23093	-122.11269	73	1199	47.94931	-122.07613	30
1148	48.22596	-122.11081	62	1200	47.94552	-122.06515	34
1149	48.22037	-122.11164	46	1201	47.94065	-122.06533	32
1150	48.21504	-122.11053	24	1202	47.93519	-122.06537	37
1151	48.20932	-122.11554	23	1203	47.92869	-122.05448	103
1152	48.20417	-122.11637	9	1204	47.92286	-122.05390	55
1153	48.19887	-122.11100	15	1205	47.91888	-122.06212	9
1154	48.19382	-122.10839	63	1206	47.91426	-122.05464	3
1155	48.18803	-122.10662	55	1207	47.90662	-122.06196	3
1156	48.18271	-122.11680	101	1208	47.90189	-122.06241	3
1157	48.17760	-122.11206	128	1209	47.89937	-122.06253	3
1158	48.17153	-122.10602	134	1210	47.89662	-122.06727	3

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
1211	47.88962	-122.07212	3	1264	47.61031	-122.03527	100
1212	47.88457	-122.06834	44	1265	47.60394	-122.03543	140
1213	47.88063	-122.05924	55	1266	47.59988	-122.03539	163
1214	47.87500	-122.05924	58	1267	47.59305	-122.03522	150
1216	47.86978	-122.06048	64	1268	47.58845	-122.03518	128
1217	47.86321	-122.06070	144	1269	47.58247	-122.03451	135
1218	47.85835	-122.06176	146	1270	47.57819	-122.02656	112
1219	47.85403	-122.02352	15	1271	47.57352	-122.02177	112
1220	47.84977	-122.01821	15	1272	47.56775	-122.02433	110
1221	47.84495	-122.01451	32	1273	47.56303	-122.02453	118
1222	47.83928	-122.01680	40	1274	47.55666	-122.02238	144
1223	47.83144	-122.05384	12	1275	47.55220	-122.02410	123
1224	47.82575	-122.05185	79	1276	47.54486	-122.03366	28
1225	47.82038	-122.04913	116	1277	47.53937	-122.03345	25
1226	47.81477	-122.04628	134	1278	47.53545	-122.02944	18
1227	47.81012	-122.04473	146	1279	47.53021	-122.02535	14
1228	47.80446	-122.04495	141	1280	47.52507	-122.03193	45
1229	47.79952	-122.04556	155	1281	47.51950	-122.02973	40
1230	47.79673	-122.04090	148	1282	47.51400	-122.02400	40
1231	47.78848	-122.05518	150	1283	47.50900	-122.02309	46
1232	47.78361	-122.05513	149	1284	47.50085	-122.02136	58
1233	47.77924	-122.05400	129	1285	47.49696	-122.02060	48
1234	47.77580	-122.05258	134	1286	47.49343	-122.02165	49
1235	47.76646	-122.06267	88	1287	47.48837	-122.02427	53
1236	47.75983	-122.06322	84	1288	47.48314	-122.02686	76
1237	47.75504	-122.06596	87	1289	47.47700	-122.02670	91
1238	47.75267	-122.02828	149	1290	47.47045	-122.02585	96
1239	47.74681	-122.02868	134	1291	47.46563	-122.02316	91
1240	47.74134	-122.02791	146	1292	47.46150	-122.02482	91
1241	47.73513	-122.02747	170	1293	47.45556	-122.02715	107
1242	47.73074	-122.02735	172	1294	47.44907	-122.03339	113
1243	47.71989	-122.00775	15	1295	47.44286	-122.05041	107
1244	47.71357	-122.00603	15	1296	47.43757	-122.03846	146
1245	47.70913	-122.00472	167	1297	47.43439	-122.01461	172
1246	47.70546	-122.00218	166	1298	47.42605	-122.01481	143
1247	47.70212	-122.01342	163	1299	47.42188	-122.01446	162
1248	47.69831	-122.01221	162	1300	47.41674	-122.01418	142
1249	47.69428	-122.01273	163	1301	47.41211	-122.01463	145
1250	47.68872	-122.01256	173	1302	47.40490	-122.01479	175
1251	47.67798	-122.00154	182	1303	47.40096	-122.01317	183
1252	47.67454	-122.00176	182	1304	47.39763	-122.01534	191
1253	47.67133	-122.02084	160	1305	47.39148	-122.01424	191
1254	47.66516	-122.02012	145	1306	47.38668	-122.00200	187
1255	47.66040	-122.02088	150	1307	47.37831	-121.98403	183
1256	47.65458	-122.02356	140	1308	47.37616	-121.99014	189
1257	47.64951	-122.02349	86	1309	47.37021	-121.97243	241
1258	47.64476	-122.02333	54	1310	47.36590	-121.96865	235
1259	47.63946	-122.00933	42	1311	47.35919	-121.98337	184
1260	47.63384	-122.01251	110	1312	47.35394	-121.98337	184
1261	47.62838	-122.01259	85	1313	47.34813	-121.99223	183
1262	47.62184	-122.01373	121	1314	47.34340	-121.99185	283
1263	47.61683	-122.03468	109	1315	47.33785	-121.98883	279

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
1316	47.33135	-121.99475	206	1368	47.05904	-122.04101	396
1317	47.32661	-121.99955	207	1369	47.05346	-122.04206	402
1318	47.32136	-122.00371	190	1370	47.04835	-122.04153	405
1319	47.31541	-122.00509	175	1371	47.04349	-122.03933	411
1320	47.31010	-122.00823	200	1372	47.03844	-122.03860	421
1321	47.30410	-122.00036	173	1373	47.03280	-122.03840	429
1322	47.29961	-121.99838	175	1374	47.02742	-122.03940	463
1323	47.29470	-121.99768	198	1375	47.02090	-122.03823	506
1324	47.28786	-121.98960	203	1376	47.01505	-122.03663	543
1325	47.28420	-121.98777	183	1377	47.01071	-122.03331	579
1326	47.27866	-121.98978	146	1378	47.00515	-122.02746	616
1327	47.27023	-121.99267	154	1379	47.00045	-122.02438	658
1328	47.26766	-121.99037	181	1380	46.99472	-122.01654	713
1329	47.26246	-121.98433	214	1381	46.98942	-122.01633	735
1330	47.25748	-121.98568	212	1382	46.98445	-122.01604	791
1331	47.25045	-121.98873	212	1383	46.97849	-122.01808	817
1332	47.24434	-121.98863	207	1384	46.97324	-122.01428	850
1333	47.24052	-121.98853	209	1385	46.96896	-122.01195	872
1334	47.23454	-121.98864	212	1386	46.96307	-122.00611	881
1335	47.22946	-121.98854	212	1387	46.95801	-121.99694	951
1336	47.22334	-121.98860	216	1388	46.95373	-121.99177	975
1337	47.22119	-121.99369	204	1389	46.94841	-121.97800	1006
1338	47.21333	-121.99784	223	1390	46.94356	-121.97171	1061
1339	47.20664	-122.00905	223	1511	46.93784	-121.96263	981
1340	47.20202	-122.00166	223	1512	46.93439	-121.93971	1012
1341	47.19614	-122.00442	221	1513	46.92950	-121.92234	1067
1342	47.18935	-122.00418	222	1391	46.93775	-121.98285	927
1343	47.18499	-122.00409	220	1392	46.93200	-121.98390	904
1344	47.18000	-122.00972	220	1393	46.92638	-121.98952	799
1345	47.17399	-122.01806	226	1394	46.92028	-122.00287	719
1346	47.16918	-122.00586	219	1395	46.91457	-122.00767	640
1347	47.16410	-122.00659	226	1396	46.90929	-122.01111	600
1348	47.15654	-122.00553	228	1397	46.90192	-122.02267	561
1349	47.15314	-122.00342	228	1398	46.89739	-122.03010	549
1350	47.14919	-122.00357	229	1399	46.89236	-122.02048	561
1351	47.14185	-122.01342	230	1400	46.88739	-122.01256	579
1352	47.13628	-122.01865	209	1401	46.88253	-122.00255	610
1353	47.13252	-122.01831	237	1402	46.87657	-121.99511	623
1354	47.12428	-122.04702	236	1403	46.87222	-121.98148	655
1355	47.11828	-122.05434	229	1404	46.86694	-121.97397	707
1356	47.11412	-122.03395	308	1405	46.86204	-121.97039	768
1357	47.10795	-122.03933	268	1406	46.85673	-121.96984	805
1358	47.10238	-122.03958	244	1407	46.85132	-121.96915	823
1359	47.09859	-122.03327	360	1409	46.84222	-121.96802	838
1360	47.09269	-122.03174	384	1410	46.83526	-121.96435	866
1361	47.08846	-122.02760	402	1411	46.82925	-121.96669	960
1362	47.08639	-122.03307	390	1412	46.82433	-121.96928	1030
1363	47.08408	-122.03383	390	1413	46.81844	-121.97568	1134
1364	47.08050	-122.04612	366	1414	46.81305	-121.97657	1170
1365	47.07564	-122.04118	358	1415	46.80748	-121.97694	1311
1366	47.06998	-122.03965	369	1416	46.80226	-121.97677	1372
1367	47.06489	-122.04065	384	1417	46.79571	-121.97602	1329

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
1418	46.79145	-121.97274	1306	1471	46.51702	-121.91896	402
1419	46.78633	-121.96894	1219	1472	46.51234	-121.91513	366
1420	46.78125	-121.96158	1177	1473	46.50592	-121.91959	274
1421	46.77629	-121.95327	1097	1474	46.50131	-121.92399	293
1422	46.77108	-121.95581	1064	1475	46.49639	-121.92052	305
1423	46.76487	-121.95693	853	1476	46.49070	-121.91733	329
1424	46.75994	-121.95285	732	1477	46.49146	-121.90748	390
1425	46.75600	-121.96707	567	1478	46.49178	-121.89894	395
1426	46.75226	-121.98013	549	1479	46.48631	-121.90044	463
1427	46.74789	-121.98109	552	1480	46.48139	-121.89820	454
1428	46.74302	-121.98127	546	1481	46.47653	-121.89502	454
1429	46.73705	-121.98117	550	1482	46.47051	-121.89628	482
1430	46.73155	-121.98086	550	1483	46.46689	-121.89614	482
1431	46.72541	-122.00391	707	1484	46.45982	-121.89006	475
1432	46.72146	-121.99900	695	1485	46.45210	-121.88999	396
1433	46.71513	-121.99070	732				
1434	46.71034	-121.98796	732				
1435	46.70533	-121.98468	765				
1436	46.69930	-121.96498	853				
1437	46.69619	-121.96097	849				
1438	46.69050	-121.95889	840				
1439	46.68450	-121.95224	855				
1440	46.67859	-121.95619	890				
1441	46.67345	-121.96006	927				
1442	46.66756	-121.96592	989				
1443	46.66335	-121.95632	1049				
1444	46.65799	-121.94117	1036				
1445	46.65280	-121.92849	1207				
1446	46.64854	-121.90325	1212				
1447	46.64324	-121.89128	1311				
1448	46.63785	-121.90283	1353				
1449	46.63213	-121.90667	1231				
1450	46.62696	-121.91308	1189				
1451	46.62204	-121.90261	1000				
1452	46.61626	-121.90676	1000				
1453	46.61079	-121.90777	939				
1454	46.60514	-121.90950	768				
1455	46.60071	-121.89014	716				
1456	46.59521	-121.89666	686				
1457	46.58888	-121.90145	684				
1458	46.58393	-121.90856	683				
1459	46.57784	-121.91351	684				
1460	46.57218	-121.91297	664				
1461	46.56618	-121.91351	668				
1462	46.56164	-121.90594	607				
1463	46.55580	-121.90972	607				
1464	46.55074	-121.90101	561				
1465	46.54567	-121.90725	390				
1467	46.53534	-121.90795	280				
1468	46.53032	-121.90396	275				
1469	46.52702	-121.91153	402				
1470	46.52161	-121.91598	402				

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
2001	46.86927	-123.05941	46	2053	46.53892	-123.14532	91
2002	46.86473	-123.08266	37	2054	46.53235	-123.14702	86
2003	46.85884	-123.09064	37	2055	46.52776	-123.14621	99
2004	46.85224	-123.09781	32	2056	46.51983	-123.12798	98
2005	46.84372	-123.09572	38	2057	46.51322	-123.13812	107
2006	46.84013	-123.09560	40	2058	46.50787	-123.13862	110
2007	46.83285	-123.09554	44	2059	46.50133	-123.13519	168
2008	46.82732	-123.09592	43	2060	46.49538	-123.14208	323
2009	46.82103	-123.09593	43	2061	46.48912	-123.14122	366
2010	46.81471	-123.09939	40	2062	46.48235	-123.14292	411
2011	46.80814	-123.10093	37	2063	46.47604	-123.14207	436
2012	46.80244	-123.11409	76	2064	46.46973	-123.13638	454
2013	46.79629	-123.11207	40	2065	46.46298	-123.12829	430
2014	46.78949	-123.09601	55	2066	46.45628	-123.12326	416
2015	46.78281	-123.09634	102	2067	46.44940	-123.11837	411
2016	46.77659	-123.09755	134	2068	46.44249	-123.11036	279
2017	46.77025	-123.09544	110	2069	46.43600	-123.09817	198
2018	46.76384	-123.09790	55	2070	46.42926	-123.09378	168
2019	46.75764	-123.09698	46	2071	46.42308	-123.09566	128
2020	46.75094	-123.09691	55	2072	46.41648	-123.09275	206
2021	46.74375	-123.10456	110	2073	46.41035	-123.09572	229
2022	46.73728	-123.11232	74	2074	46.40395	-123.09698	223
2023	46.72899	-123.11196	195	2075	46.39833	-123.10425	169
2024	46.72173	-123.11574	187	2076	46.39172	-123.09911	189
2025	46.71542	-123.11924	122	2077	46.38595	-123.11407	244
2026	46.70800	-123.11654	96	2078	46.37984	-123.11452	271
2027	46.70124	-123.11816	91	2079	46.37444	-123.12749	267
2028	46.69575	-123.11822	64	2080	46.36813	-123.12965	305
2029	46.68925	-123.11809	67	2081	46.36172	-123.13058	338
2030	46.68281	-123.11997	64	2082	46.35552	-123.13197	338
2031	46.67636	-123.12041	67	2083	46.34938	-123.13289	433
2032	46.67020	-123.11824	73	2084	46.34311	-123.12771	457
2033	46.66366	-123.11739	67	2085	46.33688	-123.13750	474
2034	46.65742	-123.11331	59	2086	46.32998	-123.13214	314
2035	46.65094	-123.11237	55	2087	46.32399	-123.12951	290
2036	46.64474	-123.11757	55	2088	46.31716	-123.12925	255
2037	46.63833	-123.11719	59	2089	46.31082	-123.12584	235
2038	46.63194	-123.11496	67	2090	46.30687	-123.14242	576
2039	46.62555	-123.10735	79	2091	46.29985	-123.14069	518
2040	46.61982	-123.10178	79	2092	46.29332	-123.13785	472
2041	46.61318	-123.11039	67	2093	46.28673	-123.13799	472
2042	46.60723	-123.11944	73	2094	46.28175	-123.13409	329
2043	46.60087	-123.12406	74	2095	46.27336	-123.13038	207
2044	46.59459	-123.12039	74	2096	46.26748	-123.12931	119
2045	46.58773	-123.11989	75	2097	46.26124	-123.13156	107
2046	46.58231	-123.12550	67	2098	46.25457	-123.13331	107
2047	46.57608	-123.12865	67	2099	46.24833	-123.13605	90
2048	46.56992	-123.13277	76	2100	46.24325	-123.13595	82
2049	46.56377	-123.13760	79	2101	46.23612	-123.13794	58
2050	46.55774	-123.14248	76	2102	46.22958	-123.14670	58
2051	46.55161	-123.14430	76	2103	46.22355	-123.14717	52
2052	46.54453	-123.14428	79	2104	46.21780	-123.14761	41

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
2105	46.21157	-123.14943	34	2157	45.89544	-123.15603	177
2106	46.20608	-123.15194	25	2158	45.88935	-123.15013	177
2107	46.19685	-123.16012	24	2159	45.88241	-123.15413	181
2108	46.19290	-123.16322	15	2160	45.87683	-123.16548	174
2109	46.18867	-123.17612	9	2161	45.87095	-123.17042	186
2110	46.18136	-123.17237	2	2162	45.86549	-123.17233	184
2111	46.17364	-123.16137	5	2163	45.85760	-123.16951	184
2112	46.16645	-123.14465	6	2164	45.85189	-123.16873	204
2113	46.15984	-123.14639	5	2165	45.84590	-123.17973	223
2114	46.15461	-123.15389	11	2166	45.83966	-123.18188	198
2115	46.14860	-123.15677	8	2167	45.83345	-123.18521	198
2116	46.14168	-123.16150	19	2168	45.82703	-123.18687	221
2117	46.13552	-123.16027	27	2169	45.82096	-123.18825	216
2118	46.13012	-123.15718	6	2170	45.81467	-123.18692	195
2119	46.12296	-123.16116	9	2171	45.80816	-123.18608	195
2120	46.11636	-123.15911	40	2172	45.80185	-123.18857	207
2121	46.11027	-123.15770	12	2173	45.79584	-123.19445	213
2122	46.10408	-123.14901	34	2174	45.78979	-123.20554	293
2123	46.09777	-123.15818	162	2175	45.78376	-123.20375	347
2124	46.09172	-123.16302	18	2176	45.77734	-123.20146	335
2125	46.08514	-123.16083	15	2177	45.77107	-123.19998	386
2126	46.07935	-123.15858	24	2178	45.76461	-123.19498	372
2127	46.07230	-123.15989	37	2179	45.75806	-123.19048	287
2128	46.06611	-123.15929	41	2180	45.75019	-123.17319	439
2129	46.05967	-123.15395	104	2181	45.74472	-123.17276	335
2130	46.05258	-123.16297	142	2182	45.73834	-123.17334	360
2131	46.04721	-123.16973	221	2183	45.73204	-123.17361	335
2132	46.04207	-123.18560	329	2184	45.72572	-123.17160	360
2133	46.03541	-123.18377	322	2185	45.71975	-123.17268	299
2134	46.02919	-123.17462	366	2186	45.71353	-123.17613	256
2135	46.02325	-123.18421	456	2187	45.70723	-123.17517	209
2136	46.01637	-123.18726	472	2188	45.70085	-123.18072	158
2137	46.00952	-123.16324	504	2189	45.69527	-123.18491	125
2138	46.00292	-123.15885	482	2190	45.68861	-123.19452	79
2139	45.99598	-123.15186	461	2191	45.68270	-123.19028	79
2140	45.98958	-123.13582	447	2192	45.67565	-123.18167	73
2141	45.98108	-123.14418	436	2193	45.66816	-123.17937	160
2142	45.97673	-123.14218	378	2194	45.66356	-123.17528	134
2143	45.97048	-123.14207	332	2195	45.65756	-123.16986	162
2144	45.96838	-123.14368	311	2196	45.64731	-123.17569	219
2145	45.96477	-123.14793	250	2197	45.64371	-123.18318	259
2146	45.95937	-123.14908	311	2198	45.63774	-123.18581	110
2147	45.95873	-123.16365	168	2199	45.63380	-123.19305	61
2148	45.95272	-123.16583	172	2200	45.62883	-123.19518	213
2149	45.94613	-123.16355	174	2201	45.62550	-123.19291	195
2150	45.94008	-123.16489	175	2202	45.61966	-123.20283	134
2151	45.93354	-123.16127	174	2203	45.61431	-123.20556	174
2152	45.92659	-123.14934	174	2204	45.60727	-123.20372	219
2153	45.91987	-123.13951	174	2205	45.60067	-123.20083	207
2154	45.91382	-123.14270	175	2206	45.59442	-123.20071	184
2155	45.90717	-123.14005	174	2207	45.58773	-123.19047	58
2156	45.90107	-123.14758	177	2208	45.58095	-123.18332	67

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
2209	45.57533	-123.20167	91	2261	45.24786	-123.22960	79
2210	45.56846	-123.19576	88	2262	45.24212	-123.22919	86
2211	45.56230	-123.18928	85	2263	45.23526	-123.22925	44
2212	45.55537	-123.18472	73	2264	45.22897	-123.22893	46
2213	45.54940	-123.17660	73	2265	45.22231	-123.22679	50
2214	45.54345	-123.16884	61	2266	45.21621	-123.22850	61
2215	45.53584	-123.16977	62	2267	45.20984	-123.22850	52
2216	45.53004	-123.16897	70	2268	45.20354	-123.22817	48
2217	45.52266	-123.16069	70	2269	45.19718	-123.22933	47
2218	45.51666	-123.15673	70	2270	45.19047	-123.22933	46
2219	45.51032	-123.16879	0	2271	45.18527	-123.22749	45
2220	45.50397	-123.18086	128	2272	45.17743	-123.20832	46
2221	45.49958	-123.20585	146	2273	45.17166	-123.20802	45
2222	45.49309	-123.20488	140	2274	45.16550	-123.20492	41
2223	45.48736	-123.20664	141	2275	45.15849	-123.19964	44
2224	45.48130	-123.20395	137	2276	45.15205	-123.20209	48
2225	45.47510	-123.22253	125	2277	45.14633	-123.22581	48
2226	45.46859	-123.22920	152	2278	45.14057	-123.22739	49
2227	45.46260	-123.23279	104	2279	45.13425	-123.22895	50
2228	45.45615	-123.23294	94	2280	45.12776	-123.23106	44
2229	45.45015	-123.23354	85	2281	45.12129	-123.23825	49
2230	45.44361	-123.22939	74	2282	45.11495	-123.22332	49
2231	45.43653	-123.21675	73	2283	45.10785	-123.20639	46
2232	45.43023	-123.21398	128	2284	45.10149	-123.20647	51
2233	45.42456	-123.22326	207	2285	45.09521	-123.20893	51
2234	45.41857	-123.23215	241	2286	45.08902	-123.21409	72
2235	45.41242	-123.23438	196	2287	45.08278	-123.20812	52
2236	45.40537	-123.22325	109	2288	45.07620	-123.20798	50
2237	45.39907	-123.22105	94	2289	45.06996	-123.20804	52
2238	45.39265	-123.22045	85	2290	45.06392	-123.20661	58
2239	45.38652	-123.21687	147	2291	45.05737	-123.20556	59
2240	45.37983	-123.21596	128	2292	45.05101	-123.20564	59
2241	45.37382	-123.21367	82	2293	45.04462	-123.20566	59
2242	45.36832	-123.21064	76	2294	45.03841	-123.20578	54
2243	45.36073	-123.21077	73	2295	45.03176	-123.20625	51
2244	45.35418	-123.21084	70	2296	45.02564	-123.20618	50
2245	45.34811	-123.21105	68	2297	45.01923	-123.20646	52
2246	45.34193	-123.20941	52	2298	45.01310	-123.20672	52
2247	45.33641	-123.21627	46	2299	45.00691	-123.20702	51
2248	45.32981	-123.23104	65	2300	45.00002	-123.20812	53
2249	45.32348	-123.22431	76	2302	44.99210	-123.21244	55
2250	45.31677	-123.21920	66	2303	44.98691	-123.21507	64
2251	45.31085	-123.21842	73	2304	44.98157	-123.21694	71
2252	45.30446	-123.22422	67	2305	44.97558	-123.21894	59
2253	45.29841	-123.22819	72	2306	44.96911	-123.22333	60
2254	45.29186	-123.22837	67	2307	44.96325	-123.22711	64
2255	45.28626	-123.22823	54	2308	44.95698	-123.22709	61
2256	45.27909	-123.21790	58	2309	44.95069	-123.22704	59
2257	45.27301	-123.21860	50	2310	44.94396	-123.22703	59
2258	45.26674	-123.22112	43	2311	44.93791	-123.22701	60
2259	45.26053	-123.22583	58	2312	44.93177	-123.22707	63
2260	45.25424	-123.22823	73	2313	44.92526	-123.22700	60

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
2314	44.91912	-123.22704	64	2367	44.59046	-123.24306	69
2315	44.91257	-123.22700	66	2368	44.58372	-123.23474	69
2316	44.90660	-123.23357	71	2369	44.57783	-123.24402	69
2317	44.90007	-123.23365	65	2370	44.57137	-123.23984	65
2318	44.89378	-123.23436	63	2371	44.56515	-123.24012	65
2319	44.88748	-123.23580	91	2372	44.56236	-123.25226	66
2320	44.88141	-123.23667	59	2374	44.55121	-123.24934	40
2321	44.87488	-123.23730	58	2375	44.54668	-123.25384	70
2322	44.86861	-123.23742	61	2376	44.53989	-123.24584	66
2323	44.86234	-123.23669	58	2377	44.53520	-123.25258	73
2324	44.85571	-123.23242	57	2378	44.52861	-123.26639	72
2325	44.84973	-123.24373	66	2379	44.52219	-123.26701	72
2326	44.84334	-123.23392	62	2380	44.51592	-123.26775	73
2327	44.83688	-123.23387	59	2381	44.50920	-123.26843	73
2328	44.83056	-123.23384	66	2382	44.50338	-123.26895	67
2329	44.82444	-123.23415	73	2383	44.49732	-123.26954	70
2330	44.81808	-123.23385	75	2384	44.49088	-123.27022	73
2331	44.81174	-123.23387	94	2385	44.48465	-123.27078	75
2332	44.80538	-123.23382	94	2386	44.47843	-123.27159	76
2333	44.79883	-123.23383	90	2387	44.47241	-123.27259	76
2334	44.79271	-123.23389	81	2388	44.46597	-123.27291	77
2335	44.78622	-123.23390	72	2389	44.45952	-123.27382	76
2336	44.77984	-123.23358	64	2390	44.45323	-123.27420	77
2337	44.77346	-123.23371	63	2391	44.44689	-123.27481	77
2338	44.76716	-123.22941	72	2392	44.44048	-123.27549	77
2339	44.76111	-123.23354	85	2393	44.43421	-123.27620	78
2340	44.75417	-123.22862	111	2394	44.42815	-123.27675	77
2341	44.74807	-123.22665	70	2395	44.42147	-123.27742	78
2342	44.74140	-123.22159	64	2396	44.41535	-123.27821	79
2343	44.73507	-123.22162	62	2397	44.40893	-123.27933	79
2344	44.72908	-123.22180	65	2398	44.40254	-123.28081	79
2345	44.72259	-123.22074	66	2399	44.39662	-123.28241	80
2346	44.71629	-123.21993	65	2400	44.39128	-123.28357	81
2347	44.71002	-123.22042	71	2401	44.38414	-123.28571	79
2348	44.70364	-123.22019	68	2402	44.37755	-123.29476	79
2349	44.69730	-123.21905	70	2403	44.37882	-123.30934	90
2350	44.69099	-123.21799	85	2404	44.37344	-123.31403	81
2352	44.68467	-123.21717	101	2405	44.36775	-123.28909	82
2353	44.67861	-123.21441	80	2406	44.36072	-123.29671	82
2354	44.67234	-123.21548	94	2407	44.35299	-123.29248	82
2355	44.66554	-123.21924	90	2408	44.34707	-123.29461	83
2356	44.65953	-123.22336	93	2409	44.34039	-123.29584	86
2357	44.65356	-123.22980	102	2410	44.33417	-123.29499	84
2358	44.64723	-123.23226	99	2411	44.32879	-123.29775	90
2359	44.64105	-123.23598	88	2412	44.32168	-123.29778	90
2360	44.63519	-123.23910	78	2413	44.31568	-123.30261	103
2361	44.62871	-123.24012	70	2414	44.30979	-123.30683	103
2362	44.62217	-123.24180	78	2415	44.30243	-123.29432	110
2363	44.61614	-123.24275	71	2416	44.29640	-123.29404	110
2364	44.60963	-123.24418	70	2417	44.28991	-123.29407	108
2365	44.60355	-123.24582	71	2418	44.28349	-123.29401	103
2366	44.59642	-123.24510	66	2419	44.27716	-123.29412	99

Instrument site locations

Location	Lat. (N) deg	Long. (W) deg	Elev. meters	Location	Lat. (N) deg	Long. (W) deg	Elev. meters
2420	44.27093	-123.29403	103	2473	43.94592	-123.38184	254
2421	44.26506	-123.29193	110	2474	43.94006	-123.38933	236
2422	44.25862	-123.29030	102	2475	43.93411	-123.39495	236
2423	44.25196	-123.28896	102	2476	43.92757	-123.38896	249
2424	44.24528	-123.28464	94	2477	43.92133	-123.38963	329
2425	44.23854	-123.28394	95	2478	43.91521	-123.39457	415
2426	44.23239	-123.28390	95	2479	43.90776	-123.37634	526
2427	44.22623	-123.28531	98	2480	43.90169	-123.37573	427
2428	44.22087	-123.28613	105	2481	43.89566	-123.37354	317
2429	44.21353	-123.28509	97	2482	43.88924	-123.37325	319
2430	44.20737	-123.28559	98	2483	43.88312	-123.37617	415
2431	44.20087	-123.28521	99	2484	43.87689	-123.38139	379
2432	44.19464	-123.28513	98	2600	44.98980	-123.21361	59
2433	44.18838	-123.29140	101	2601	44.98416	-123.21604	68
2435	44.17539	-123.28459	105	2602	44.97852	-123.21796	65
2436	44.16926	-123.29460	139	2603	44.97224	-123.22121	60
2437	44.16350	-123.30189	146	2604	44.96622	-123.22520	62
2438	44.15713	-123.30621	125	2605	44.95994	-123.22711	62
2439	44.15134	-123.30994	128	2606	44.95377	-123.22707	60
2440	44.14514	-123.31409	116	2607	44.94725	-123.22704	59
2441	44.13899	-123.31928	134	2608	44.94101	-123.22702	59
2442	44.13299	-123.32094	141	2609	44.93513	-123.22704	61
2443	44.12646	-123.32266	121	2610	44.92888	-123.22704	62
2444	44.12049	-123.32422	118	2611	44.92201	-123.22703	62
2445	44.11455	-123.32566	118	2612	44.91572	-123.22702	65
2446	44.10873	-123.32728	116	2613	44.90950	-123.23042	69
2447	44.10192	-123.32995	116	2614	44.90333	-123.23366	68
2448	44.09563	-123.33414	118	2615	44.89693	-123.23401	66
2449	44.08955	-123.33943	119	2616	44.89087	-123.23503	61
2450	44.08358	-123.34503	119	2617	44.88452	-123.23622	59
2451	44.07743	-123.35044	115	2618	44.87788	-123.23701	60
2452	44.07203	-123.35216	121	2619	44.87172	-123.23737	61
2453	44.06508	-123.35814	117	2620	44.86553	-123.23707	59
2454	44.05851	-123.37179	117	2621	44.85905	-123.23457	61
2455	44.05213	-123.37199	117	2622	44.85339	-123.23683	59
2456	44.04657	-123.38088	174	2623	44.84653	-123.24043	79
2457	44.04075	-123.38964	169	2624	44.84018	-123.23727	59
2458	44.03474	-123.38913	206	2631	44.82667	-123.26913	140
2459	44.03250	-123.39625	296	2632	44.82653	-123.25005	180
2460	44.02748	-123.37759	210	2633	44.82986	-123.26109	189
2461	44.02201	-123.38578	192	2634	44.83806	-123.30229	201
2462	44.01598	-123.39073	158	2635	44.83638	-123.28561	223
2463	44.01006	-123.39013	164	3332	44.83147	-122.61767	0
2464	44.00222	-123.38044	164	3339	44.82888	-122.58700	0
2465	43.99595	-123.36780	157				
2466	43.99011	-123.35782	155				
2467	43.98496	-123.35776	232				
2468	43.97709	-123.37388	344				
2469	43.97016	-123.35904	319				
2470	43.96444	-123.36421	293				
2471	43.95802	-123.36902	277				
2472	43.95241	-123.37526	256				

Appendix BAppendix B - SEG Y Data File Format

The data from this experiment are archived in an extended version of the standard SEG Y seismic data format. Data is organized by shotgathers; one SEG Y file per shotpoint. SEG Y data files are sequentially written to tape with intervening End-Of-File marks.

```

c
c  INCLUDE FILE FOR FORTRAN PROGRAMS TO READ SEG Y DATA FILES
c
c  This file is an implicit definition of SEG Y format with additions
c  for refraction work. It is the SEG Y standard of Barry et al
c  Geophysics (1975) with extensions labelled LDS USE and USGS use
c  for refraction work. When used as an include file for a FORTRAN
c  program, all variables will be set after reading arrays SEG Y1A,
c  SEG Y1B, and SEG YDB.
c
c  Character code is EBCDIC unless IEEE data format (see variable icode)
c  If IEEE, then the character code is ASCII.
c
c  Written by Carl Spencer and Isa Asudeh  4/2/86 original specification
c  This version is compatible with the final Lithoprobe version dated 5/12/87.
c
c
c  Maximum number of bytes allowed in a trace (system dependent)
c  MAXLEN = ((max trace length) * (sample rate) * (bytes per sample)) + 240
c
c      parameter (MAXLEN=16620)
c
c
c  SEG Y REEL IDENTIFICATION HEADER PART 1
c      byte segy1a(3200)
c  SEG Y REEL IDENTIFICATION HEADER PART 2
c      byte segy1b(400)
c  SEG Y TRACE DATA BLOCK
c      byte segydb(MAXLEN)
c      common/segycom/iioopen,segy1a,segy1b,segydb
c
c  EBCDIC CARDS
c      character*80  cards(40)
c      equivalence  (segy1a(1),cards(1))
c
c  TRACE IDENTIFICATION HEADER
c      byte thead(240)
c      equivalence  (segydb(1),thead(1))
c
c  DATA WORDS
c      integer*2      iidata((MAXLEN-240)/2)
c      integer*4      jdata((MAXLEN-240)/4)
c      real*4         rdata((MAXLEN-240)/4)
c      equivalence  (segydb(241),iidata(1),jdata(1),rdata(1))
c

```


Appendix B

```

c
c-----
c Binary area of file (or reel) Identification Header starts here
c-----
c
c
c
c Job Identification number                      SEGY STANDARD
      integer*4  jobid
      equivalence (segylb(1),jobid)
c
c Line number                                    SEGY STANDARD
      integer*4  lineno
      equivalence (segylb(5),lineno)
c
c Reel number                                    SEGY STANDARD
      integer*4  reelno
      equivalence (segylb(9),reelno)
c
c Number of data traces per record               SEGY STANDARD
      integer*2  ntrace
      equivalence (segylb(13),ntrace)
c
c Number of auxiliary traces per record          SEGY STANDARD
      integer*2  nauxt
      equivalence (segylb(15),nauxt)
c
c Sample interval in microseconds - this data   SEGY STANDARD
      integer*2  sint
      equivalence (segylb(17),sint)
c
c Sample interval in microseconds (in field)    SEGY STANDARD
      integer*2  sint2
      equivalence (segylb(19),sint2)
c
c No of samples per trace - this data            SEGY STANDARD
      integer*2  nsam
      equivalence (segylb(21),nsam)
c
c No of samples per trace (in field)            SEGY STANDARD
      integer*2  nsam2
      equivalence (segylb(23),nsam2)
c

```

Appendix B

c Data sample format code	SEGY STANDARD
c icode=0001 (1) IBM FLOATING POINT	SEGY STANDARD
c icode=0002 (2) FIXED POINT (4 bytes)	SEGY STANDARD
c icode=0003 (3) FIXED POINT (2 bytes)	SEGY STANDARD
c icode=0004 (4) FIXED POINT WITH GAIN	SEGY STANDARD
c icode=0100 (256) FLOATING POINT - IEEE	VERITAS STANDARD
c icode=0200 (512) FIXED POINT (4 bytes) - IEEE	
c icode=0300 (768) FIXED POINT (2 bytes) - IEEE	
c icode=0500 (1280) LUNCHBOX FORMAT	LDS USE
c icode=0600 (1536) VAX R*4 FORMAT	LDS USE
integer*2 icode	
equivalence (segylb(25),icode)	
c	
c Number of traces in CDP ensemble	SEGY STANDARD
integer*2 ncdp	
equivalence (segylb(27),ncdp)	
c	
c Trace sorting code	SEGY STANDARD
c itsort=1 as recorded	SEGY STANDARD
c itsort=2 CDP ensemble	SEGY STANDARD
c itsort=3 Single fold continuous	SEGY STANDARD
c itsort=4 Horizontal stack	SEGY STANDARD
c No LDS or USGS use.	
integer*2 itsort	
equivalence (segylb(29),itsort)	
c	
c Vertical sum code	SEGY STANDARD
c vcode=n sum on n traces	
integer*2 vcode	
equivalence (segylb(31),vcode)	
c	
c Start sweep frequency (hz)	SEGY STANDARD
integer*2 ssweep	
equivalence (segylb(33),ssweep)	
c	
c End sweep frequency (hz)	SEGY STANDARD
integer*2 esweep	
equivalence (segylb(35),esweep)	
c	
c Sweep length in milliseconds	SEGY STANDARD
integer*2 sleng	
equivalence (segylb(37),sleng)	
c	
c Sweep type	SEGY STANDARD
c stype=1 Linear	SEGY STANDARD
c stype=2 Parabolic	SEGY STANDARD
c stype=3 Exponential	SEGY STANDARD
c stype=4 Other	SEGY STANDARD
c stype=5 Borehole source	LDS USE
c stype=6 Water explosive source	LDS USE
c stype=7 Airgun source	LDS USE
integer*2 stype	
equivalence (segylb(39),stype)	

c		
c	Trace number of sweep channel	SEGY STANDARD
	integer*2 nts	
	equivalence (segylb(41),nts)	
c		
c	Sweep trace taper in milliseconds at start	SEGY STANDARD
	integer*2 stts	
	equivalence (segylb(43),stts)	
c		
c	Sweep trace taper in milliseconds at end	SEGY STANDARD
	integer*2 stte	
	equivalence (segylb(45),stte)	
c		
c	Taper type	SEGY STANDARD
c	ttype=1 Linear	SEGY STANDARD
c	ttype=2 cos**2	SEGY STANDARD
c	ttype=3 Other	SEGY STANDARD
	integer*2 ttype	
	equivalence (segylb(47),ttype)	
c		
c	Correlated data traces	SEGY STANDARD
c	cort=1 no 2 yes	
	integer*2 cort	
	equivalence (segylb(49),cort)	
c		
c	Binary gain recovered	SEGY STANDARD
c	bgr=1 Yes. For USGS data, the data has also been demeaned.	
c	bgr=2 No	
	integer*2 bgr	
	equivalence (segylb(51),bgr)	
c		
c	Amplitude recovery methods	SEGY STANDARD
c	arm=1 none 2 spherical 3 AGC 4 other	
	integer*2 arm	
	equivalence (segylb(53),arm)	
c		
c	Measurement system	SEGY STANDARD
c	isys=1 meters 2 feet	
	integer*2 isys	
	equivalence (segylb(55),isys)	
c		
c	Polarity	SEGY STANDARD
c	ipol=1 Upward movement gives neg. number	SEGY STANDARD
c	ipol=2 Upward movement gives pos. number	SEGY STANDARD
	integer*2 ipol	
	equivalence (segylb(57),ipol)	
c		
c	Vibrator polarity code	SEGY STANDARD
	integer*2 vpc	
	equivalence (segylb(59),vpc)	
c		

Appendix B

c	Number of traces in the file	LDS USE
c	Used for disk files.	
	integer*2 notif	
	equivalence (segylb(61),notif)	
c		
c	Attribute information	LDS USE
c	attri=0 velocity/displacement data	
c	attri=1 instantaneous amplitude	
c	attri=2 instantaneous frequency	
c	attri=3 instantaneous phase	
c	attri=4 slowness (m/ms)	
c	attri=5 semblance (0-1000)	
	integer*2 attri	
	equivalence (segylb(63),attri)	
c		
c	Mean amplitude of all samples	LDS USE
c	in all traces in file Used for disk files.	
	real*4 meanas	
	equivalence (segylb(65),meanas)	
c		
c	Domain of data	LDS USE
c	domain=0 Time - distance domain	
c	domain=1 Frequency - wavenumber domain	
c	domain=2 Intercept time - slowness domain	
	integer*2 domain	
	equivalence (segylb(69),domain)	
c		
c	Bytes 71, 72 unused to align four byte boundaries.	
c		
c	Reduction velocity meters/sec if data is reduced	LDS USE
	integer*4 vred	
	equivalence (segylb(73),vred)	
c		
c	Minimum of all samples in file.	LDS USE
	real*4 minass	
	equivalence (segylb(77),minass)	
c		
c	Maximum of all samples in file.	LDS USE
	real*4 maxass	
	equivalence (segylb(81),maxass)	
c		
c	Recording instrument type	USGS USE
c	iinstr=1 EDA lunchbox recorder	
c	iinstr=2 USGS seismic cassette recorder	
c	iinstr=3 GEOS	
c	iinstr=99 Mixed	
	integer*2 iinstr	
	equivalence (segylb(85),iinstr)	
c		
c	File creation date - Last two digits of year	USGS USE
	integer*2 cryear	
	equivalence (segylb(87),cryear)	
c		

Appendix B

c File creation date - Month of year USGS USE
integer*2 crmnth
equivalence (segylb(89),crmnth)

c

c File creation date - Day of month USGS USE
integer*2 crday
equivalence (segylb(91),crday)

c

c Bytes 93-398 of the binary File Identification Header are not used

c

c Format version number (x100)

c Version 0.99 "Discussion version", October 1986.

c Version 1.00 "Final version", December 5, 1987
integer*2 fvn
equivalence (segylb(399),fvn)

c

Appendix B

```

c -----
c Trace Identification Header (total of 240 bytes) starts here
c -----
c
c Trace sequence number within line                      SEGY STANDARD
  integer*4  tsnl
  equivalence (thead(1),tsnl)
c
c Trace sequence number within file                      SEGY STANDARD
  integer*4  tsnt
  equivalence (thead(5),tsnt)
c
c Original field record number                          SEGY STANDARD
c For LDS use this will be sequential shot number      LDS USE
  integer*4  ofrn
  equivalence (thead(9),ofrn)
c
c Trace number within original field record             SEGY STANDARD
  integer*4  tnofr
  equivalence (thead(13),tnofr)
c
c Energy source point number                            SEGY STANDARD
  integer*4  espn
  equivalence (thead(17),espn)
c
c CDP number                                             SEGY STANDARD
  integer*4  cdp
  equivalence (thead(21),cdp)
c
c Trace number within CDP                              SEGY STANDARD
  integer*4  tncdp
  equivalence (thead(25),tncdp)
c
c Trace identification code                             SEGY STANDARD
c 1 = Seismic data,      2 = Dead,      3 = Dummy      SEGY STANDARD
c 4 = Time break,       5 = Uphole,     6 = Sweep      SEGY STANDARD
c 7 = Timing,           8 = Water break  SEGY STANDARD
c 9 = Deleted trace                                USGS USE
c 10 = Long Period data (see thead(117),isi)          USGS USE
  integer*2  tic
  equivalence (thead(29),tic)
c
c Number of vertically summed traces
c   yielding this trace                                SEGY STANDARD
  integer*2  nvs
  equivalence (thead(31),nvs)
c
c Number of horizontally stacked traces
c   yielding this trace                                SEGY STANDARD
  integer*2  nhs
  equivalence (thead(33),nhs)
c

```


Appendix B

c Data use (1=production 2=test) integer*2 duse equivalence (thead(35),duse)	SEGY STANDARD
c	
c Distance from source to receiver integer*4 idist equivalence (thead(37),idist)	SEGY STANDARD
c	
c Receiver group elevation integer*4 irel equivalence (thead(41),irel)	SEGY STANDARD
c	
c Surface elevation of source integer*4 ishe equivalence (thead(45),ishe)	SEGY STANDARD
c	
c Shot depth integer*4 ishd equivalence (thead(49),ishd)	SEGY STANDARD
c	
c Datum elevation at receiver integer*4 delr equivalence (thead(53),delr)	SEGY STANDARD
c	
c Datum elevation at source integer*4 dels equivalence (thead(57),dels)	SEGY STANDARD
c	
c Water depth at source integer*4 wds equivalence (thead(61),wds)	SEGY STANDARD
c	
c Water depth at receiver integer*4 wdr equivalence (thead(65),wdr)	SEGY STANDARD
c	
c Scalar multiplier/divisor for bytes 41-68 integer*2 smul1 equivalence (thead(69),smul1)	SEGY STANDARD
c	
c Scalar multiplier/divisor for bytes 73-88 integer*2 smul2 equivalence (thead(71),smul2)	SEGY STANDARD
c	
c Source coordinate X or longitude (East positive) integer*4 ishlo equivalence (thead(73),ishlo)	SEGY STANDARD
c	
c Source coordinate Y or latitude (North positive) integer*4 ishla equivalence (thead(77),ishla)	SEGY STANDARD
c	

Appendix B

c	Group coordinate X or longitude (East positive)	SEGY STANDARD
	integer*4 irlo	
	equivalence (thead(81),irlo)	
c		
c	Group coordinate Y or latitude (North positive)	SEGY STANDARD
	integer*4 irla	
	equivalence (thead(85),irla)	
c		
c	Coordinate units	SEGY STANDARD
c	1: meters/feet	
c	2: seconds of arc (smul2 holds multiplier)	
c	N: mod 100 = TX zone	
c	div 100 = RX zone	
	integer*2 cunits	
	equivalence (thead(89),cunits)	
c		
c	Weathering velocity (m/s?)	SEGY STANDARD
	integer*2 wvel	
	equivalence (thead(91),wvel)	
c		
c	Subweathering velocity (m/s?)	SEGY STANDARD
	integer*2 swvel	
	equivalence (thead(93),swvel)	
c		
c	Uphole time at source	SEGY STANDARD
	integer*2 utimes	
	equivalence (thead(95),utimes)	
c		
c	Uphole time at group	SEGY STANDARD
	integer*2 utimeg	
	equivalence (thead(97),utimeg)	
c		
c	Source static correction (ms?)	SEGY STANDARD
	integer*2 sstati	
	equivalence (thead(99),sstati)	
c		
c	Group static	SEGY STANDARD
	integer*2 gstati	
	equivalence (thead(101),gstati)	
c		
c	Total static	SEGY STANDARD
	integer*2 tstati	
	equivalence (thead(103),tstati)	
c		
c	Lag time A	SEGY STANDARD
	integer*2 istance	
	equivalence (thead(105),istance)	
c		
c	Lag time B	SEGY STANDARD
	integer*2 ibtime	
	equivalence (thead(107),ibtime)	
c		

Appendix B

c Delay recording time (reduced start time) (msec)	SEGY STANDARD
integer*2 ictime	
equivalence (thead(109),ictime)	
c	
c Mute start time	SEGY STANDARD
integer*2 mtimes	
equivalence (thead(111),mtimes)	
c	
c Mute end time	SEGY STANDARD
integer*2 mtimee	
equivalence (thead(113),mtimee)	
c	
c No of samples in this trace	SEGY STANDARD
integer*2 length	
equivalence (thead(115),length)	
c	
c Sampling interval in microseconds	SEGY STANDARD
c If (thead(29),itic) = 10, in milliseconds	USGS STANDARD
integer*2 isi	
equivalence (thead(117),isi)	
c	
c Gain type (1=fixed 2=binary 3=floating)	SEGY STANDARD
integer*2 gaint	
equivalence (thead(119),gaint)	
c	
c Gain constant	SEGY STANDARD
integer*2 gc	
equivalence (thead(121),gc)	
c	
c Instrument or initial gain in DB	SEGY STANDARD
integer*2 gidb	
equivalence (thead(123),gidb)	
c	
c Correlated 1=no 2=yes	SEGY STANDARD
integer*2 tcorr	
equivalence (thead(125),tcorr)	
c	
c Start sweep frequency (hz)	SEGY STANDARD
integer*2 tsswee	
equivalence (thead(127),tsswee)	
c	
c End sweep frequency (hz)	SEGY STANDARD
integer*2 teswee	
equivalence (thead(129),teswee)	
c	
c Sweep length in milliseconds	SEGY STANDARD
integer*2 tsleng	
equivalence (thead(131),tsleng)	
c	

Appendix B

c Sweep type	SEGY STANDARD
c stype=1 Linear	SEGY STANDARD
c stype=2 Parabolic	SEGY STANDARD
c stype=3 Exponential	SEGY STANDARD
c stype=4 Other	SEGY STANDARD
c stype=5 Borehole source	LDS USE
c stype=6 Water explosive source	LDS USE
c stype=7 Airgun source	LDS USE
integer*2 tstype	
equivalence (thead(133),tstype)	
c	
c Sweep trace taper in milliseconds at start	SEGY STANDARD
integer*2 tstts	
equivalence (thead(135),tstts)	
c	
c Sweep trace taper in milliseconds at end	SEGY STANDARD
integer*2 tstte	
equivalence (thead(137),tstte)	
c	
c Taper type	SEGY STANDARD
c ttype=1 Linear	SEGY STANDARD
c ttype=2 Cos**2	SEGY STANDARD
c ttype=3 Other	SEGY STANDARD
integer*2 tttype	
equivalence (thead(139),tttype)	
c	
c Antialias filter frequency	SEGY STANDARD
integer*2 aif	
equivalence (thead(141),aif)	
c	
c Alias filter slope	SEGY STANDARD
integer*2 ais	
equivalence (thead(143),ais)	
c	
c Notch filter frequency	SEGY STANDARD
integer*2 nif	
equivalence (thead(145),nif)	
c	
c Notch filter slope	SEGY STANDARD
integer*2 nis	
equivalence (thead(147),nis)	
c	
c Low cut frequency	SEGY STANDARD
integer*2 flc	
equivalence (thead(149),flc)	
c	
c High cut frequency	SEGY STANDARD
integer*2 fhc	
equivalence (thead(151),fhc)	
c	
c Low cut slope	SEGY STANDARD
integer*2 slc	
equivalence (thead(153),slc)	

Appendix B

c		
c	High cut slope	SEGY STANDARD
	integer*2 shc	
	equivalence (thead(155),shc)	
c		
c	Year of start of trace	SEGY STANDARD
	integer*2 tyear	
	equivalence (thead(157),tyear)	
c		
c	Day of start of trace	SEGY STANDARD
	integer*2 tday	
	equivalence (thead(159),tday)	
c		
c	Hour of start of trace	SEGY STANDARD
	integer*2 thour	
	equivalence (thead(161),thour)	
c		
c	Minute of start of trace	SEGY STANDARD
	integer*2 tmin	
	equivalence (thead(163),tmin)	
c		
c	Second of start of trace	SEGY STANDARD
	integer*2 tsec	
	equivalence (thead(165),tsec)	
c		
c	Time basis code 1=local 2=GMT	SEGY STANDARD
	integer*2 tbcode	
	equivalence (thead(167),tbcode)	
c		
c	Trace weighting factor	SEGY STANDARD
	integer*2 twf	
	equivalence (thead(169),twf)	
c		
c	Geophone group no. on roll switch first position	SEGY STANDARD
	integer*2 ggrp1	
	equivalence (thead(171),ggrp1)	
c		
c	Geophone group no. trace position 1	SEGY STANDARD
c	on field record	
	integer*2 ggtp	
	equivalence (thead(173),ggtp)	
c		
c	Time code translator error light	USGS USE
c	1=No error 2=Error	
	integer*2 errlt	
	equivalence (thead(175),errlt)	
c		
c	Distance-azimuth calculation algorithm	USGS USE
c	1 = Sodano algorithm. The program utilizes the Sodano and Robinson	
c	(1963) direct solution of geodesics (Army Map Service, Tech Rep	
c	#7, Section IV).	
	integer*2 daca	
	equivalence (thead(177),daca)	

Appendix B

c			
c	Earth dimension code	USGS USE	
c	1 = Fischer spheroid (1960),		
c	OMEGA & NASA datums	6378166.	298.30
c	2 = Clark ellipsoid (1866),		
c	N. American datum 1927	6378206.4	294.98
c	3 = Ref ellipsoid (1967), S. American datum	6378160	298.25
c	4 = Hayford International Ellipsoid (1910)	6378388.	297.00
c	5 = World Geodetic Survey Ellipsoid (1972)	6378135.	298.26
c	6 = Bessel (1841), Tokyo datum	6377397.	299.15
c	7 = Everest (1830), India datum	6377276.	300.80
c	8 = Airy (1936),		
c	Ordnance survey of Great Britain	6377563.	299.32
c	9 = Hough (1960), Wake-Eniwetok	6378270.	297.00
c	10 = Fischer (1968), Modified Mercury	6378150.	298.30
c	11 = Clarke (1880)	6378249.	293.47
	integer*2 edc		
	equivalence (thead(179),edc)		
c			
c	Microseconds of trace start time	LDS USE	
	integer*4 mst		
	equivalence (thead(181),mst)		
c			
c	Millisecond of timing correction	LDS USE	
	integer*2 cor		
	equivalence (thead(185),cor)		
c			
c	Charge size in kg	LDS USE	
	integer*2 charge		
	equivalence (thead(187),charge)		
c			
c	Shot time - Year	LDS USE	
	integer*2 syear		
	equivalence (thead(189),syear)		
c			
c	Shot time - Day	LDS USE	
	integer*2 sday		
	equivalence (thead(191),sday)		
c			
c	Shot time - Hour	LDS USE	
	integer*2 shour		
	equivalence (thead(193),shour)		
c			
c	Shot time - Minute	LDS USE	
	integer*2 shmin		
	equivalence (thead(195),shmin)		
c			
c	Shot time - Second	LDS USE	
	integer*2 sseco		
	equivalence (thead(197),sseco)		
c			

Appendix B

c Shot time - Microsecond	LDS USE
integer*4 ssmic	
equivalence (thead(199),ssmic)	
c	
c Azimuth of receiver from shot (minutes of arc)	LDS USE
integer*2 azimuth	
equivalence (thead(203),azimut)	
c	
c Azimuth of geophone orientation axis with	
c respect to true north in minutes of arc	LDS USE
integer*2 geoazi	
equivalence (thead(205),geoazi)	
c	
c Angle between geophone orientation axis and	
c vertical in minutes of arc	LDS USE
integer*2 geover	
equivalence (thead(207),geover)	
c	
c Time to be added to recorded trace time to get	
c actual trace start time. To be used when data	
c has been reduced but start time is not updated	
c so that the actual time can be recovered even if	
c distance and shot time have changed	
c (microseconds)	LDS USE
integer*4 ttrace	
equivalence (thead(209),ttrace)	
c	
c Recording instrument number	LDS USE
character*4 scrs	
equivalence (thead(213),scrs)	
c	
c Deployment name	LDS USE
character*4 deploy	
equivalence (thead(217),deploy)	
c	
c Shotpoint name (shotpoint number)	LDS USE
character*4 spname	
equivalence (thead(221),spname)	
c	
c Receiver site name (station number)	LDS USE
character*4 rstnam	
equivalence (thead(225),rstnam)	
c	
c Shot name (shot number)	LDS USE
character*4 shotid	
equivalence (thead(229),shotid)	
c	

Appendix B

c	Line name	LDS USE
	character*4 lineid	
	equivalence (thead(233),lineid)	
c		
c	Geophone orientation eg R40,Z	LDS USE
	character*4 geoor	
	equivalence (thead(237),geoor)	
c		
c	End of Trace Identification Header	

