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Data Report for the 1993 Seismic Refraction Experiment in the San Francisco Bay Area, California

By

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Introduction

The San Andreas fault trends along the western San Francisco and Marin Peninsulas, which represent the western-most extension of the North American plate at the latitude of San Francisco. The San Francisco Bay Area is one of the most seismically active metropolitan areas in the U. S. and contains one of the most densely occupied seismic networks in the world. However, although a major earthquake hazard exists in the Bay Area, little is known of its crustal velocity structure. Knowledge of the crustal velocity structure is important in accurately locating regional earthquakes and may be a key in understanding the tectonic processes which produce the seismicity.

In recent years, seismic refraction surveys have been conducted to the south and east of the San Francisco Bay Area (Mooney and Colburn, 1985; Mooney and Luetgert, 1982; Blümling et al., 1985; Walter and Mooney, 1982), but such seismic surveys have not been conducted in the immediate Bay Area. As a result, much of what is known of the velocity structure has been derived from earthquake measurements (e.g. Michael and Eberhart-Phillips, 1991; Oppenheimer and Eaton, 1984). However, these measurements do not provide the desired resolution and information on the intermediate to deep velocity structure. It is important to determine the deep velocity structure because of its possible contribution to strong ground motion (Catchings and Kohler, in preparation). Mooney and Colburn (1985) analyzed data from a 40-km-long refraction line extending from the Pacific Ocean near Watsonville, northeast across the San Andreas, Sargent, and Calaveras Faults. Mooney and Luetgert (1982) analyzed data from two refraction lines in the Santa Clara Valley. In 1991, the USGS collected seismic refraction data along a 180-km-long line which parallels the San Andreas Fault as it passes through the San Francisco Area (figure 1) (Murphy and others, 1992). Brocher and others (1992) and Page and Brocher (1992) interpreted data from a marine, airgun source offshore from Aptos recorded on land, resulting in two long unreversed profiles which cross our Peninsula Line. The 1991 Bay Area Seismic Imaging Experiment (BASIX) provides marine reflection data for San Francisco Bay and the Sacramento/San Joaquin River Delta areas (McCarthy and Hart, 1993). Brocher and Moses (1993) present recordings of the BASIX airgun sources by USGS five-day recorders. In a companion paper, Brocher and Pope (1994) present recordings of the BASIX sources by the Northern California Seismic Network (CALNET). In this report, we present data from a USGS seismic refraction experiment conducted in 1993, which continues the work begun in the 1991 USGS experiment.

Experimental Design

This experiment is a continuation of an experiment conducted in May, 1991 (Murphy and others, 1992). A total of 17 shots[1] was fired into three seismic lines (table 1; figure 2). The instrument spacing for each line was approximately 1.5 kilometers. The first line, referred to here as the Peninsula Line, extends about 200 km from the small village of Tres Pinos, along the San Francisco and Marin Peninsulas to the town of Inverness. The northern 180 km of this line coincides with a line shot in the 1991 experiment. The second line, referred to here as the East Bay Line, extends about 220 km from Tres Pinos, along the East Bay hills, and across San Pablo Bay, ending at Annadel State Park. The southern end of the East Bay Line is coincident with an earlier study by Blümling and others (1985). The third line,

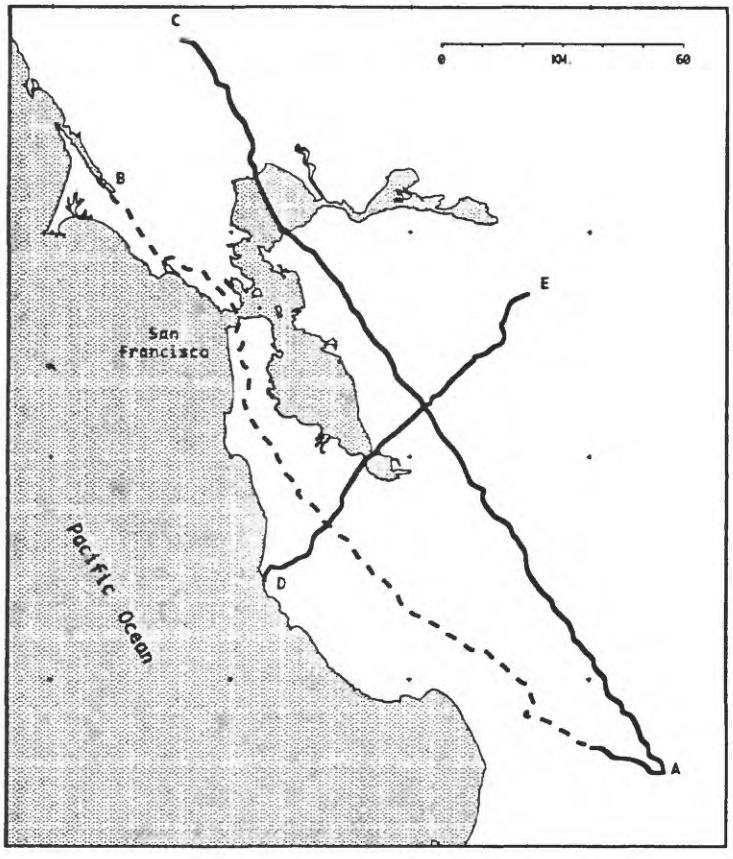

Figure 1. Map of the San Francisco Bay Area showing seismic lines from the 1991 experiment (Murphy and others, 1992) and the 1993 experiment (this report). Dashed line was shot in the 1991 experiment and reshot in 1993. The heavy solid lines are new lines, shot in 1993.

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[1] In this report, the term "shotpoint" refers to a site where one or more explosive charges were detonated. The term "shot" refers to an explosion at a shotpoint.

Table 1. Shotpoint Coordinates

Shot Point	Latitude[2] (deg,min)	Longitude (deg,min)	Elevation (m)	Nearby Landmark
1	38 25.404	122 37.747	280	Annadel State Park / Santa Rosa
2	37 51.892	122 11.295	244	Orinda / Gudde Ridge
3	37 36.460	121 57.899	411	Niles Canyon
4	37 12.296	121 38.678	201	O'Connell Ranch / Anderson Res
5	36 47.561	121 17.626	299	Tobias Ranch / Tres Pinos
6	37 32.412	122 24.361	340	Crystal Springs Reservoir
7	37 20.138	122 13.928	536	Langley Hill Quarry
8	38 10.065	122 27.100	2	Sears Point
9	38 00.225	122 21.868	21	Pinole Point
10	37 46.793	122 06.972	198	Upper San Leandro Reservoir
12	37 29.044	121 51.178	622	Weller Road / Monument Peak
13	37 18.980	121 42.135	463	Grant Ranch County Park
14	37 05.855	121 32.714	253	Coyote Reservoir
15	36 58.031	121 27.150	44	Soda Lake
17	37 32.098	122 04.387	21	Dumbarton Quarry
18	37 43.782	121 47.281	235	Marciel Ranch / Livermore

referred to here as the Cross Line, extends about 100 km from the Pacific coast, through the cities of Palo Alto, Fremont, and Pleasanton, to the town of Byron. Portable instruments were deployed twice. In the first deployment, the Peninsula and Cross Lines were occupied, and five shots, at shotpoints 5, 6, 7, 17, and 18, were fired (table 2). In the second deployment, the East Bay and Cross Lines were occupied, and twelve shots, at shotpoints 1, 2, 3, 4, 5, 8, 9, 10, 12, 13, 14, and 15 were fired (table 2).

Three types of seismic recorders were used in the experiment. SGR III portable seismographs equipped with eight-hertz vertical geophone strings were used for land recording. These instruments were built by Globe Universal Systems of Houston, Texas and modified by the U.S. Geological Survey. A set of PASCAL Refteks equipped with four-hertz, three component geophones provided additional vertical-component data, as well as two horizontal components. The horizontal Reftek geophones were aligned in geographic north-south and east-west directions. Four

[2] Coordinates are for the North American Datum of 1927

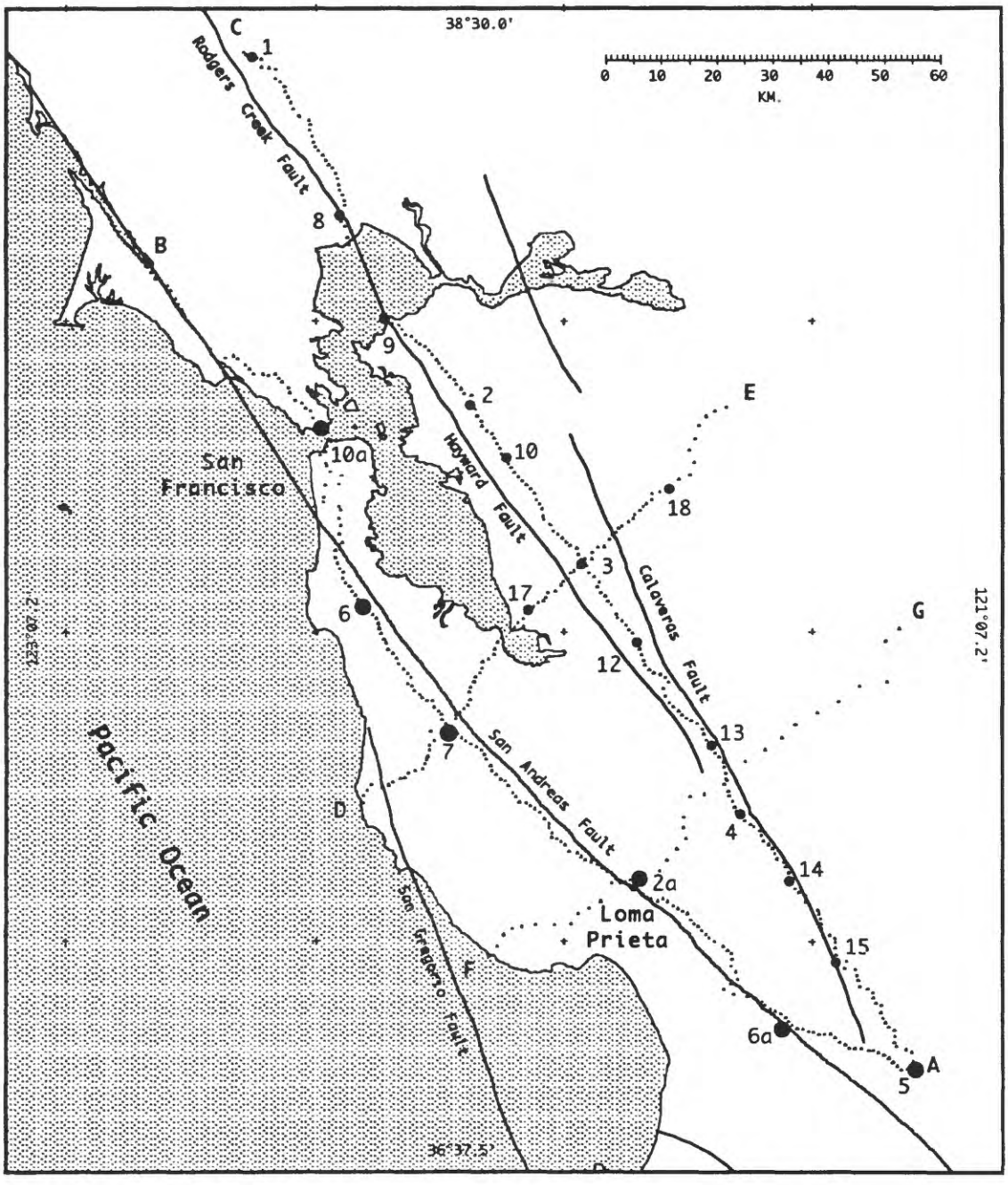

Figure 2. Map of the San Francisco Bay Area showing shotpoint and station locations. Portable receiver sites are shown as small dots. Seismic line AB is referred to as the Peninsula Line in this report; line AC is the East Bay Line; line DE is the Cross Line. Line FG was occupied by USGS Seismic Cassette Recorders. Shotpoints are represented by numbered solid circles. Shotpoints 2a, 6a, and 10a were fired into the Peninsula Line as part of a 1991 refraction experiment (Murphy and others, 1992). Heavy lines are prominent fault traces.

ocean-bottom seismographs from the Woods Hole Oceanographic Institution provided recordings from the bottom of San Pablo Bay. Within each of the deployment lines, SGRs and Refteks were deployed at alternating stations (appendix A, B). This allowed us to obtain three component data for the entire study area, at a wider station spacing than for the vertical components.

Table 2. List of Shots Fired

Deployment	Shot Number	Shot Point	Local Time	UCT Time (day,hr,min)	Charge Size (lbs)	Shot Efficiency
1	1	5	1:00am	146 08:00	3000	Good
1	2	7	1:02am	146 08:02	2000	Good
1	3	17	1:04am	146 08:04	200	Poor
1	4	18	1:06am	146 08:06	2000	Poor
1	5	6	1:08am	146 08:08	2000	Good
2	6	4	12:00am	148 07:00	2000	Poor
2	7	15	12:02am	148 07:02	200	Fair
2	8	3	12:04am	148 07:04	2000	Good
2	9	8	12:08am	148 07:08	200	Good
2	10	5	12:10am	148 07:10	4000	Poor
2	11	1	12:12am	148 07:12	4000	Good
2	12	2	1:00am	148 08:00	600	Good
2	13	13	2:00am	148 09:00	200	Poor
2	14	14	2:02am	148 09:02	200	Fair
2	15	12	2:04am	148 09:04	200	Poor
2	16	10	2:06am	148 09:06	300	Good
2	17	9	2:08am	148 09:08	300	Good

Data Reduction and Quality Control

Data from the SGRs were recorded on cartridge tapes. At the end of each deployment, a Dell PC computer was used to read the cartridge tapes, and convert the data to SEGY format. The SEGY data were then written to nine-track tape reels. The original field data were recorded at a sampling interval of 2 milliseconds, but the data were decimated to an 8 milliseconds sampling interval before the SEGY tapes were written.

Data from each Reftek were recorded on a hard disk contained within the seismograph. After each deployment, the data from each instrument were uploaded to a SUN workstation. Computer programs on the SUN workstation were used to reformat the data to SEGY format. The data were then written to nine-track SEGY tape reels.

Data from the ocean bottom seismometers, stored on exabyte tapes, were received from Woods Hole Oceanographic Institute.

Data from each of the three types of instruments were read on the VAX/VMS 4000/100 computer "SAMOA" at the U.S.G.S. in Menlo Park. Using software written in-house, the data were "windowed", so that each trace has a 32 second record length. Latitude and longitude coordinates were compiled and written to the trace headers, as well as shotpoint-to-station distances and azimuths. Finally, using the VAX computer, we wrote a SEGY tape containing data from all three types of instruments.

During the experiment, several mistakes were made which had adverse effects on the data quality and quantity. Due to an instrument programming error, no SGR data were recorded for deployment 1, stations 4068 - 4098. Also, we did not obtain any data recordings from the Reftek instruments for deployment 2, shot 10, shotpoint 5. However, this shot was extremely weak, and we do not think that any useful data was lost.

Inspection of the record sections (appendix D) reveals that several of the shots were extremely weak, including all the shots on the southeast end of the East Bay line (table 2, shotpoints 4, 5, 12, 13, 14, and 15). In addition, shotpoints 17 and 18 on the Cross Line were weak. We speculate that one or more of the following effects may have been responsible for the weak recordings:

1. The explosives may have been of poor quality. The explosives were received in several shipments, and one of the shipments may have contained faulty explosives.

2. The shot holes may have been too shallow, and/or the shots were poorly coupled to bedrock.

3. Some of the explosives may have washed from the hole due to movement of ground water.

4. The explosives may not have completely detonated.

The rest of the shots were stronger, and were well recorded to distances of 50 kilometers or more.

Shot number 12, shotpoint 2, was fired into a delayed SGR recording window. As a result, first arrivals from this shot were not recorded at about 25 stations (see figure D14).

Some of the Reftek instruments had built-in GPS clocks, which provided an accurate time standard. Other Reftek instruments kept time using an internal clock which was checked at the beginning and end of the experiment. Some of the Reftek internal clocks were inaccurate, resulting in timing errors of up to one second. For example, see figure D18, station 5145. This station was occupied by a Reftek with a faulty clock. Timing for Refteks with GPS clocks and timing for all SGR clocks is accurate to about 0.02 second.

Some station coordinates were obtained using a GPS satellite receiver, and others were obtained by locating the stations on U.S.G.S. topographic maps. We estimate that all station coordinates are accurate to about 30 meters.

SEGY Data Tapes

Data for this experiment are stored on one digital tape written in SEGY format (Barry and others, 1975). The format of the header blocks follows the SEGY standard as closely as possible, but in some cases, the header values are not entered. In other cases, the header fields contain data, but the definitions of these header fields differ somewhat from the SEGY standard. The definitions of the binary reel header fields for this data tape are listed in table 3, and the definitions of the trace header fields are listed in table 4. If a header field is not mentioned in tables 3 or 4, the field is unused.

Table 3. SEGY Tape Reel Binary Header Fields

Byte Numbers	Field Name	Value (this data set)	Description
1 - 4	jobid	1	Job identification number
5 - 8	lineno	1	Line number
17 - 18	sint	8000	Sampling interval in microseconds - this data
21 - 22	nsam	4001	Number of samples per trace - this data
25 - 26	icode	1	Data sample format code: IBM Floating point
55 - 56	isys	1	Measurement system: 1 = Meters
73 - 76	vred	6000	Reduction velocity (meter per second)

The data samples are encoded in IBM floating point format, with four bytes per sample. Each trace contains 4001 samples, and the record length of each data trace is 16244 bytes. The sampling interval is eight milliseconds, so each trace contains 32 seconds of data. The start time, T_{start}, in seconds, of each trace varies according to the formula:

$$T_{start} = (ictime / 1000) + (idist / vred)$$

where ictime is the reduced start time in milliseconds (table 3, bytes 109-110).
idist is the distance from source to receiver in meters (table 3, bytes 37-40).
vred is the reduction velocity in meters per second (table 2, bytes 73-76).

For this data set, ictime is always -8000 milliseconds, and vred is 6000 meters per second. No digital filtering has been applied to the data.

Each combination of shot, instrument type, and component has its own unique "file number", and a complete list of file numbers is shown in appendix C. In table 4, the file number is labeled "ofrn", and is stored in bytes 9 - 12 of the trace headers.

Table 4. SEGY Tape Trace Header Fields

Byte Numbers	Field Name	Description
1 - 4	tsnl	Trace sequence number within line.
5 - 8	tsnt	Trace sequence number within reel.
9 - 12	ofrn	Original field record number (sequential shot number)
13 - 16	tnofr	Trace number (station location number)
17 - 20	espn	Energy source point number (shotpoint number)
29 - 30	tic	Trace identification code (always 1 = Seismic data)
37 - 40	idist	Distance from source to receiver (meters)
41 - 44	irel	Receiver group elevation
45 - 48	ishe	Surface elevation of source
53 - 56	delr	Datum elevation at receiver
57 - 60	dels	Datum elevation at source
69 - 70	smul1	Scalar multiplier/divisor for bytes 41-68
71 - 72	smul2	Scalar multiplier/divisor for bytes 73-88
73 - 76	ishlo	Source longitude (East positive)
77 - 80	ishla	Source latitude (North positive)
81 - 84	irlo	Receiver longitude (East positive)
85 - 88	irla	Receiver latitude (North positive)
89 - 90	cunits	Coordinate units for bytes 73-88 (always 2=seconds of arc)
103 - 104	tstati	Total static
109 - 110	ictime	Reduced start time (milliseconds) (always -8000)
115 - 116	length	No of samples in this trace (always 4001)
117 - 118	isi	Sampling interval in microseconds (always 8000)
119 - 120	gaint	Gain type (always 1=fixed)
121 - 122	gc	Gain constant (always 1)
157 - 158	tyear	Year of start of trace
159 - 160	tday	Day of start of trace
161 - 162	thour	Hour of start of trace
163 - 164	tmin	Minute of start of trace
165 - 166	tsec	Second of start of trace
167 - 168	tbcode	Time basis code (always 2=GMT)
181 - 184	mst	Microseconds of start of trace
189 - 190	syear	Year of shot time
191 - 192	sday	Day of shot time
193 - 194	shour	Hour of shot time
195 - 196	smin	Minute of shot time
197 - 198	sseco	Second of shot time
199 - 202	ssmic	Microseconds of shot time
203 - 204	azimut	Azimuth of receiver from shot in minutes of arc
213 - 216	scrs	Recording instrument number (4 ASCII characters)
221 - 224	spname	Shotpoint number (4 ASCII characters)
225 - 228	rstnam	Station number (4 ASCII characters)

Acknowledgments

We wish to give thanks to the many individuals and organizations who made this experiment possible. Some of the key players are listed below.

Shotpoint drilling, loading of shot holes with explosives, and detonating of shotpoints was accomplished by Thomas Burdette, Edward Criley, Brian Laird, James Luetgert, Ronald Mandel, and David Reneau, all from the USGS.

The seismic recording equipment was tested and repaired by Donald Farrell and Gray Jensen (USGS), and Marcos Alvarez and Steven Michnick (PASSCAL Instrument Center).

Stations were surveyed and road logs were written by Mike Moses, Janice Murphy, William Kohler, and Rufus Catchings, all from the USGS.

Seismic instruments were deployed both by USGS personnel and a group of volunteers. USGS personnel include Rufus Catchings, David Croker, Lynn Dietz, Gary Fuis, William Kohler, Nan MacGregor-Scott, Michael Moses, Janice Murphy, Marty Sanders, Allan Walter, and Victoria Zepeda-Girol. Other volunteers include Jay Badagliacca, Louis Boussard, Shelaswau Bushnell (Fort Valley State, LA), Joseph Catchings, Alex Cole, Jason Herschburger (USC), Monique Jones, Greg Miller (Woods Hole), Brooks Ramsdell (Cal State Hayward), Prof Donald Reed and students (SJ State), Keith Rice, Jose Rodriguez, Catherine Saavedra (Cal State Hayward), Norma Saavedra, Quenton Smith, Lisa White, and Teresa Williams (UC Berkeley)

Several public agencies assisted in the experiment by allowing us access to land or cleared the project on environmental issues, including:

- California Department of Fish and Game
- California Department of Parks and Recreation, Silverado District
- East Bay Municipal Utilities District
- East Bay Regional Parks District
- Mid Peninsula Regional Open Space District
- San Francisco Water Department
- Santa Clara County Parks and Recreation Department
- Zone 7 Water Agency

Many private landowners graciously provided permission to deploy seismic instruments and detonate explosive charges on their property.

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Appendix A
Deployment #1 Shotpoint and Receiver Coordinates

In deployment 1, the Peninsula Line from the 1991 Loma Prieta Experiment was reoccupied, and additional instruments were deployed on the newly surveyed Cross Line. Shots were fired into the entire array, resulting in both inline and fan shot/station configurations. Station coordinates are derived from various sources. Some stations, marked DIG TABLET, were located on USGS topographic maps, and then latitude, longitude values were found by digitizing the maps with a digitizing tablet. Stations marked GPS were determined using a Global Positioning System (GPS) receiver. For stations marked LP91, coordinates were taken directly from the earlier experiment. The coordinates of station 3038 were estimated by interpolating the coordinates of adjacent stations. All coordinates are for the North American Datum of 1927. Positive latitudes are North; positive longitudes are East.

Box (seismograph) numbers less than 1000 are SGRs. Box numbers greater than 1000 are Refteks. Boxes labeled "Reftek" are Refteks for which we do not know the box number. If the box number for a station is left blank, no data were recovered at that station.

All shotpoints were located on USGS topographic maps, and then latitude, longitude values were found by digitizing the maps with a digitizing tablet.

Deployment #1 Shotpoint Coordinates

Shot point	Latitude (deg)	Longitude (deg)	Elev (m)
5	36.79268	-121.29377	299
6	37.54020	-122.40602	340
7	37.33563	-122.23213	536
17	37.53497	-122.07312	21
18	37.72970	-121.78802	235

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Peninsula Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
3001	6096	36.79234	-121.28563	282	GPS
3002	624	36.79237	-121.29315	292	GPS
3003	625	36.79552	-121.30078	242	GPS
3004	6025	36.79258	-121.31061	174	GPS
3005	626	36.79103	-121.32197	145	GPS
3006	627	36.79749	-121.33053	150	GPS
3007	6104	36.80381	-121.33891	160	GPS
3008	630	36.81108	-121.34678	143	GPS
3009		36.81528	-121.35677	136	GPS
3010	6035	36.81882	-121.36840	134	GPS
3011	633	36.82275	-121.37850	107	GPS
3012	636	36.82367	-121.38691	89	GPS
3013	6111	36.82521	-121.40216	83	GPS
3014	640	36.82626	-121.41492	85	GPS
3015	641	36.82599	-121.42619	88	GPS
3016	6057	36.83160	-121.43435	92	GPS
3017	643	36.83602	-121.44491	92	GPS
3018	646	36.84372	-121.45448	74	GPS
3019	6101	36.84917	-121.46387	71	GPS
3020	647	36.84906	-121.47571	59	GPS
3021	649	36.84893	-121.48642	57	GPS
3022	6109	36.85242	-121.49790	51	GPS
3023	651	36.85404	-121.50775	59	GPS
3024	653	36.85717	-121.51912	52	GPS
3025	6103	36.85900	-121.53043	50	GPS
3026	654	36.86367	-121.54164	41	GPS
3027	6116	36.86984	-121.54820	46	GPS
3028	601	36.87624	-121.55313	40	GPS
3029	611	36.88279	-121.56323	47	GPS
3030	6069	36.88752	-121.57514	143	GPS
3031		36.89090	-121.58526	180	GPS
3032	602	36.89736	-121.59696	109	GPS
3033	6021	36.90218	-121.60201	40	GPS
3034	619	36.90823	-121.61508	35	GPS
3035	620	36.91079	-121.63016	35	GPS
3036	6018	36.91483	-121.65771	25	GPS
3037	596	36.92269	-121.67846	21	GPS
3038	603	36.93102	-121.66437	442	INTERPOLATED
3039		36.939356	-121.650274	442	LP91 2174
3040	6067	36.950972	-121.653800	437	LP91 2175
3041	621	36.961075	-121.662959	463	LP91 2176
3042		36.972009	-121.660601	408	LP91 2177
3043	6110	36.980554	-121.662286	374	LP91 2178
3044	622	36.986341	-121.669860	505	LP91 2179
3045		36.992436	-121.678553	481	LP91 2180
3046	637	36.99971	-121.69604	486	GPS

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Peninsula Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
3047	6053	37.00587	-121.70777	493	GPS
3048	656	37.01098	-121.71335	567	GPS
3049	662	37.01762	-121.72305	551	GPS
3050	6030	37.02438	-121.73072	584	GPS
3051	667	37.02830	-121.73918	607	GPS
3052	639	37.03479	-121.74516	652	GPS
3053	674	37.04505	-121.75209	634	GPS
3054	675	37.04800	-121.76099	698	GPS
3055	6130	37.05280	-121.77105	736	GPS
3056	543	37.05672	-121.78033	768	GPS
3057	6057	37.06407	-121.79177	821	GPS
3058		37.06790	-121.80084	855	GPS
3059	6113	37.06540	-121.81158	819	GPS
3060	515	37.06787	-121.82446	671	GPS
3061	561	37.07075	-121.83318	545	GPS
3062	673	37.07660	-121.84043	515	GPS
3063	6126	37.083250	-121.851697	491	LP91 2150
3064		37.08729	-121.86045	524	GPS
3065		37.09078	-121.86895	575	GPS
3066	6050	37.09458	-121.87600	575	GPS
3067	628	37.09829	-121.88592	578	GPS
3068	677	37.10113	-121.89479	561	GPS
3069	6066	37.10705	-121.90104	569	GPS
3070	679	37.11229	-121.91363	541	GPS
3071	678	37.11797	-121.92237	473	GPS
3072	6004	37.12304	-121.93195	473	GPS
3073	572	37.12764	-121.94544	462	GPS
3074	580	37.13127	-121.95674	463	GPS
3075	6125	37.13644	-121.96593	515	GPS
3076	544	37.14237	-121.97315	551	GPS
3077	664	37.14474	-121.99032	613	GPS
3078	6119	37.15449	-121.99903	652	GPS
3079		37.15986	-122.00696	654	GPS
3080	567	37.16556	-122.01480	599	GPS
3081	6062	37.16697	-122.02530	646	GPS
3082	559	37.17350	-122.02454	663	GPS
3083		37.18231	-122.03037	721	GPS
3084	6022	37.18869	-122.03049	698	GPS
3085	577	37.19648	-122.03972	726	GPS
3086	557	37.20639	-122.04854	750	GPS
3087	6080	37.212521	-122.059278	834	LP91 2126
3088	558	37.21684	-122.06900	864	GPS
3089	570	37.22178	-122.07665	898	GPS
3090	6049	37.22359	-122.08978	934	GPS
3091	574	37.23261	-122.09735	892	GPS
3092	529	37.23882	-122.10364	875	GPS

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Peninsula Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
3093	6058	37.25016	-122.11247	835	GPS
3094	659	37.25720	-122.11907	804	GPS
3095	540	37.26003	-122.12840	772	GPS
3096	6027	37.26733	-122.13733	768	GPS
3097	541	37.27417	-122.14637	759	GPS
3098	527	37.28219	-122.14864	687	GPS
3099	6132	37.29258	-122.15735	681	GPS
3100	526	37.30056	-122.16122	649	GPS
3101	507	37.30845	-122.16684	651	GPS
3102	6093	37.31295	-122.17678	639	GPS
3103	613	37.31674	-122.18794	695	GPS
3104	623	37.32196	-122.19830	739	GPS
3105	6024	37.32743	-122.20669	685	GPS
3106		37.33462	-122.21478	623	GPS
3107	663	37.341188	-122.219257	609	LP91 2106
3108	6102	37.34667	-122.22851	621	GPS
3109	503	37.351143	-122.238287	598	LP91 2104
3110	514	37.357492	-122.245364	568	LP91 2103
3111	6097	37.36610	-122.24677	549	GPS
3112	666	37.37175	-122.25325	536	GPS
3113	599	37.37843	-122.26158	494	GPS
3114	6020	37.38869	-122.26614	457	GPS
3115	542	37.38921	-122.27686	510	GPS
3116	517	37.39370	-122.28689	589	GPS
3117	6117	37.398969	-122.292078	685	LP91 2093
3118	520	37.40592	-122.30250	670	GPS
3119	539	37.41360	-122.30744	687	GPS
3120	6064	37.41668	-122.31548	718	GPS
3121	536	37.42738	-122.30958	617	GPS
3122	528	37.43390	-122.31568	603	GPS
3123	6129	37.44145	-122.32338	656	GPS
3124	522	37.44810	-122.33431	632	GPS
3125	506	37.45707	-122.33783	585	GPS
3126	6114	37.46467	-122.34533	516	GPS
3127	689	37.47142	-122.35483	450	GPS
3128	508	37.48201	-122.35845	377	GPS
3129	6085	37.48731	-122.36266	335	GPS
3130	660	37.49685	-122.36871	274	GPS
3131	682	37.50485	-122.37235	333	GPS
3132	6128	37.51269	-122.37505	331	GPS
3133	681	37.52123	-122.37866	327	GPS
3134	687	37.52688	-122.38632	328	GPS
3135	6098	37.53228	-122.39383	337	GPS
3136	685	37.53863	-122.40148	329	GPS
3137	689	37.54452	-122.41077	344	GPS
3138	6039	37.55073	-122.41596	343	GPS

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Peninsula Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
3139	655	37.55785	-122.42111	255	GPS
3140	617	37.56393	-122.42723	327	GPS
3141	6060	37.57206	-122.43240	352	GPS
3142	657	37.57720	-122.44128	417	GPS
3143	690	37.58483	-122.44557	382	GPS
3144	6083	37.59542	-122.44484	359	GPS
3145	692	37.59961	-122.45229	330	GPS
3146	680	37.60944	-122.45678	381	GPS
3147	6003	37.61840	-122.46085	320	GPS
3148	695	37.62999	-122.46074	189	GPS
3149	607	37.64254	-122.44785	99	GPS
3150	6120	37.656236	-122.453247	76	LP91 2058
3151	696	37.670633	-122.450376	29	LP91 2057
3152	691	37.68171	-122.45399	58	GPS
3153	6051	37.69616	-122.45077	85	GPS
3154	645	37.70035	-122.45408	225	GPS
3155	683	37.70796	-122.48505	7	GPS
3156	6052	37.71560	-122.48441	18	GPS
3157	694	37.736210	-122.481588	27	LP91 2051
3158	684	37.73725	-122.45358	229	GPS
3159	6045	37.75066	-122.44789	250	GPS
3160	634	37.75736	-122.47094	156	GPS
3161		37.76774	-122.47885	102	GPS
3162	6100	37.77154	-122.48026	52	GPS
3163	697	37.78354	-122.49230	54	GPS
3164	642	37.79064	-122.48134	0	GPS
3165	6071	37.79883	-122.47732	69	GPS
3166		37.80613	-122.46923	36	GPS
3167	693	37.80932	-122.47513	-1	GPS
3168		37.827254	-122.489755	12	LP91 2021
3169	6034	37.83592	-122.49657	980	GPS
3170	631	37.844304	-122.505718	85	LP91 2023
3171	629	37.855232	-122.510370	241	LP91 2024
3172	6099	37.860831	-122.520985	265	LP91 2025
3173	594	37.868339	-122.528569	11	LP91 2026
3174	525	37.872727	-122.541257	177	LP91 2027
3175	6086	37.88497	-122.55359	195	GPS
3176	635	37.89360	-122.55595	207	GPS
3177	661	37.90256	-122.56846	304	GPS
3178	6131	37.90852	-122.57500	281	GPS
3179		37.915093	-122.582579	293	LP91 2032
3180	579	37.91276	-122.59619	377	GPS
3181	6084	37.91512	-122.60689	640	GPS
3182	670	37.91561	-122.62587	606	GPS
3183	671	37.92278	-122.63390	542	GPS
3184	6031	37.92907	-122.64239	500	GPS

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Peninsula Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
3185	571	37.93957	-122.65751	476	GPS
3186	575	37.94399	-122.66616	358	GPS
3187	6091	37.94053	-122.68260	301	GPS
3188	512	37.93512	-122.69761	-12	GPS
3189	519	37.94768	-122.70964	53	GPS
3190	6112	37.95587	-122.71314	71	GPS
3191	546	37.96430	-122.72166	136	GPS
3192	548	37.97283	-122.72935	122	GPS
3193	6134	37.98090	-122.73734	118	GPS
3194	560	37.99049	-122.74753	94	GPS
3195	569	37.99970	-122.75498	59	GPS
3196	6124	38.01108	-122.76407	48	GPS
3197	573	38.01802	-122.76967	37	GPS
3198	587	38.027795	-122.777514	46	LP91 2011
3199	6028	38.035556	-122.781864	24	LP91 2012
3200	606	38.048977	-122.791904	11	LP91 2013
3201	638	38.056154	-122.797635	6	LP91 2014
3202	6044	38.063271	-122.810349	3	LP91 2015
3203	644	38.068195	-122.821859	3	LP91 2016
3204	665	38.077301	-122.830215	3	LP91 2017
3205	6081	38.087731	-122.840170	3	LP91 2018
3206	668	38.094605	-122.847911	3	LP91 2019
3207	698	38.109285	-122.863898	3	LP91 2020

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Cross Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
4003	6092	37.221560	-122.405313	18	DIG TABLET
4004	556	37.233890	-122.404027	61	DIG TABLET
4005		37.242534	-122.396990	55	DIG TABLET
4006	6065	37.251130	-122.388017	7	DIG TABLET
4007	549	37.246862	-122.366923	18	DIG TABLET
4008	582	37.250645	-122.353398	21	DIG TABLET
4009	6122	37.254616	-122.345311	37	DIG TABLET
4010	554	37.260822	-122.330141	24	DIG TABLET
4011	555	37.262516	-122.321483	37	DIG TABLET
4012	6095	37.269740	-122.314665	37	DIG TABLET
4013	562	37.273926	-122.300847	67	DIG TABLET
4014	550	37.277227	-122.285597	67	DIG TABLET
4015	6115	37.285299	-122.281305	146	DIG TABLET
4016	552	37.291960	-122.277877	195	DIG TABLET
4017	553	37.297449	-122.275285	308	DIG TABLET
4018	6057	37.308102	-122.271719	140	DIG TABLET
4019	551	37.315434	-122.271633	128	DIG TABLET
4020	564	37.323187	-122.261944	241	DIG TABLET
4021	6026	37.338149	-122.268888	177	DIG TABLET
4022	610	37.336442	-122.246251	488	DIG TABLET
4023	591	37.337836	-122.233938	506	DIG TABLET
4024	6040	37.34667	-122.22851	621	GPS (=3108)
4025	592	37.358375	-122.217815	226	DIG TABLET
4026	590	37.364770	-122.217371	195	DIG TABLET
4027	6042	37.369602	-122.209913	189	DIG TABLET
4028	584	37.375279	-122.201952	149	DIG TABLET
4029	586	37.381264	-122.194079	122	DIG TABLET
4030	6041	37.390875	-122.189502	98	DIG TABLET
4031	618	37.402573	-122.191499	73	DIG TABLET
4032	609	37.411101	-122.189354	82	DIG TABLET
4033	6123	37.420223	-122.181714	70	DIG TABLET
4034	598	37.428075	-122.178973	37	DIG TABLET
4035	600	37.434770	-122.169792	23	DIG TABLET
4036	6046	37.442273	-122.165543	20	DIG TABLET
4037		37.451820	-122.164296	18	DIG TABLET
4038	588	37.456471	-122.152614	14	DIG TABLET
4039	6019	37.463249	-122.141604	6	DIG TABLET
4040	615	37.472853	-122.140194	5	DIG TABLET
4041	616	37.483252	-122.134189	2	DIG TABLET
4042	6108	37.490005	-122.125312	2	DIG TABLET
4044	Reftek	37.501504	-122.106111	2	DIG TABLET
4045	578	37.507098	-122.100092	2	DIG TABLET
4046	Reftek	37.513794	-122.094290	2	DIG TABLET
4047	6036	37.520898	-122.083261	2	DIG TABLET
4048	589	37.529502	-122.077406	2	DIG TABLET
4049		37.535547	-122.072453	12	DIG TABLET

Appendix A, continued
Deployment #1 Shotpoint and Receiver Coordinates

Cross Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
4050	608	37.539200	-122.062320	3	DIG TABLET
4051	Reftek	37.545566	-122.052697	5	DIG TABLET
4052	Reftek	37.548548	-122.042701	6	DIG TABLET
4053		37.553140	-122.037482	8	DIG TABLET
4054	Reftek	37.561874	-122.033092	9	DIG TABLET
4055		37.564799	-122.018345	12	DIG TABLET
4056		37.574062	-122.006137	15	DIG TABLET
4057	Reftek	37.579629	-122.002237	15	DIG TABLET
4058	Reftek	37.584583	-121.993599	24	DIG TABLET
4059		37.593289	-121.987310	244	DIG TABLET
4060	6135	37.596896	-121.980259	290	DIG TABLET
4061	576	37.602979	-121.972043	396	DIG TABLET
4062		37.60703	-121.96449	411	GPS (=5112)
4063	6118	37.616801	-121.958442	512	DIG TABLET
4064	6090	37.616894	-121.943764	219	DIG TABLET
4065	505	37.626292	-121.943085	256	DIG TABLET
4066	6121	37.634771	-121.932551	579	DIG TABLET
4067	605	37.635850	-121.919349	280	DIG TABLET
4068		37.647758	-121.908955	183	DIG TABLET
4069		37.654959	-121.904269	98	DIG TABLET
4070	6061	37.659252	-121.895858	101	DIG TABLET
4071		37.665767	-121.890519	101	DIG TABLET
4072		37.669550	-121.883387	101	DIG TABLET
4073	6127	37.676380	-121.870710	107	DIG TABLET
4074		37.682139	-121.861443	110	DIG TABLET
4075		37.688410	-121.857556	110	DIG TABLET
4076	6029	37.694498	-121.847473	107	DIG TABLET
4077		37.700610	-121.840434	110	DIG TABLET
4078		37.705382	-121.834298	128	DIG TABLET
4079	6043	37.712088	-121.822729	134	DIG TABLET
4080		37.722708	-121.823263	155	DIG TABLET
4081		37.724732	-121.807582	158	DIG TABLET
4083	6088	37.730122	-121.788257	235	DIG TABLET
4085		37.745142	-121.768711	177	DIG TABLET
4087		37.752473	-121.745905	196	DIG TABLET
4089	6063	37.772351	-121.737968	238	DIG TABLET
4090		37.792968	-121.748106	174	DIG TABLET
4092		37.809981	-121.736272	119	DIG TABLET
4094	6087	37.831953	-121.728107	101	DIG TABLET
4096		37.847224	-121.712992	70	DIG TABLET
4098		37.855029	-121.695262	55	DIG TABLET
4100	6048	37.862165	-121.672324	55	DIG TABLET

Appendix B
Deployment #2 Shotpoint and Receiver Coordinates

In deployment 2, the Cross Line from deployment 1 was reoccupied, and additional instruments were deployed on the newly surveyed East Bay Line. Shots were fired into the entire array, resulting in both inline and fan shot/station configurations. Station coordinates are derived from various sources. Some stations, marked DIG TABLET, were located on USGS topographic maps, and then latitude, longitude values were found by digitizing the maps with a digitizing tablet. Stations marked GPS were determined using a Global Positioning System (GPS) receiver. Stations 5901-5904 were occupied by OBS receivers in San Pablo Bay. The coordinates of station 5029 were estimated by interpolating the coordinates of adjacent stations. All coordinates are for the North American Datum of 1927. Positive latitudes are North; positive longitudes are East.

Box (seismograph) numbers less than 1000 are SGRs. Box numbers greater than 1000 are Refteks. If no box number is entered for a station, no data were recovered.

All shotpoints were located on USGS topographic maps, and then latitude, longitude values were found by digitizing the maps with a digitizing tablet.

Deployment #2 Shotpoint Coordinates

Shot point	Latitude (deg)	Longitude (deg)	Elev (m)
1	38.42340	-122.62912	280
2	37.86486	-122.18826	244
3	37.60766	-121.96499	411
4	37.20493	-121.64463	201
5	36.79268	-121.29377	299
8	38.16774	-122.45167	2
9	38.00375	-122.36447	21
10	37.77989	-122.11620	198
12	37.48407	-121.85296	622
13	37.31633	-121.70225	463
14	37.09758	-121.54524	253
15	36.96718	-121.45250	44

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

Cross Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
4003	6022	37.221560	-122.405313	18	DIG TABLET
4004		37.233890	-122.404027	61	DIG TABLET
4005	521	37.242534	-122.396990	55	DIG TABLET
4006	6096	37.251130	-122.388017	7	DIG TABLET
4007		37.246862	-122.366923	18	DIG TABLET
4008	676	37.250645	-122.353398	21	DIG TABLET
4009	6117	37.254616	-122.345311	37	DIG TABLET
4010	664	37.260822	-122.330141	24	DIG TABLET
4011	581	37.262516	-122.321483	37	DIG TABLET
4012	6085	37.269740	-122.314665	37	DIG TABLET
4013	509	37.273926	-122.300847	67	DIG TABLET
4014	529	37.277227	-122.285597	67	DIG TABLET
4015	6098	37.285299	-122.281305	146	DIG TABLET
4016	555	37.291960	-122.277877	195	DIG TABLET
4017	574	37.297449	-122.275285	308	DIG TABLET
4018	6064	37.308102	-122.271719	140	DIG TABLET
4019	551	37.315434	-122.271633	128	DIG TABLET
4020	644	37.323187	-122.261944	241	DIG TABLET
4021	6129	37.338149	-122.268888	177	DIG TABLET
4022	610	37.336442	-122.246251	488	DIG TABLET
4023	589	37.337836	-122.233938	506	DIG TABLET
4024	7061	37.34667	-122.22851	621	GPS (=3108)
4025		37.358375	-122.217815	226	DIG TABLET
4026	582	37.364770	-122.217371	195	DIG TABLET
4027	6092	37.369602	-122.209913	189	DIG TABLET
4028	588	37.375279	-122.201952	149	DIG TABLET
4029	626	37.381264	-122.194079	122	DIG TABLET
4030	6101	37.390875	-122.189502	98	DIG TABLET
4031	7045	37.402573	-122.191499	73	DIG TABLET
4032	633	37.411101	-122.189354	82	DIG TABLET
4033	7042	37.420223	-122.181714	70	DIG TABLET
4034		37.428075	-122.178973	37	DIG TABLET
4035	531	37.434770	-122.169792	23	DIG TABLET
4036		37.442273	-122.165543	20	DIG TABLET
4037	681	37.451820	-122.164296	18	DIG TABLET
4038	598	37.456471	-122.152614	14	DIG TABLET
4039	7051	37.463249	-122.141604	6	DIG TABLET
4040	592	37.472853	-122.140194	5	DIG TABLET
4041	672	37.483252	-122.134189	2	DIG TABLET
4042	6135	37.490005	-122.125312	2	DIG TABLET
4044	7055	37.501504	-122.106111	2	DIG TABLET
4045	559	37.507098	-122.100092	2	DIG TABLET
4046	7058	37.513794	-122.094290	2	DIG TABLET
4047	535	37.520898	-122.083261	2	DIG TABLET
4048	7047	37.529502	-122.077406	2	DIG TABLET
4049		37.535547	-122.072453	12	DIG TABLET

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

Cross Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
4050		37.539200	-122.062320	3	DIG TABLET
4051	7040	37.545566	-122.052697	5	DIG TABLET
4052	7064	37.548548	-122.042701	6	DIG TABLET
4053		37.553140	-122.037482	8	DIG TABLET
4054		37.561874	-122.033092	9	DIG TABLET
4055	7046	37.564799	-122.018345	12	DIG TABLET
4056		37.574062	-122.006137	15	DIG TABLET
4057	7044	37.579629	-122.002237	15	DIG TABLET
4058	7063	37.584583	-121.993599	24	DIG TABLET
4059	6104	37.593289	-121.987310	244	DIG TABLET
4060	6084	37.596896	-121.980259	290	DIG TABLET
4061	7065	37.602979	-121.972043	396	DIG TABLET
4062	6113	37.60703	-121.96449	411	GPS (=5112)
4063	6099	37.616801	-121.958442	512	DIG TABLET
4064	6067	37.616894	-121.943764	219	DIG TABLET
4065	6121	37.626292	-121.943085	256	DIG TABLET
4066	7041	37.634771	-121.932551	579	DIG TABLET
4067	7059	37.635850	-121.919349	280	DIG TABLET
4068	653	37.647758	-121.908955	183	DIG TABLET
4069	621	37.654959	-121.904269	98	DIG TABLET
4070	6132	37.659252	-121.895858	101	DIG TABLET
4071	501	37.665767	-121.890519	101	DIG TABLET
4072	534	37.669550	-121.883387	101	DIG TABLET
4073	6097	37.676380	-121.870710	107	DIG TABLET
4074	532	37.682139	-121.861443	110	DIG TABLET
4075	538	37.688410	-121.857556	110	DIG TABLET
4076	6058	37.694498	-121.847473	107	DIG TABLET
4077	537	37.700610	-121.840434	110	DIG TABLET
4078	628	37.705382	-121.834298	128	DIG TABLET
4079	6035	37.712088	-121.822729	134	DIG TABLET
4080	627	37.722708	-121.823263	155	DIG TABLET
4081	567	37.724732	-121.807582	158	DIG TABLET
4083	6027	37.730122	-121.788257	235	DIG TABLET
4085	539	37.745142	-121.768711	177	DIG TABLET
4087	504	37.752473	-121.745905	196	DIG TABLET
4089	6119	37.772351	-121.737968	238	DIG TABLET
4090	518	37.792968	-121.748106	174	DIG TABLET
4092	661	37.809981	-121.736272	119	DIG TABLET
4094	6093	37.831953	-121.728107	101	DIG TABLET
4096	687	37.847224	-121.712992	70	DIG TABLET
4098	523	37.855029	-121.695262	55	DIG TABLET
4100	6102	37.862165	-121.672324	55	DIG TABLET

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

East Bay Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
5004	6066	36.79237	-121.29315	292	GPS
5005	619	36.80187	-121.29205	249	GPS
5006	620	36.80464	-121.29888	236	GPS
5007	7052	36.81990	-121.30215	191	GPS
5008	667	36.82409	-121.31299	220	GPS
5009	656	36.82934	-121.33221	192	GPS
5010	6126	36.83611	-121.33594	136	GPS
5011	596	36.84577	-121.33507	157	GPS
5012	569	36.85619	-121.33593	140	GPS
5013	6083	36.86114	-121.34720	101	GPS
5014		36.86843	-121.35342	90	GPS
5015	512	36.87571	-121.35904	86	GPS
5016	6130	36.88557	-121.36256	78	GPS
5017		36.89711	-121.36265	68	GPS
5018	508	36.90067	-121.37376	61	GPS
5019	6028	36.90910	-121.37832	62	GPS
5020	611	36.91770	-121.37930	59	GPS
5021	617	36.92416	-121.38965	59	GPS
5022	7043	36.92791	-121.40582	45	GPS
5023	637	36.93772	-121.40880	48	GPS
5024	639	36.94590	-121.41147	57	GPS
5025	6124	36.95530	-121.41452	64	GPS
5026	640	36.956886	-121.435373	47	DIG TABLET
5027	662	36.96800	-121.43193	32	GPS
5028	6046	36.967488	-121.451815	44	DIG TABLET
5029	682	36.978632	-121.453082	57	INTERPOLATED
5030	685	36.989775	-121.454349	70	DIG TABLET
5031	6131	36.998646	-121.453745	155	DIG TABLET
5032		37.005248	-121.454970	219	DIG TABLET
5033	645	37.010319	-121.466008	329	DIG TABLET
5034	6034	37.021001	-121.482380	299	DIG TABLET
5035	663	37.028605	-121.483284	341	DIG TABLET
5036	599	37.037228	-121.483866	387	DIG TABLET
5037	6090	37.045066	-121.487330	448	DIG TABLET
5038	528	37.051021	-121.489525	472	DIG TABLET
5039	684	37.05878	-121.50423	424	GPS
5040	6032	37.064241	-121.513118	372	DIG TABLET
5041		37.07504	-121.51493	252	GPS
5042	680	37.07846	-121.52726	248	GPS
5043	6069	37.08485	-121.53485	257	GPS
5044	654	37.09370	-121.54246	243	GPS
5045	587	37.10270	-121.54500	240	GPS
5046	7060	37.11104	-121.54713	247	GPS
5047	693	37.121122	-121.552753	226	DIG TABLET
5048	6031	37.128516	-121.555924	201	DIG TABLET
5049		37.132786	-121.571232	378	DIG TABLET

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

East Bay Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
5050		37.140678	-121.575760	274	DIG TABLET
5051	593	37.149046	-121.580947	262	DIG TABLET
5052	6053	37.155463	-121.588365	201	DIG TABLET
5053	636	37.161273	-121.598216	226	DIG TABLET
5054		37.170509	-121.603159	268	DIG TABLET
5055		37.178169	-121.604882	344	DIG TABLET
5056		37.184036	-121.616706	277	DIG TABLET
5057		37.188345	-121.624116	247	DIG TABLET
5058	6108	37.194275	-121.635084	241	DIG TABLET
5059	580	37.204393	-121.644980	195	DIG TABLET
5060	536	37.208693	-121.651449	207	DIG TABLET
5061	6045	37.215400	-121.655537	198	DIG TABLET
5062	670	37.224528	-121.659611	219	DIG TABLET
5063	570	37.233735	-121.666629	244	DIG TABLET
5064	6071	37.241485	-121.668257	262	DIG TABLET
5065	608	37.252074	-121.676349	307	DIG TABLET
5066	590	37.261155	-121.674278	341	DIG TABLET
5067	6134	37.269696	-121.674346	326	DIG TABLET
5068	690	37.280648	-121.677290	335	DIG TABLET
5069		37.288651	-121.679071	347	DIG TABLET
5070	6041	37.296807	-121.687630	433	DIG TABLET
5071	575	37.303136	-121.695432	506	DIG TABLET
5072	612	37.312282	-121.701388	518	DIG TABLET
5073	6052	37.320041	-121.705062	451	DIG TABLET
5074		37.324962	-121.712818	475	DIG TABLET
5075		37.334454	-121.717740	488	DIG TABLET
5076		37.342040	-121.720632	500	DIG TABLET
5077		37.350830	-121.731595	537	DIG TABLET
5078	571	37.355935	-121.742915	567	DIG TABLET
5079	6050	37.360566	-121.752972	503	DIG TABLET
5080	6061	37.364816	-121.762004	460	DIG TABLET
5081	695	37.372169	-121.768551	448	DIG TABLET
5082	6109	37.378834	-121.779674	354	DIG TABLET
5083	6025	37.385670	-121.788128	543	DIG TABLET
5084	577	37.396833	-121.795907	183	DIG TABLET
5085	6122	37.409023	-121.800209	616	DIG TABLET
5086	6118	37.419403	-121.789907	671	DIG TABLET
5087	643	37.427607	-121.795839	518	DIG TABLET
5088	6110	37.431951	-121.806318	500	DIG TABLET
5089	6065	37.435291	-121.818979	415	DIG TABLET
5090	513	37.439552	-121.828526	329	DIG TABLET
5091	6003	37.447684	-121.837709	293	DIG TABLET
5092	6026	37.454621	-121.839571	390	DIG TABLET
5093	692	37.463645	-121.843795	488	DIG TABLET
5094	6057	37.473082	-121.847621	543	DIG TABLET
5095	641	37.480028	-121.850732	585	DIG TABLET

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

East Bay Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
5096	629	37.487618	-121.857767	634	DIG TABLET
5097	635	37.498096	-121.861954	683	DIG TABLET
5098	646	37.503008	-121.869679	707	DIG TABLET
5099	525	37.510872	-121.875362	658	DIG TABLET
5100	6114	37.517444	-121.883434	628	DIG TABLET
5101		37.522193	-121.892439	518	DIG TABLET
5102	547	37.527856	-121.895103	347	DIG TABLET
5103	6111	37.542231	-121.905597	219	DIG TABLET
5104	550	37.548172	-121.912558	235	DIG TABLET
5105	552	37.556397	-121.917156	140	DIG TABLET
5106	6042	37.562140	-121.926338	183	DIG TABLET
5107	6004	37.570536	-121.932955	219	DIG TABLET
5108	564	37.578424	-121.929155	305	DIG TABLET
5109		37.587757	-121.939516	335	DIG TABLET
5110	572	37.593541	-121.950056	61	DIG TABLET
5111	630	37.60467	-121.95495	414	GPS
5112	6060	37.60703	-121.96449	411	GPS
5113		37.61469	-121.96558	433	GPS
5114	694	37.62419	-121.97103	451	GPS
5114	6036	37.62419	-121.97103	451	GPS
5115	7039	37.633455	-121.974563	482	DIG TABLET
5117		37.638395	-121.988424	442	DIG TABLET
5118	6103	37.644427	-121.996935	442	DIG TABLET
5119		37.650937	-122.004300	445	DIG TABLET
5120		37.656841	-122.013346	378	DIG TABLET
5121	6063	37.661654	-122.022720	320	DIG TABLET
5122		37.672268	-122.028275	290	DIG TABLET
5123	522	37.679247	-122.041948	203	DIG TABLET
5124	6087	37.685148	-122.042972	113	DIG TABLET
5125	506	37.697340	-122.044732	55	DIG TABLET
5126	618	37.704482	-122.049520	104	DIG TABLET
5127	6020	37.710823	-122.055666	85	DIG TABLET
5128	517	37.72226	-122.06029	205	GPS
5129	584	37.72953	-122.06756	251	GPS
5130	6029	37.73606	-122.07596	75	GPS
5131	586	37.74199	-122.08485	139	GPS
5132	600	37.74902	-122.09235	201	GPS
5133	6043	37.75567	-122.10087	265	GPS
5134	515	37.76368	-122.10714	258	GPS
5135	609	37.77025	-122.11342	240	GPS
5136	6040	37.77775	-122.12432	198	GPS
5137	660	37.78619	-122.12747	138	GPS
5138	533	37.79542	-122.12998	205	GPS
5139	6039	37.80281	-122.13575	235	GPS
5140	624	37.81107	-122.14091	194	GPS
5141	573	37.81854	-122.14541	150	GPS

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

East Bay Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
5142	6123	37.82342	-122.15577	152	GPS
5143	542	37.83107	-122.16578	208	GPS
5144		37.83932	-122.16623	326	GPS
5145	7038	37.84795	-122.17538	376	GPS
5146		37.85747	-122.17916	234	GPS
5147	698	37.86238	-122.18613	265	GPS
5148	6112	37.86875	-122.18804	318	GPS
5149	669	37.88103	-122.18688	149	GPS
5150	511	37.88266	-122.20197	269	GPS
5151	6120	37.89125	-122.20798	208	GPS
5152	622	37.89807	-122.21797	208	GPS
5153	671	37.90619	-122.22143	105	GPS
5154	6125	37.91061	-122.23082	105	GPS
5155	679	37.918118	-122.238144	122	DIG TABLET
5156	673	37.92454	-122.24643	80	GPS
5157	6127	37.93161	-122.25282	100	GPS
5158	606	37.93846	-122.25779	115	GPS
5159	526	37.94709	-122.26687	56	GPS
5160	6049	37.95369	-122.27245	58	GPS
5161	675	37.95999	-122.27986	51	GPS
5162	527	37.963760	-122.291039	40	DIG TABLET
5163	6080	37.967786	-122.298713	34	DIG TABLET
5164	541	37.975929	-122.308011	82	DIG TABLET
5165	623	37.978571	-122.320021	85	DIG TABLET
5166	6115	37.987358	-122.327033	21	DIG TABLET
5167	505	37.993828	-122.333425	24	DIG TABLET
5168	543	37.995636	-122.346612	24	DIG TABLET
5169	6095	38.001971	-122.353804	11	DIG TABLET
5170		38.004585	-122.362503	20	DIG TABLET
5171		38.012316	-122.364273	15	DIG TABLET
5173	659	38.12185	-122.43283	-1	GPS
5174	594	38.13281	-122.43685	-1	GPS
5175	6116	38.14322	-122.42877	-2	GPS
5176	579	38.15027	-122.44191	-6	GPS
5177	565	38.15780	-122.44872	-3	GPS
5178	6030	38.16795	-122.45127	-7	GPS
5179	605	38.17401	-122.44866	16	GPS
5180	638	38.18360	-122.44152	29	GPS
5181	6056	38.19152	-122.44228	-3	GPS
5182	553	38.20106	-122.44660	2	GPS
5183	613	38.20871	-122.45220	13	GPS
5184	7053	38.21756	-122.45373	-3	GPS
5185	519	38.22726	-122.45690	-13	GPS
5186	540	38.23640	-122.46031	-6	GPS
5187	6088	38.24531	-122.46676	0	GPS
5188	549	38.24969	-122.47354	4	GPS

Appendix B, continued
Deployment #2 Shotpoint and Receiver Coordinates

East Bay Line Receiver Coordinates

Station	Box	Latitude (deg)	Longitude (deg)	Elev (m)	Coordinate Source
5189	503	38.25787	-122.48015	7	GPS
5190	6128	38.26476	-122.48584	10	GPS
5191	578	38.27286	-122.49485	20	GPS
5192	665	38.278489	-122.501332	37	DIG TABLET
5193	6024	38.285911	-122.504676	55	DIG TABLET
5194	560	38.296779	-122.507456	58	DIG TABLET
5195	554	38.30612	-122.51245	62	GPS
5196	6044	38.31536	-122.51144	65	GPS
5197		38.32195	-122.51413	103	GPS
5198	546	38.327755	-122.532842	293	DIG TABLET
5199	6108	38.33004	-122.53387	298	GPS
5200	566	38.33996	-122.54531	320	GPS
5201	666	38.35061	-122.55027	298	GPS
5202	6086	38.35935	-122.55577	241	GPS
5203	514	38.36710	-122.56107	203	GPS
5204	602	38.37610	-122.56417	178	GPS
5205	6051	38.38328	-122.57288	168	GPS
5206	507	38.38859	-122.58175	210	GPS
5207	563	38.40399	-122.58161	239	GPS
5208	6048	38.40547	-122.59495	359	GPS
5209	677	38.40729	-122.60950	390	GPS
5210	562	38.41945	-122.60993	368	GPS
5211	6021	38.42215	-122.61966	354	GPS
5212	591	38.42225	-122.62555	303	GPS
5213	556	38.42583	-122.64055	220	GPS
5214	6062	38.43001	-122.64508	171	GPS
5901	OBS	38.02363	-122.38413	0	GPS
5902	OBS	38.05775	-122.41088	0	GPS
5903	OBS	38.07121	-122.42522	0	GPS
5904	OBS	38.08878	-122.44038	0	GPS

Appendix C
SEGY Tape File Numbers

All data are stored on one SEGY tape reel. To distinguish between different shots, instrument types, and components, unique "file numbers" from 1 to 184 are assigned. The file number for each trace is stored in bytes 9 - 12 in the trace header block. In the following table, the file number is indicated as "ofrn", which stands for "original field record number" as described by Barry and others (1975). The component type is indicated here:

Component	Description
S	SGR vertical
Z	Reftek vertical
N	Reftek north-south horizontal
E	Reftek east-west horizontal
O1	OBS channel 1 - Vertical
O2	OBS channel 2 - Horizontal
O3	OBS channel 3 - Horizontal
O4	OBS channel 4 - Hydrophone

The "# traces" column contains the number of traces written to the SEGY and plotted. No attempt has been made to edit out noisy traces or traces from malfunctioning instruments. The figure number refers to a figure in Appendix D.

Peninsula Line

Shot 1, Shotpoint 5, In-Line Shot

ofrn	Component	# traces	Figure
1	S	125	D1
2	Z	50	D1
3	N	50	
4	E	50	

Shot 2, Shotpoint 7, In-Line Shot

ofrn	Component	# traces	Figure
5	S	124	D2
6	Z	50	D2
7	N	50	D3
8	E	50	

Shot 3, Shotpoint 17, Fan Shot

ofrn	Component	# traces	Figure
9	S	125	D4
10	Z	49	D4
11	N	49	
12	E	49	

Shot 4, Shotpoint 18, Fan Shot

ofrn	Component	# traces	Figure
13	S	124	D5
14	Z	49	D5
15	N	49	
16	E	49	

Shot 5, Shotpoint 6, In-Line Shot

ofrn	Component	# traces	Figure
17	S	125	D6
18	Z	48	D6
19	N	48	
20	E	48	

Appendix C, continued
SEGY Tape File Numbers

East Bay Line

Shot 6, Shotpoint 4, In-Line Shot

ofrn	Component	# traces	Figure
21	S	109	D7
22	Z	46	D7
23	N	46	
24	E	46	
25	O1	4	D7
26	O2	4	
27	O3	4	
28	O4	4	

Shot 7, Shotpoint 15, In-Line Shot

ofrn	Component	# traces	Figure
29	S	110	D8
30	Z	46	D8
31	N	46	
32	E	46	
33	O1	4	D8
34	O2	4	
35	O3	4	
36	O4	4	

Shot 8, Shotpoint 3, In-Line Shot

ofrn	Component	# traces	Figure
37	S	109	D9
38	Z	45	D9
39	N	45	D10
40	E	45	
41	O1	4	D9
42	O2	4	D10
43	O3	4	
44	O4	4	

Shot 9, Shotpoint 8, In-Line Shot

ofrn	Component	# traces	Figure
45	S	109	D11
46	Z	45	D11
47	N	45	
48	E	45	
49	O1	4	D11
50	O2	4	
51	O3	4	
52	O4	4	

Shot 10, Shotpoint 5, In-Line Shot

ofrn	Component	# traces	Figure
53	S	110	D12
54	Z	0	
55	N	0	
56	E	0	
57	O1	4	D12
58	O2	4	
59	O3	4	
60	O4	4	

Shot 11, Shotpoint 1, In-Line Shot

ofrn	Component	# traces	Figure
61	S	108	D13
62	Z	45	D13
63	N	45	
64	E	45	
65	O1	4	D13
66	O2	4	
67	O3	4	
68	O4	4	

Shot 12, Shotpoint 2, In-Line Shot

ofrn	Component	# traces	Figure
69	S	110	D14
70	Z	45	D14
71	N	45	
72	E	45	
73	O1	4	D14
74	O2	4	
75	O3	4	
76	O4	4	

Shot 13, Shotpoint 13, In-Line Shot

ofrn	Component	# traces	Figure
77	S	110	D15
78	Z	45	D15
79	N	45	
80	E	45	
81	O1	4	D15
82	O2	4	
83	O3	4	
84	O4	4	

Shot 14, Shotpoint 14, In-Line Shot

ofrn	Component	# traces	Figure
85	S	109	D16
86	Z	44	D16
87	N	44	
88	E	43	
89	O1	4	D16
90	O2	4	
91	O3	4	
92	O4	4	

Shot 15, Shotpoint 12, In-Line Shot

ofrn	Component	# traces	Figure
93	S	109	D17
94	Z	40	D17
95	N	40	
96	E	40	
97	O1	4	D17
98	O2	4	
99	O3	4	
100	O4	4	

Appendix C, continued
SEGY Tape File Numbers

East Bay Line

Shot 16, Shotpoint 10, In-Line Shot

ofrn	Component	# traces	Figure
101	S	108	D18
102	Z	39	D18
103	N	39	
104	E	39	
105	O1	4	D18
106	O2	4	
107	O3	4	
108	O4	4	

Shot 17, Shotpoint 9, In-Line Shot

ofrn	Component	# traces	Figure
109	S	109	D19
110	Z	39	D19
111	N	39	
112	E	39	
113	O1	4	D19
114	O2	4	
115	O3	4	
116	O4	4	

Cross Line

Shot 1, Shotpoint 5, Fan Shot

ofrn	Component	# traces	Figure
117	S	30	D20
118	Z	30	D20
119	N	30	
120	E	30	

Shot 2, Shotpoint 7, In-Line Shot

ofrn	Component	# traces	Figure
121	S	30	D21
122	Z	30	D21
123	N	30	
124	E	30	

Shot 3, Shotpoint 17, In-Line Shot

ofrn	Component	# traces	Figure
125	S	30	D22
126	Z	30	D22
127	N	30	
128	E	30	

Shot 4, Shotpoint 18, In-Line Shot

ofrn	Component	# traces	Figure
129	S	30	D23
130	Z	30	D23
131	N	30	
132	E	30	

Shot 5, Shotpoint 6, Fan Shot

ofrn	Component	# traces	Figure
133	S	29	D24
134	Z	30	D24
135	N	30	
136	E	30	

Shot 6, Shotpoint 4, Fan Shot

ofrn	Component	# traces	Figure
137	S	39	D25
138	Z	30	D25
139	N	30	
140	E	30	

Shot 7, Shotpoint 15, Fan Shot

ofrn	Component	# traces	Figure
141	S	39	D26
142	Z	30	D26
143	N	30	
144	E	30	

Shot 8, Shotpoint 3, In-Line Shot

ofrn	Component	# traces	Figure
145	S	39	D27
146	Z	30	D27
147	N	30	
148	E	30	

Shot 9, Shotpoint 8, Fan Shot

ofrn	Component	# traces	Figure
149	S	40	D28
150	Z	30	D28
151	N	30	
152	E	30	

Shot 10, Shotpoint 5, Fan Shot

ofrn	Component	# traces	Figure
153	S	40	D29
154	Z	0	
155	N	0	
156	E	0	

Appendix C, continued
SEGY Tape File Numbers

Cross Line

Shot 11, Shotpoint 1, Fan Shot

ofrn	Component	# traces	Figure
157	S	39	D30
158	Z	30	D30
159	N	30	
160	E	30	

Shot 12, Shotpoint 2, Fan Shot

ofrn	Component	# traces	Figure
161	S	40	D31
162	Z	30	D31
163	N	30	
164	E	30	

Shot 13, Shotpoint 13, Fan Shot

ofrn	Component	# traces	Figure
165	S	40	D32
166	Z	29	D32
167	N	29	
168	E	29	

Shot 14, Shotpoint 14, Fan Shot

ofrn	Component	# traces	Figure
169	S	40	D33
170	Z	29	D33
171	N	29	
172	E	29	

Shot 15, Shotpoint 12, Fan Shot

ofrn	Component	# traces	Figure
173	S	40	D34
174	Z	29	D34
175	N	29	
176	E	29	

Shot 16, Shotpoint 10, Fan Shot

ofrn	Component	# traces	Figure
177	S	39	D35
178	Z	29	D35
179	N	29	
180	E	29	

Shot 17, Shotpoint 9, Fan Shot

ofrn	Component	# traces	Figure
181	S	40	D36
182	Z	29	D36
183	N	29	
184	E	29	

Appendix D
Record Section Plots

Plots of merged SGR, Reftek, and OBS data follow. Vertical-component plots are presented for each shot into each line. Horizontal-component plots are presented for only two selected shots (figures D3 and D10). The reduction velocity for each plot is 6.0 km/sec, and the time is displayed from -2 to 8 seconds reduced time. For the Peninsula and East Bay lines, plotted distances increase to the northwest. For the Cross line, plotted distances increase to the northeast. For in-line shots, the distance displayed is the true shot-receiver distance. For fan shots, the distance displayed is the distance from a reference point to each station. The reference point for Peninsula Line fan plots is at station 3002. The reference point for Cross Line fan plots is at station 4004.

Before plotting, all traces were band-pass filtered from 0.5 to 15 hz. The frequency content of the data varies from trace to trace, since data from SGRs and Refteks are plotted together. The Refteks were used with 4 hz geophones, and the SGRs were used with 8 hz geophones. As a result, Reftek traces have more low-frequency information that SGR traces. Each plot is "trace-normalized", ie, each trace is scaled according to it's peak amplitude in the displayed time window.

The plots show a subset of the complete data set, which is stored on the SEGY tape. The plots show a 10 second time window, while the SEGY tape contains a full 32 seconds of data for each trace. Vertical-component plots are included for each shot into each line. Only two horizontal-component plots are included, figures D3 and D10. Noisy traces are plotted as written on the SEGY tape. In some cases, it may be possible to recover bad traces by filtering and replotting.

List of Record Sections

Appendix D, continued

List of Record Sections

Appendix D, continued

List of Record Sections

Figure D1: Peninsula line, Shot 1, Shotpoint 5, Vertical component of in-line traces.

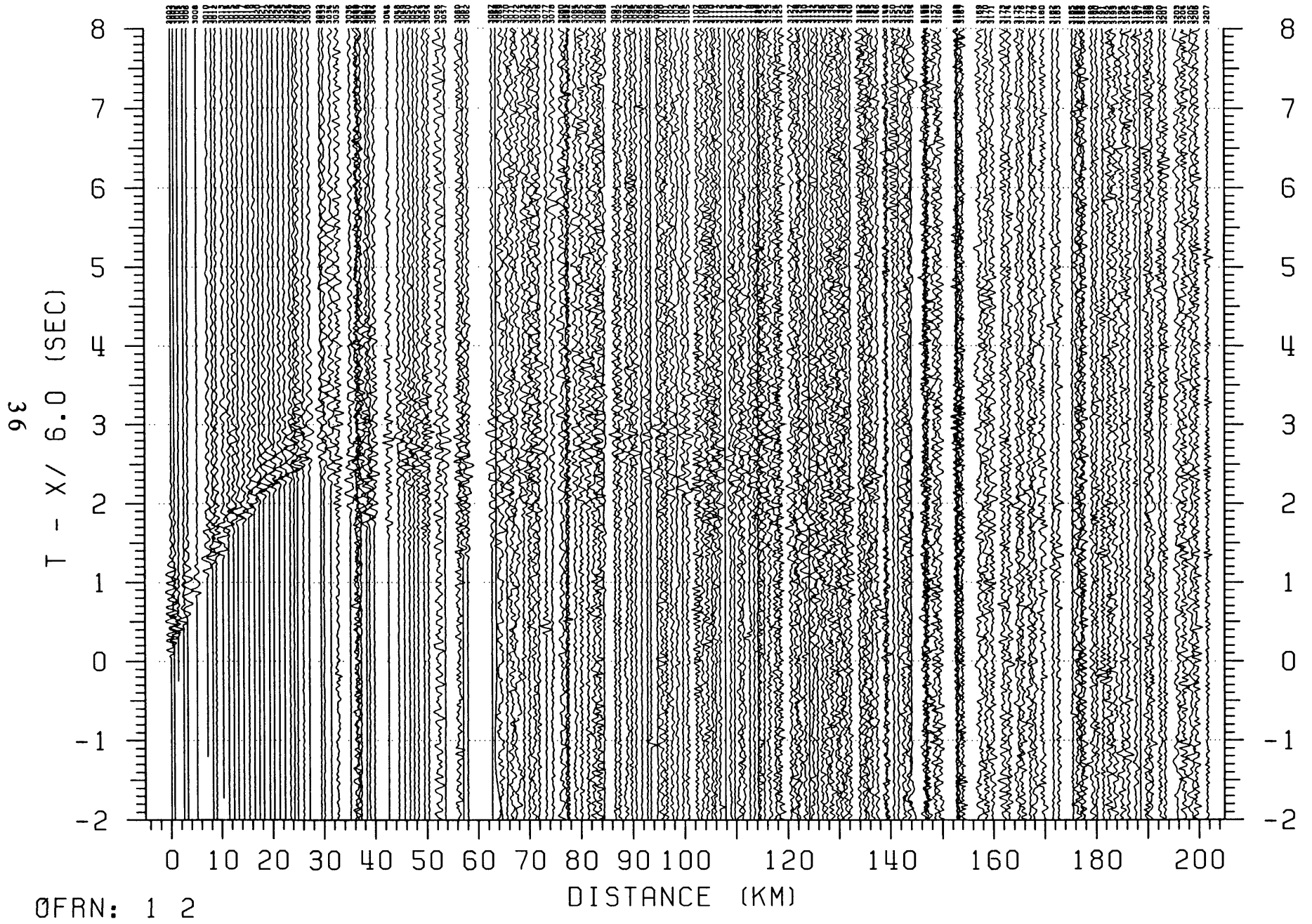


Figure D2: Peninsula line, Shot 2, Shotpoint 7, Vertical component of in-line traces.

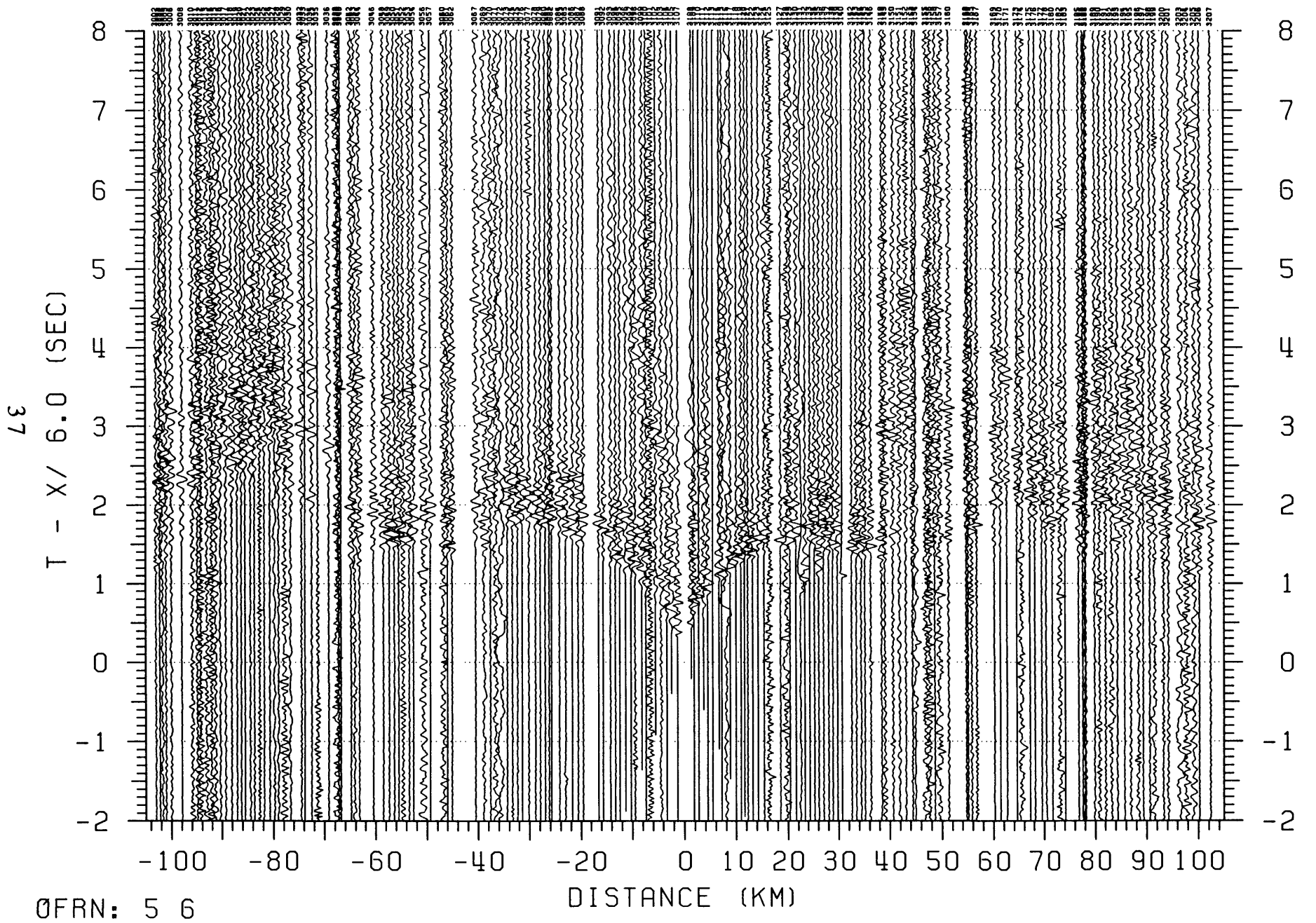


Figure D3: Peninsula line, Shot 2, Shotpoint 7, North-south component of in-line traces.

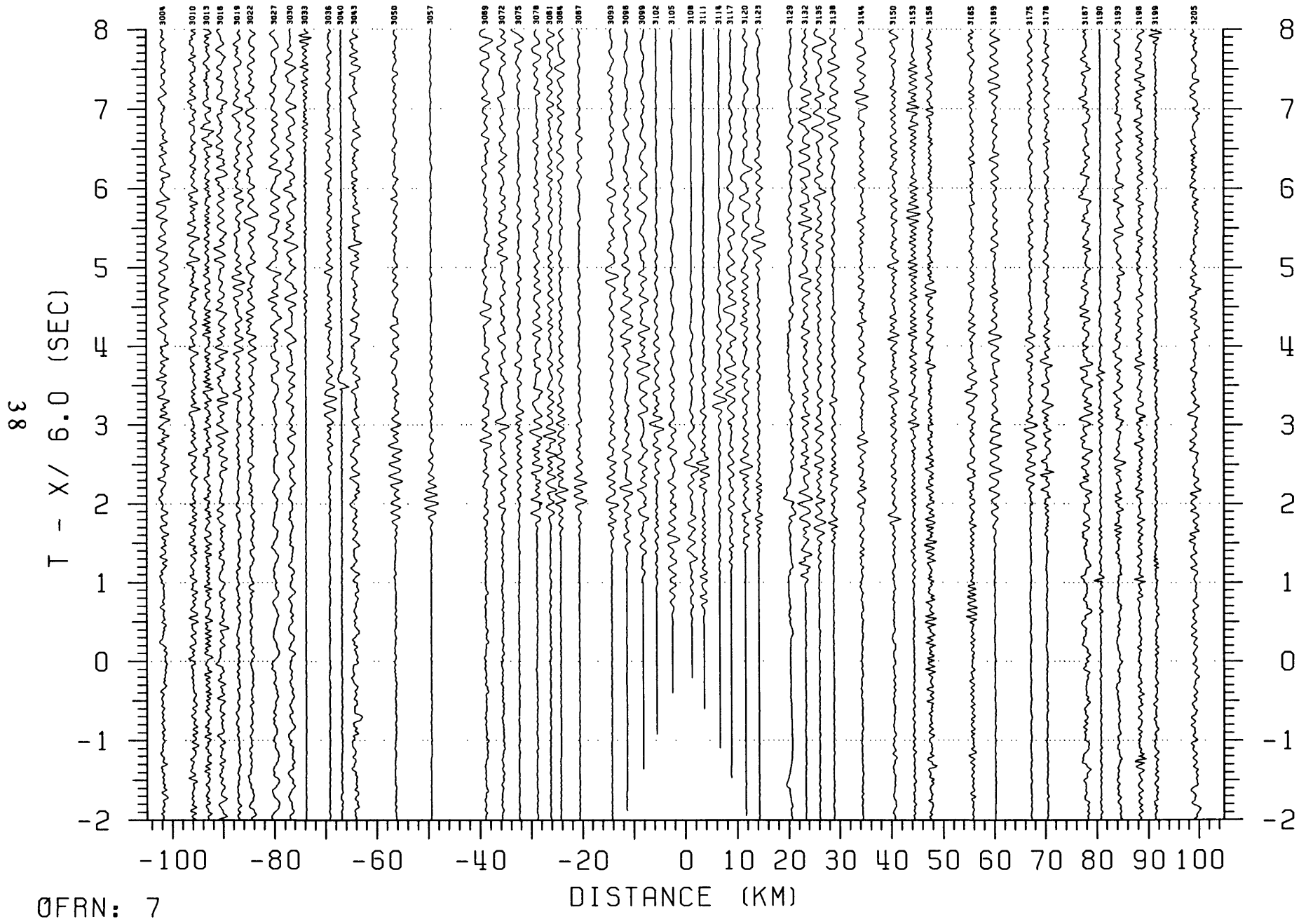
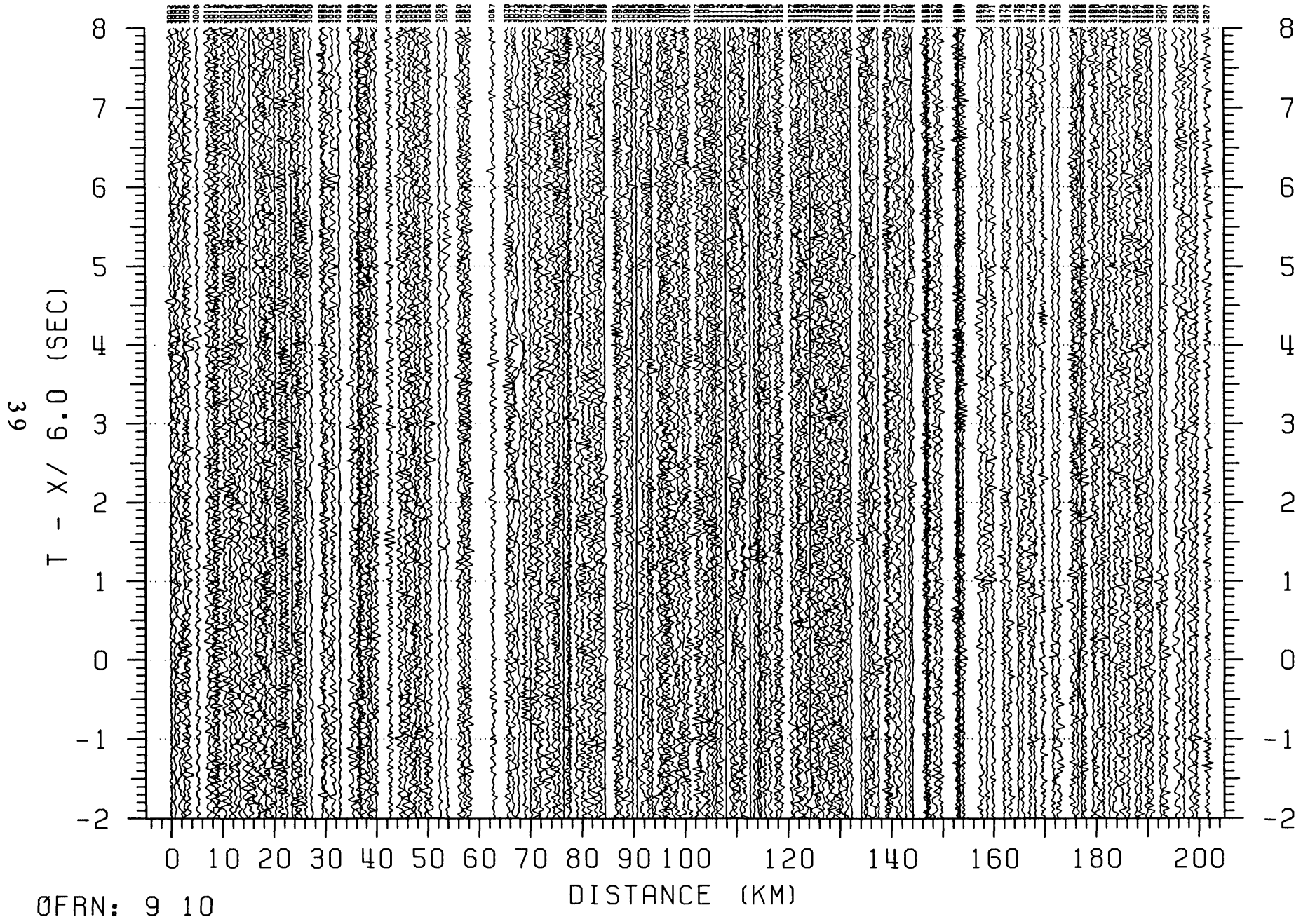


Figure D4: Peninsula line, Shot 3, Shotpoint 17, Vertical component of fan-shot traces.



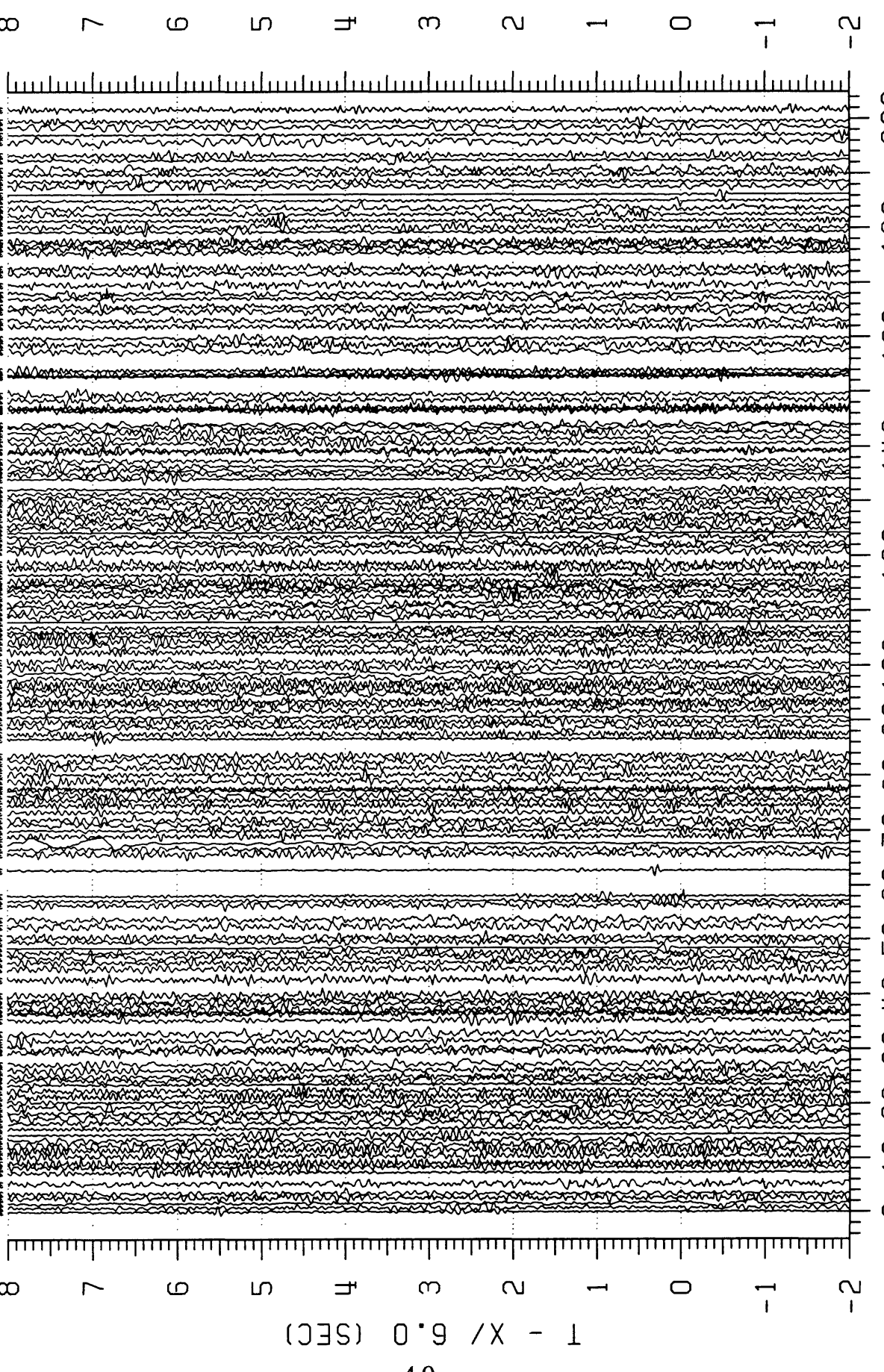
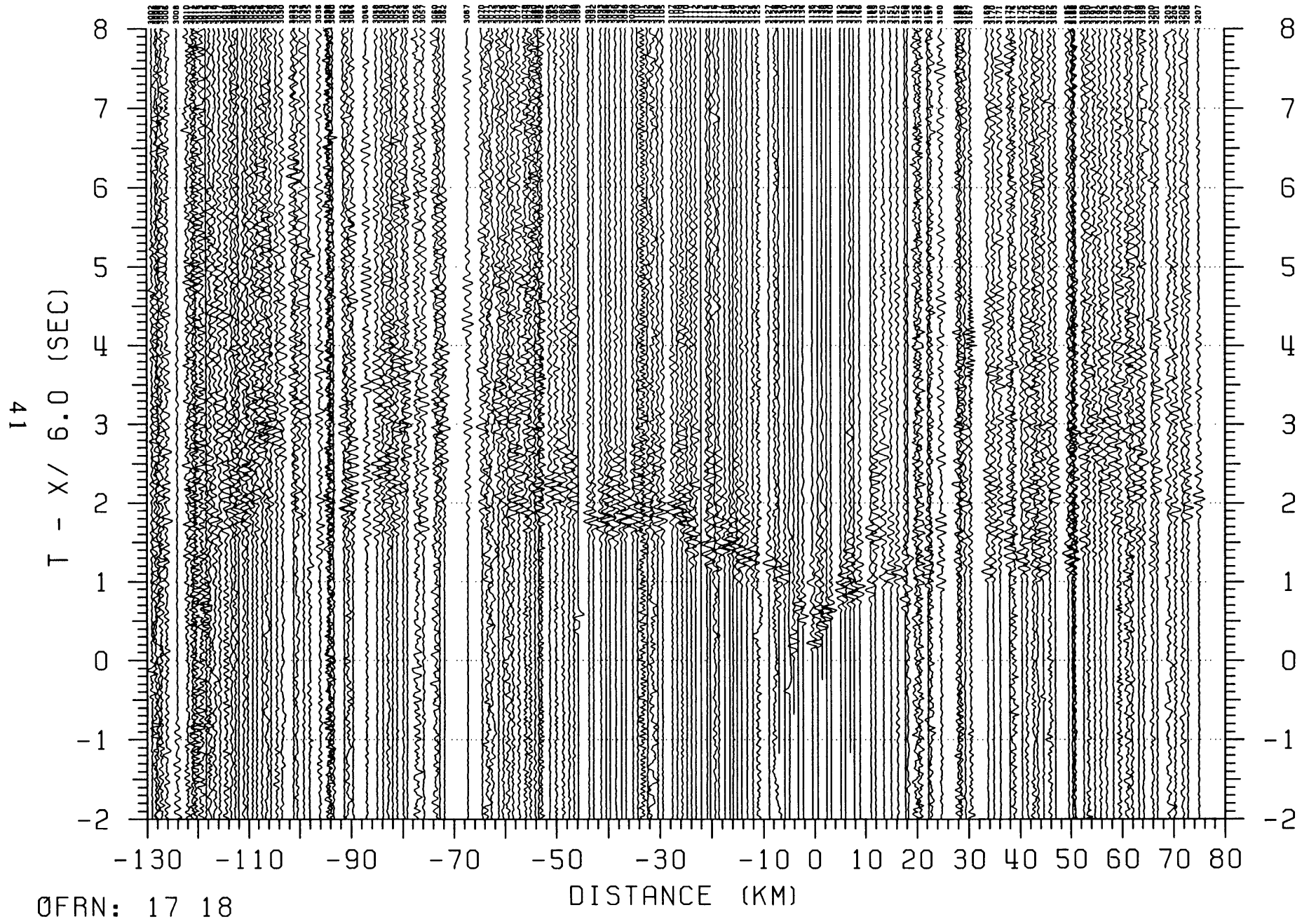


Figure D5: Peninsula line, Shot 4, Shotpoint 18, Vertical component of fan-shot traces.

Figure D6: Peninsula line, Shot 5, Shotpoint 6, Vertical component of in-line traces.



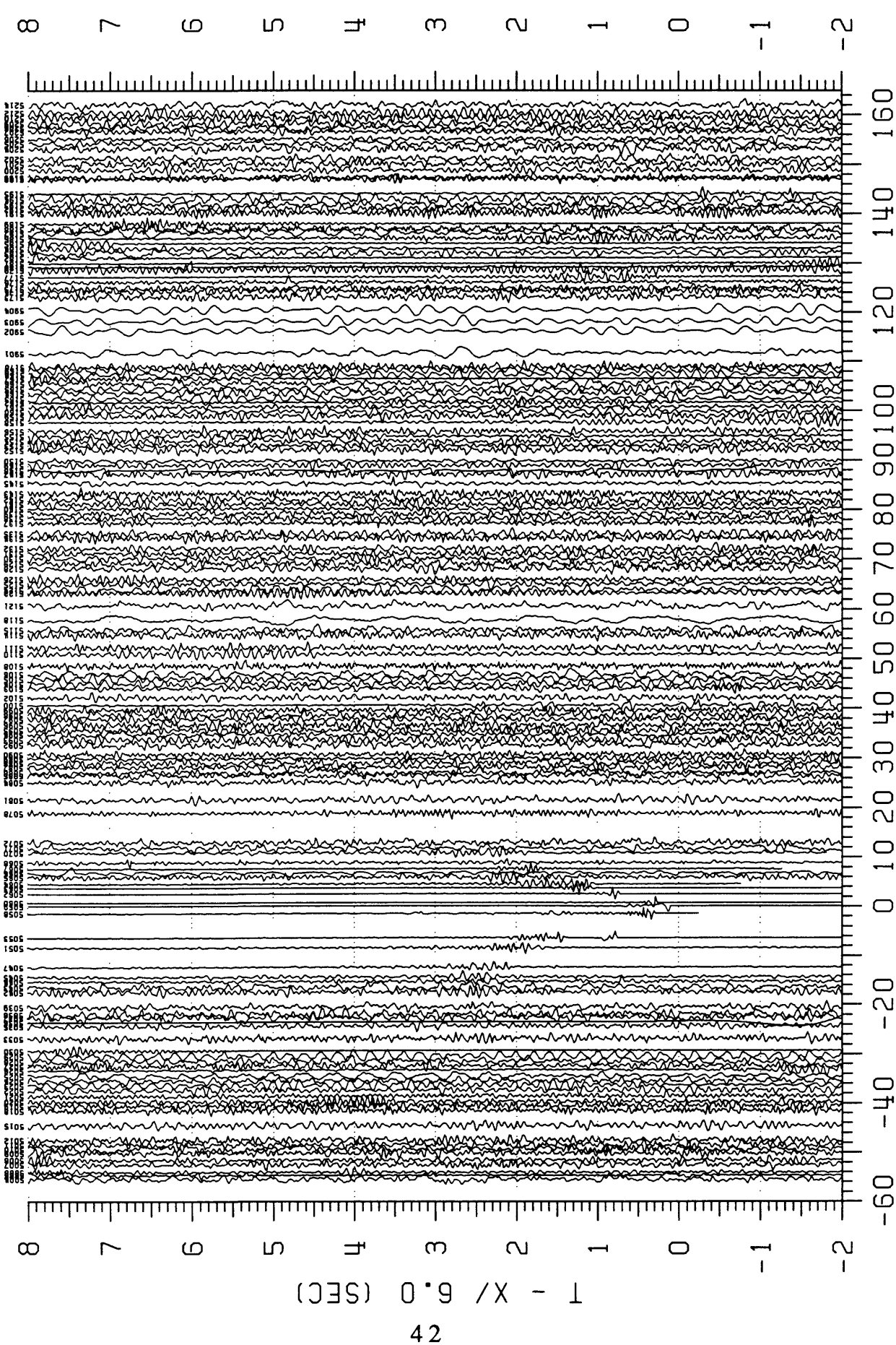


Figure D7: East-bay line, Shot 6, Shotpoint 4, Vertical component of in-line traces.

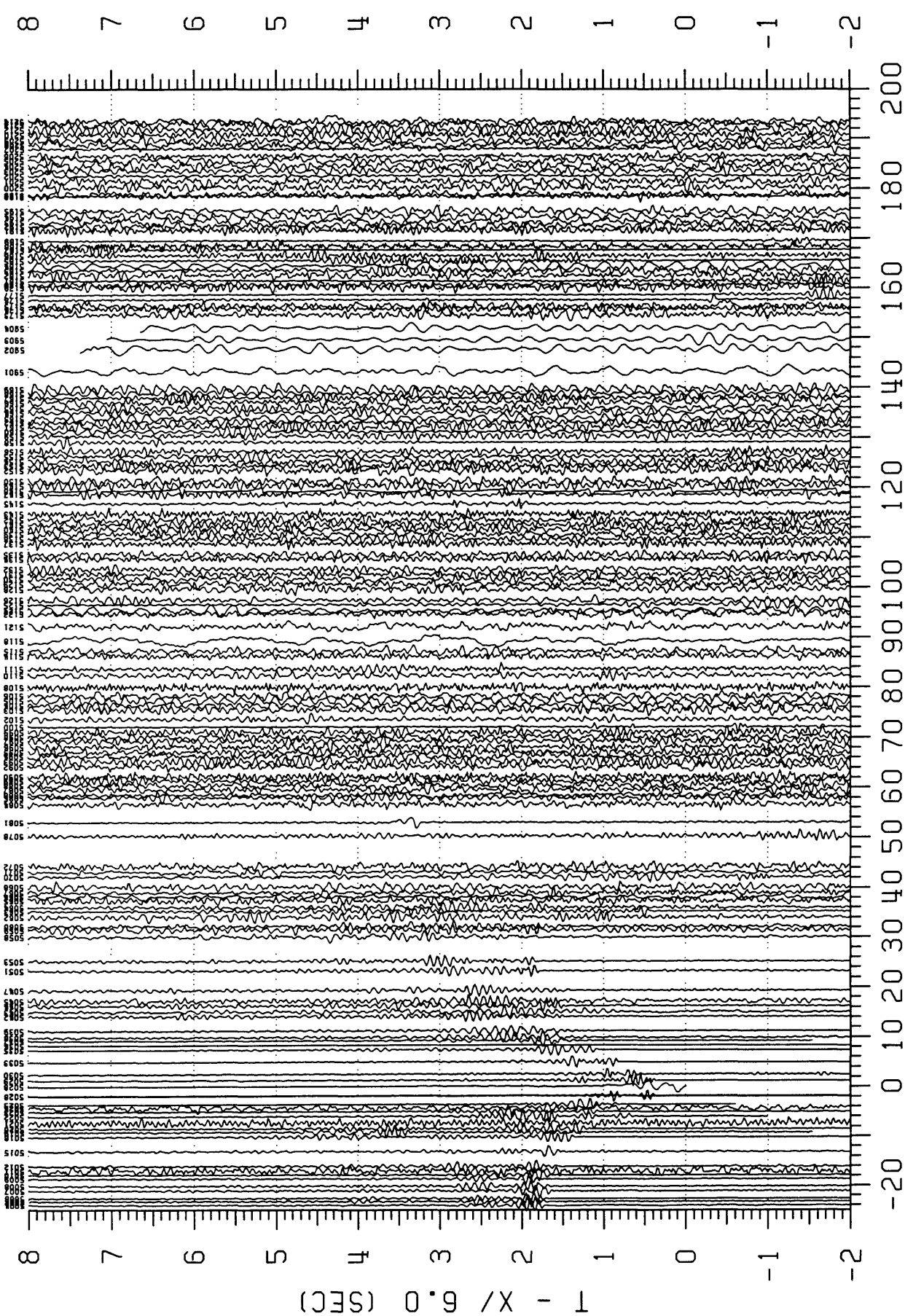
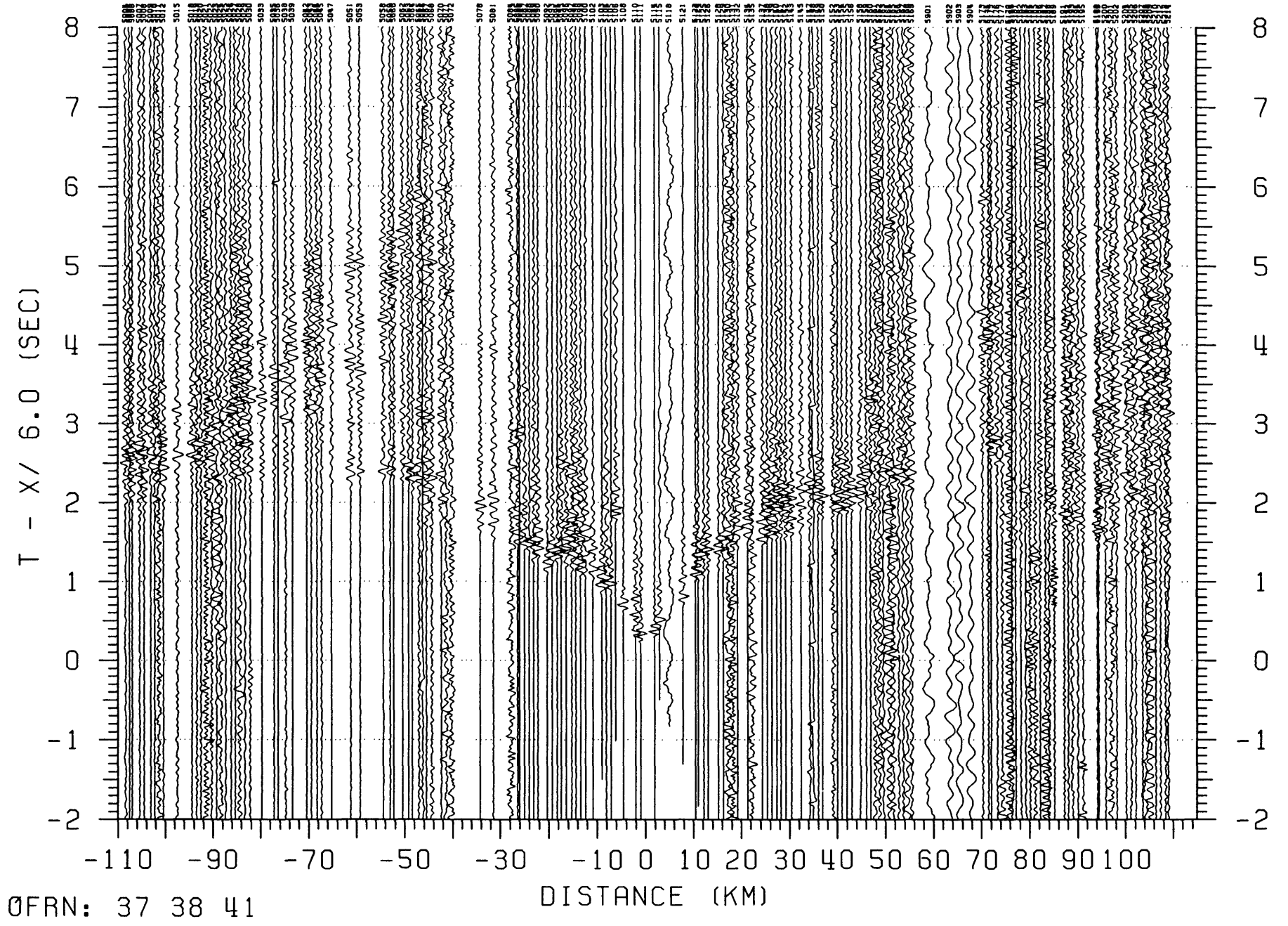


Figure D8: East-bay line, Shot 7, Shotpoint 15, Vertical component of in-line traces.

Figure D9: East-bay line, Shot 8, Shotpoint 3, Vertical component of in-line traces.



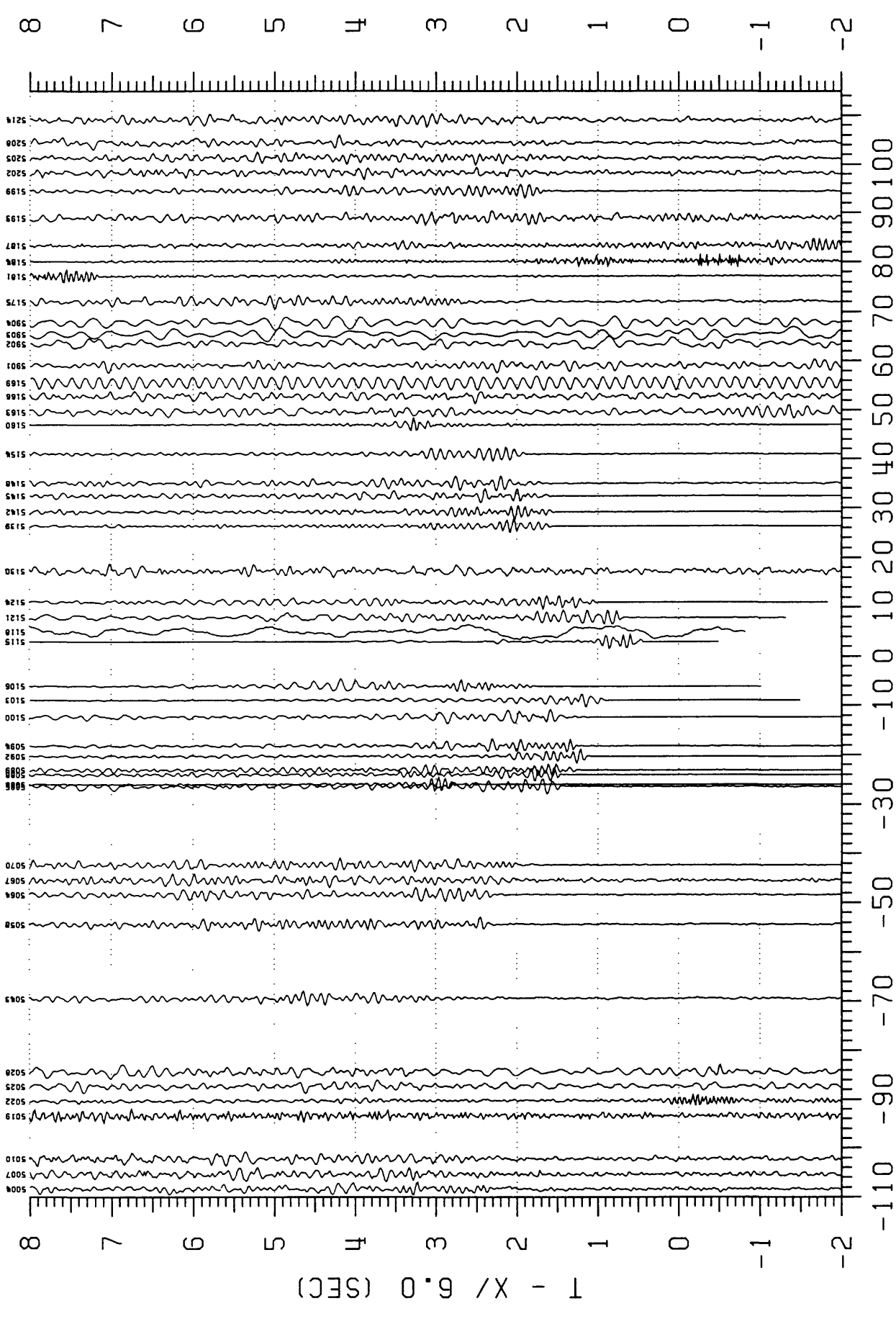


Figure D10: East-bay line, Shot 8, Shotpoint 3, North-south component of in-line traces.

Figure D11: East-bay line, Shot 9, Shotpoint 8, Vertical component of in-line traces.

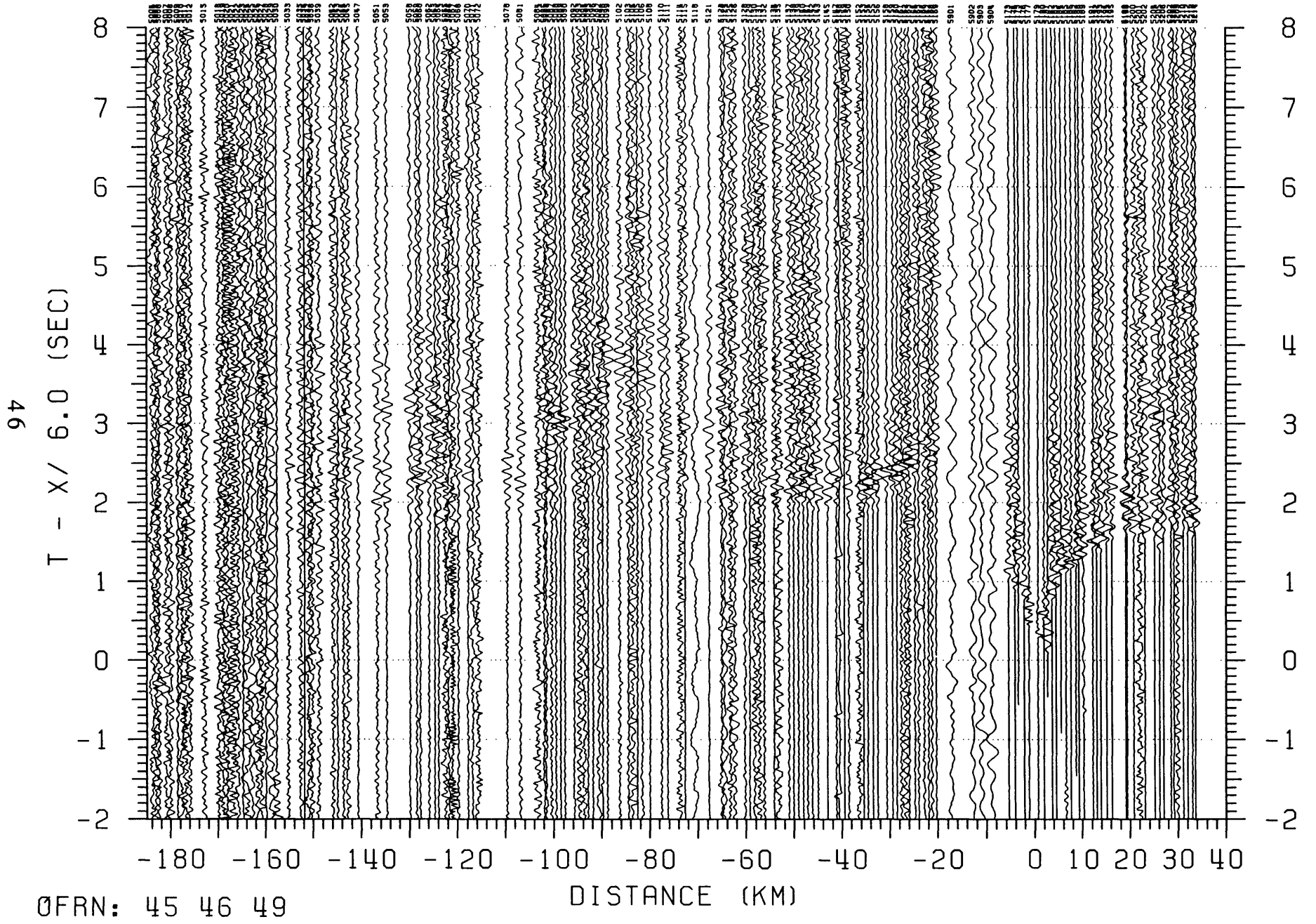


Figure D12: East-bay line, Shot 10, Shotpoint 5, Vertical component of in-line traces.

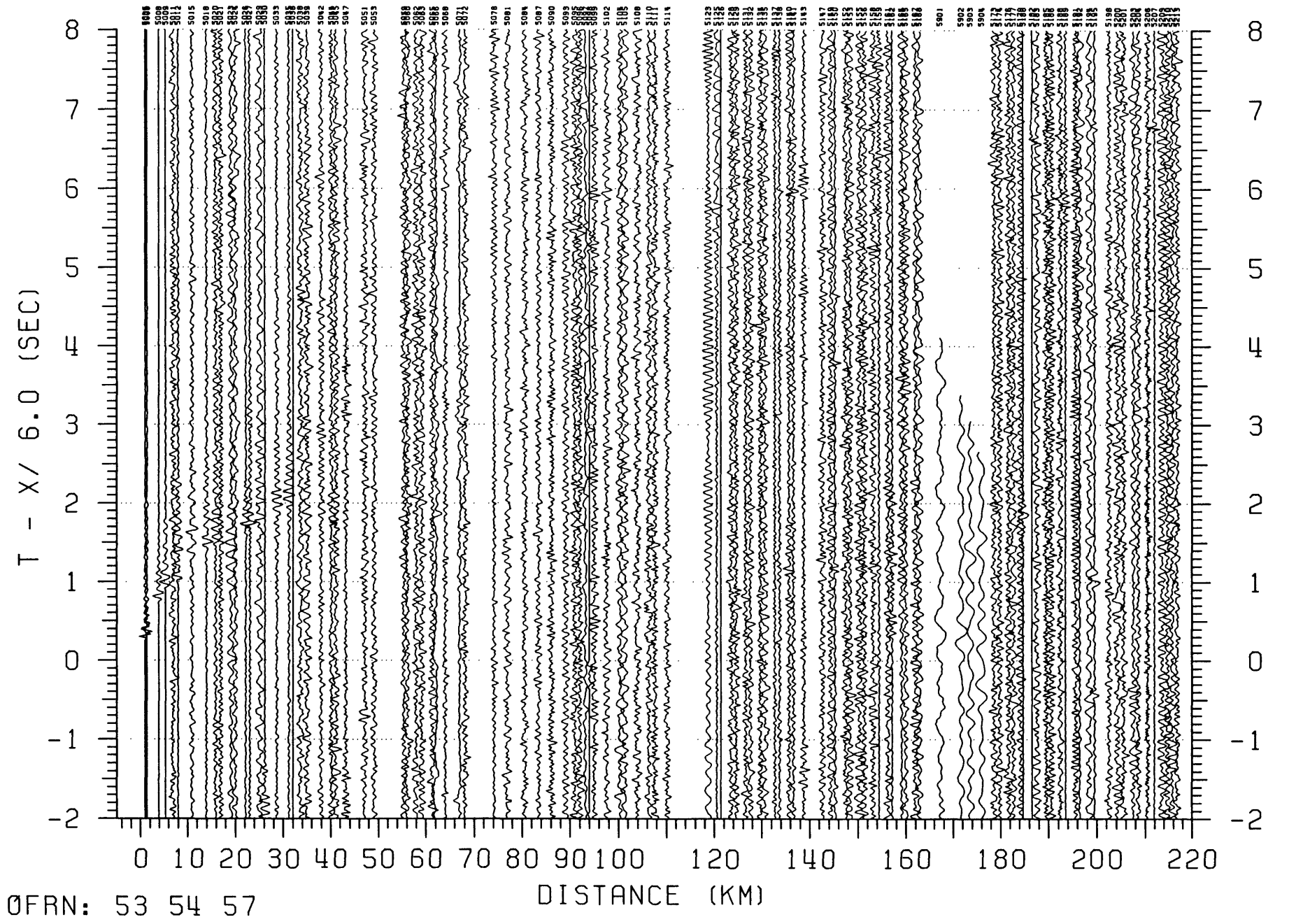


Figure D13: East-bay line, Shot 11, Shotpoint 1, Vertical component of in-line traces.

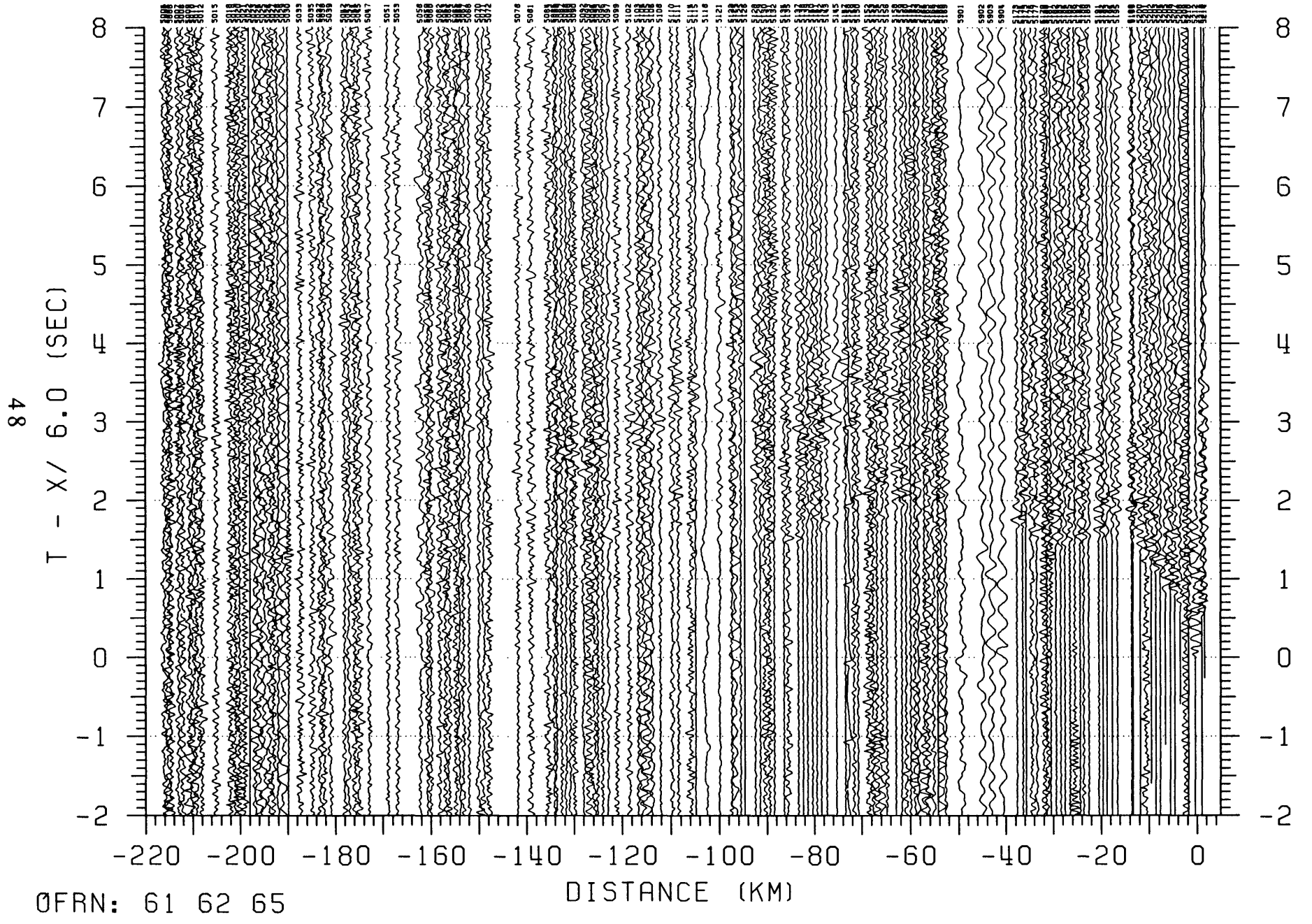


Figure D14: East-bay line, Shot 12, Shotpoint 2, Vertical component of in-line traces.

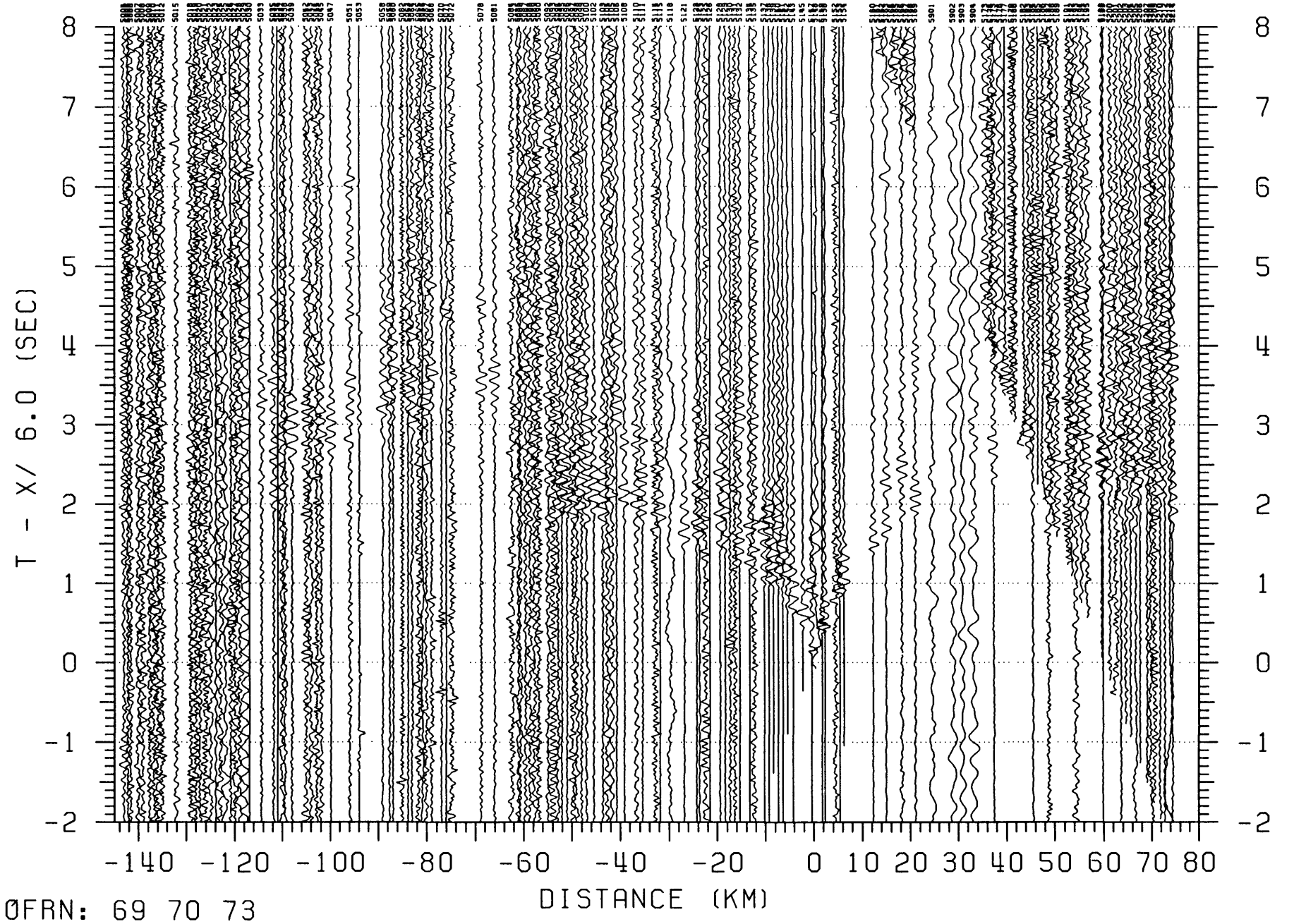


Figure D15: East-bay line, Shot 13, Shotpoint 13, Vertical component of in-line traces.

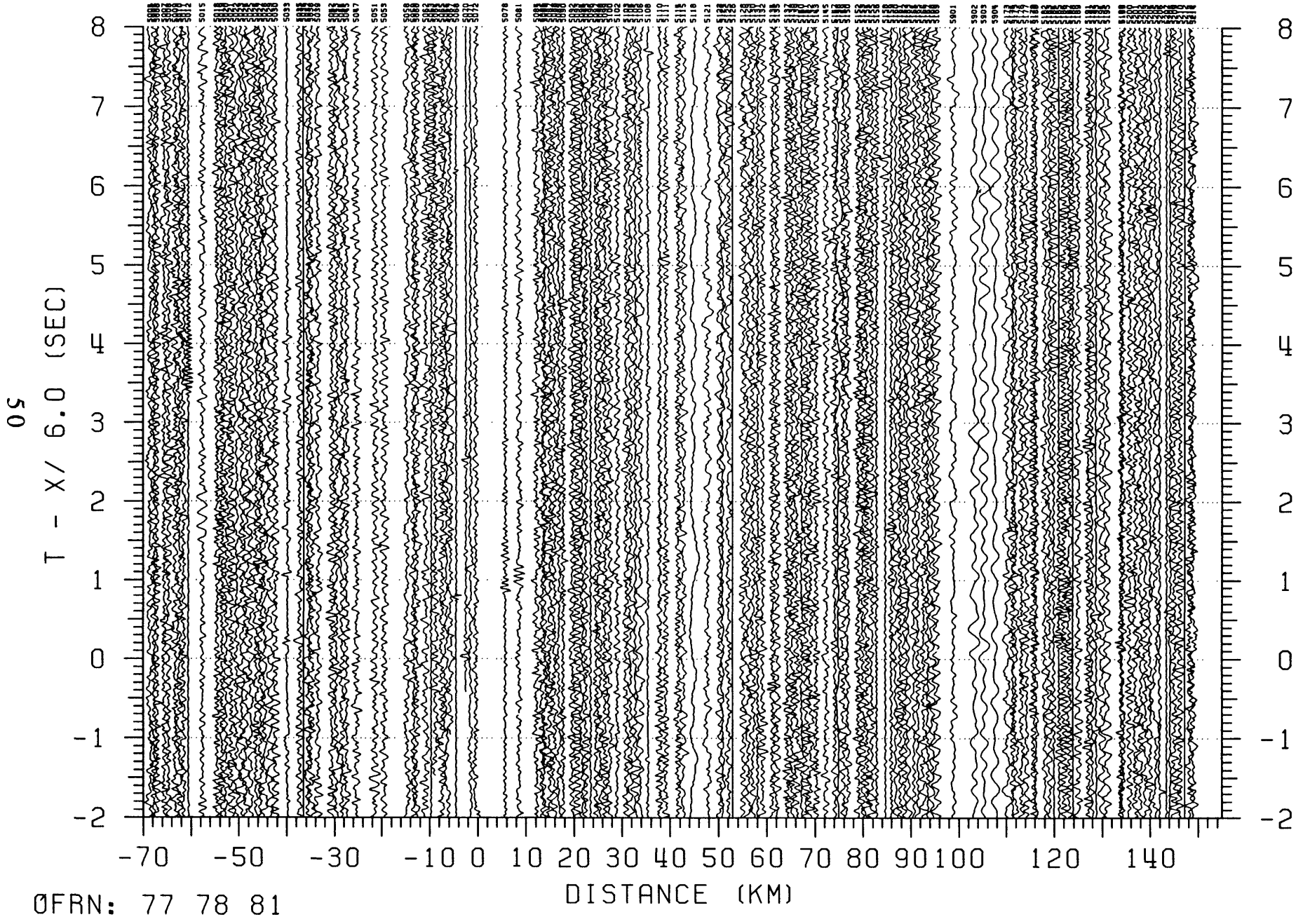
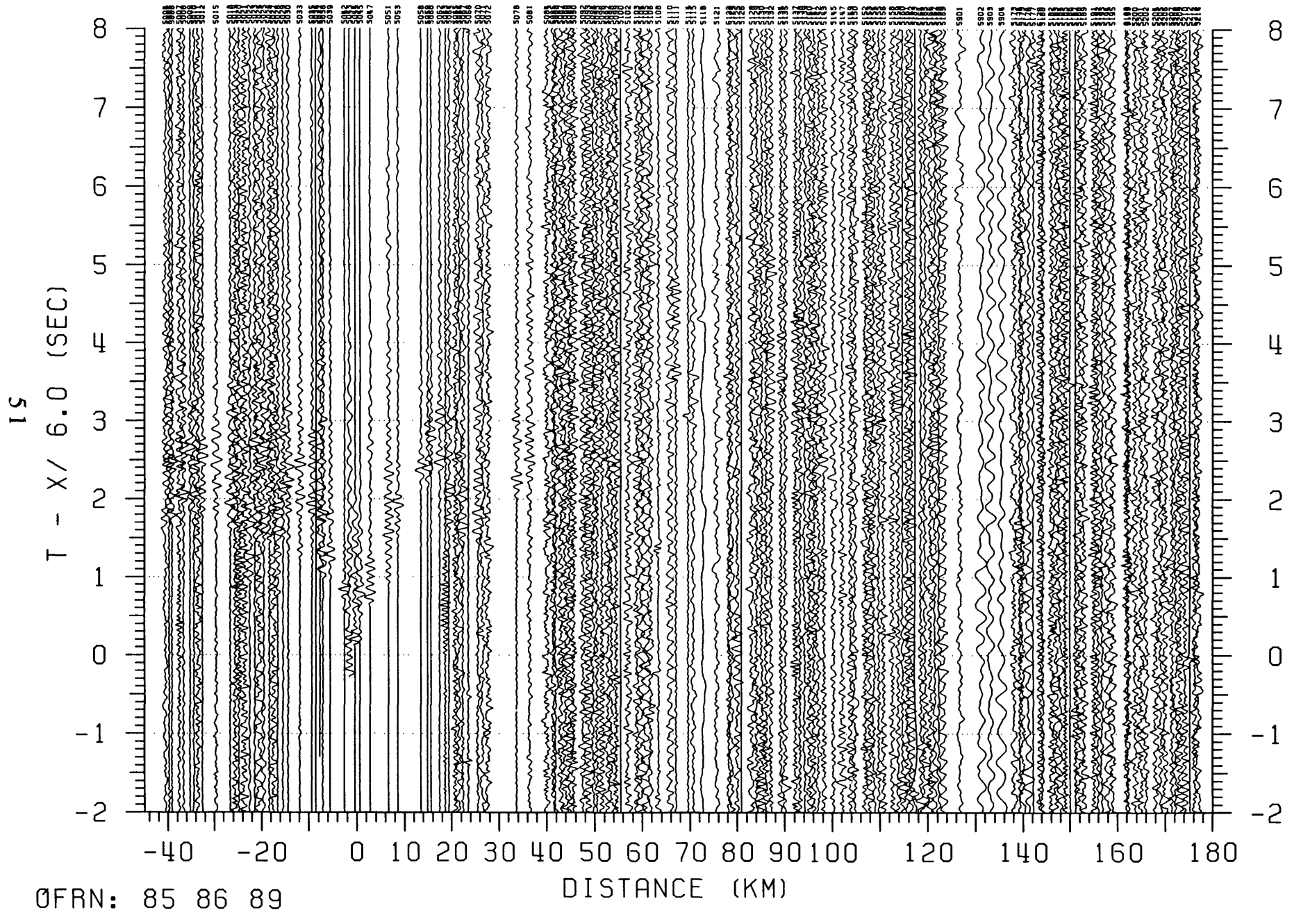


Figure D16: East-bay line, Shot 14, Shotpoint 14, Vertical component of in-line traces.



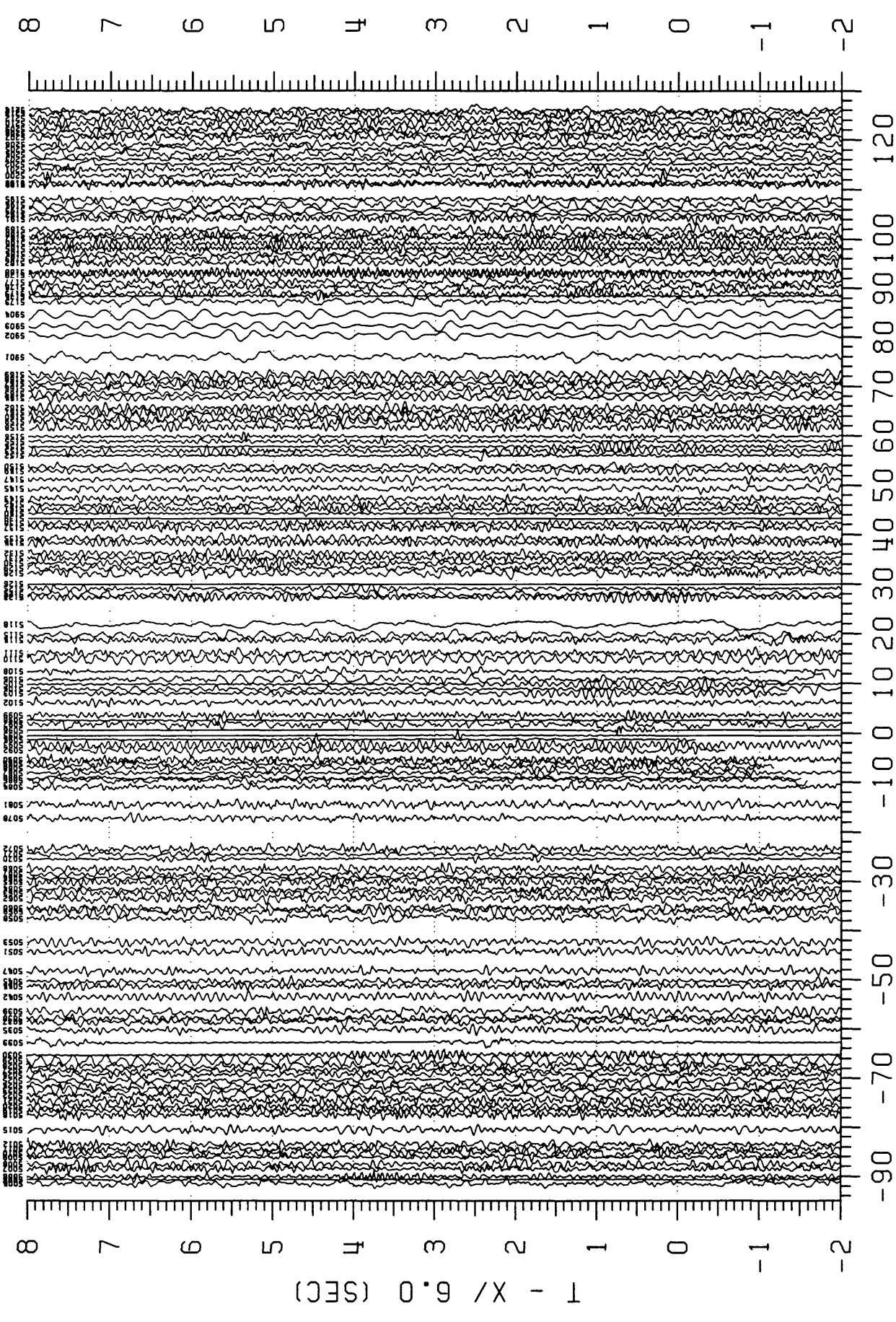


Figure D17: East-bay line, Shot 15, Shotpoint 12, Vertical component of in-line traces.

Figure D18: East-bay line, Shot 16, Shotpoint 10, Vertical component of in-line traces.

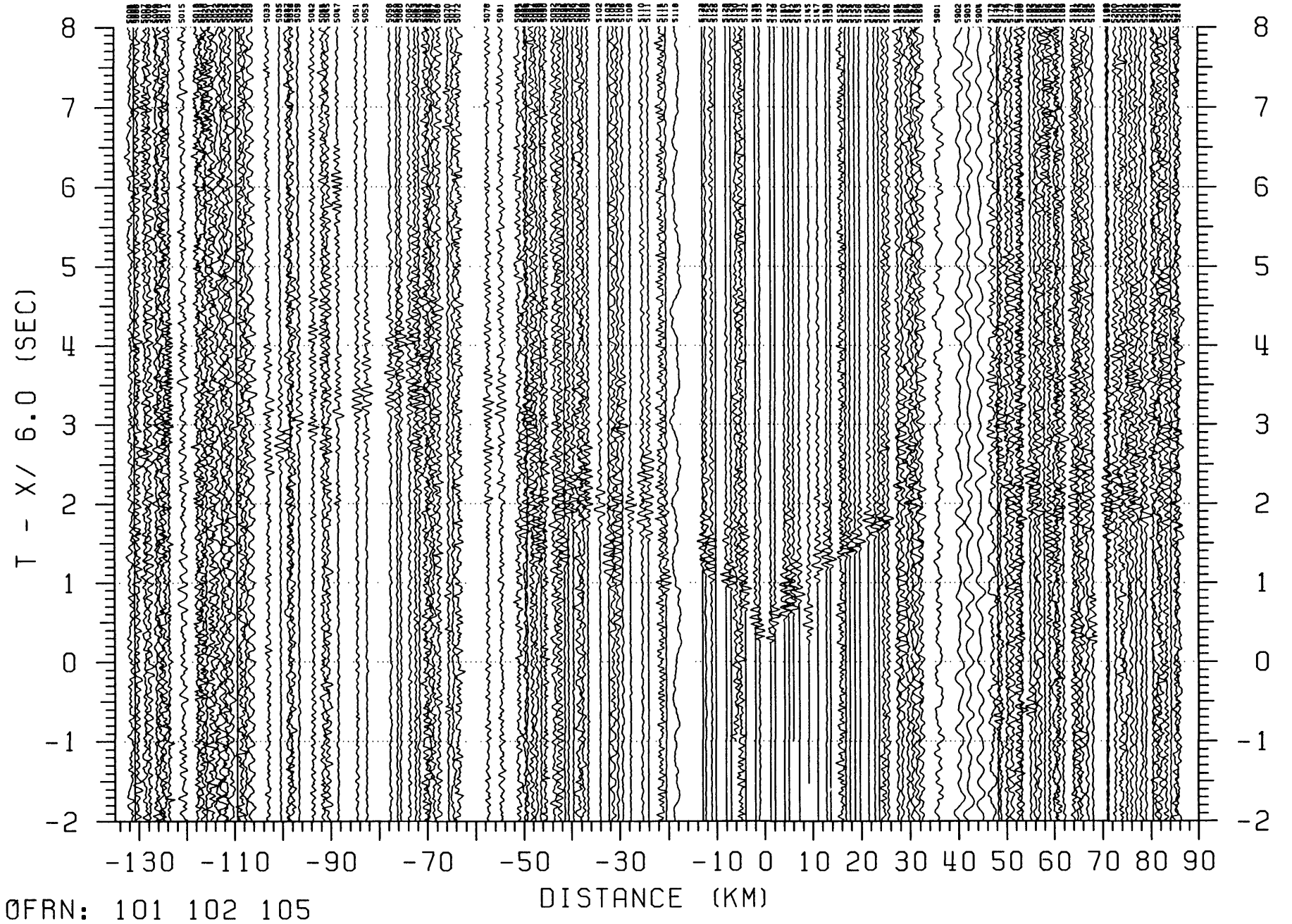


Figure D19: East-bay line, Shot 17, Shotpoint 9, Vertical component of in-line traces.

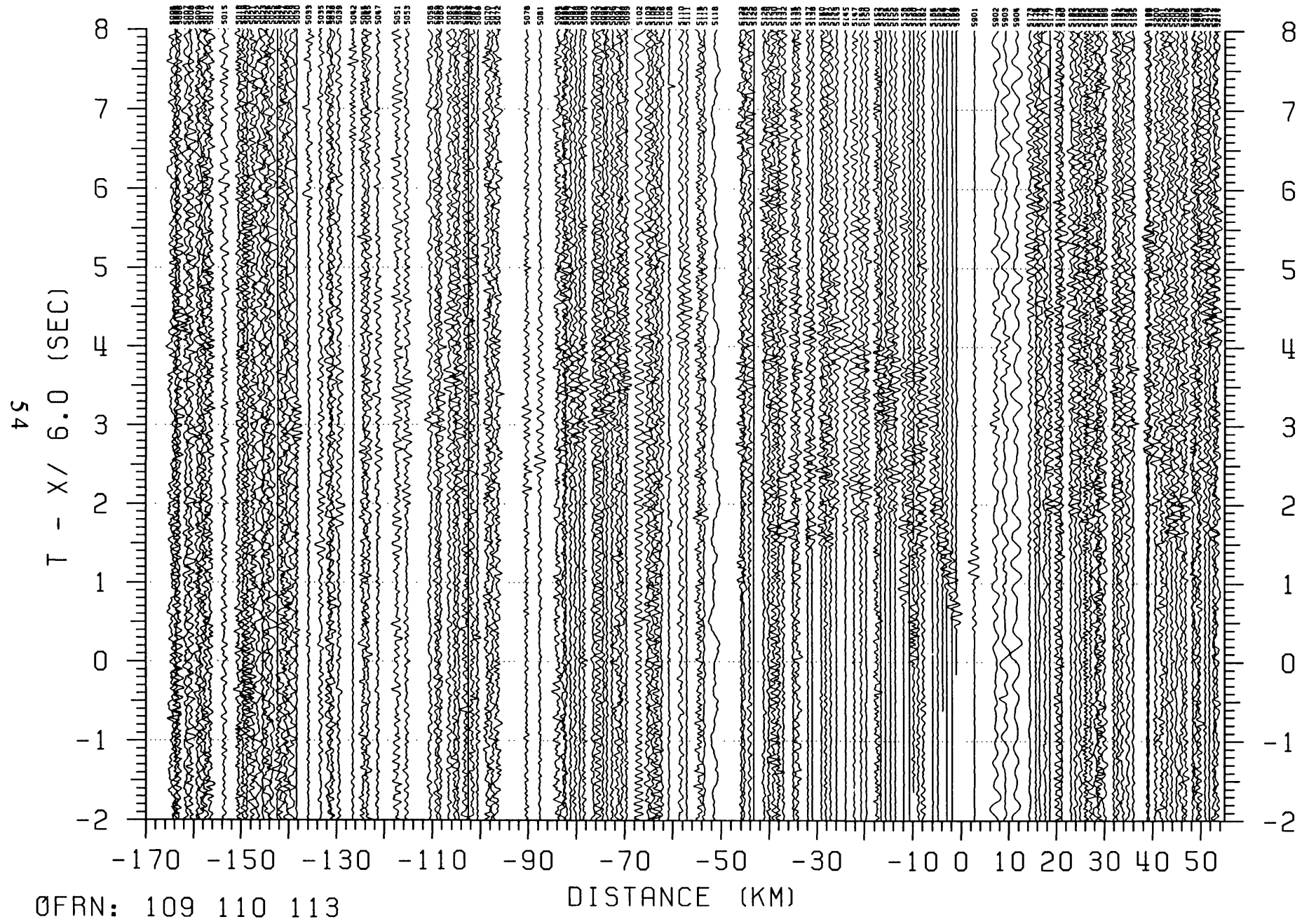


Figure D20: Cross line, Shot 1, Shotpoint 5, Vertical component of fan-shot traces.

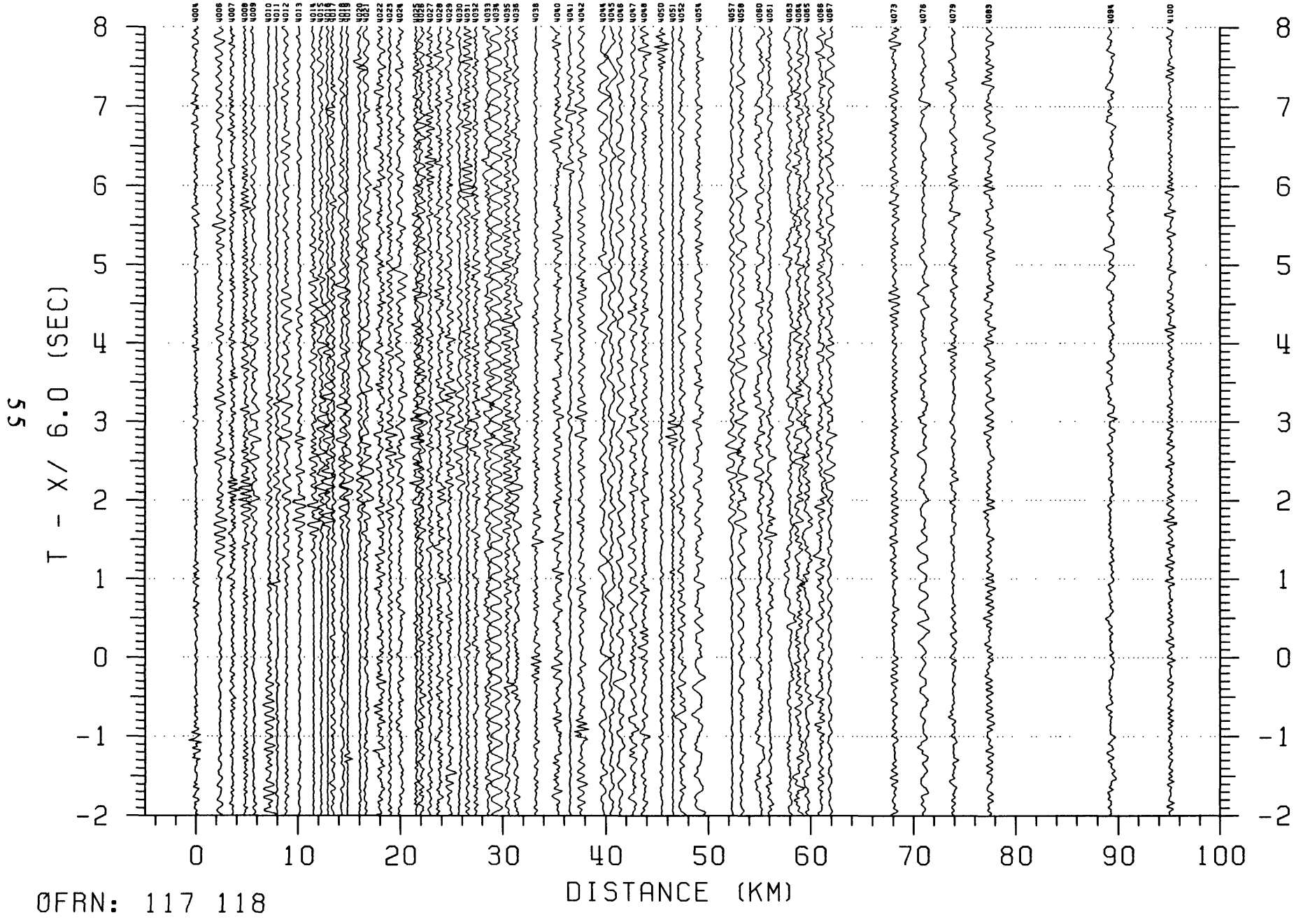


Figure D21: Cross line, Shot 2, Shotpoint 7, Vertical component of in-line traces.

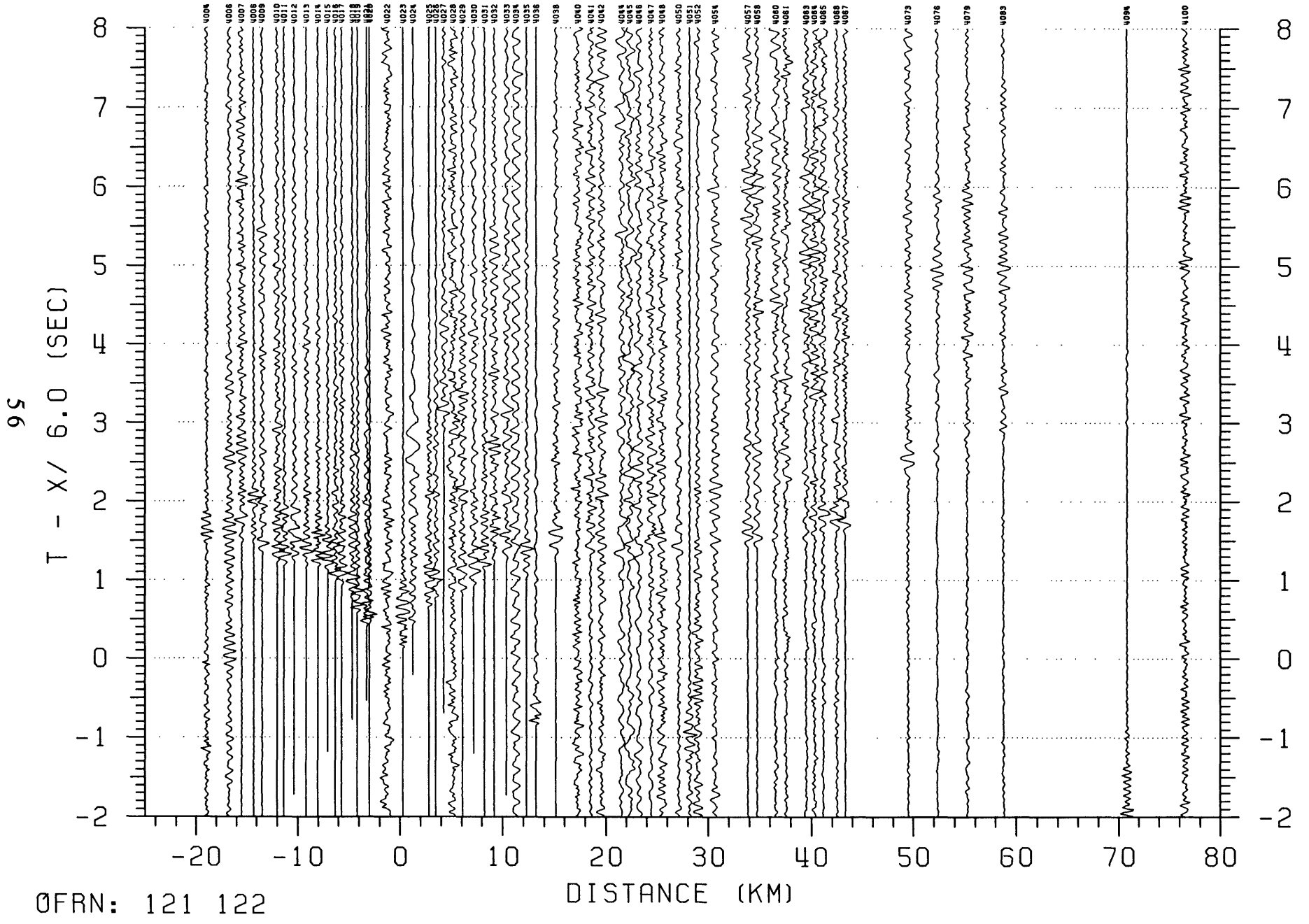


Figure D22: Cross line, Shot 3, Shotpoint 17, Vertical component of in-line traces.

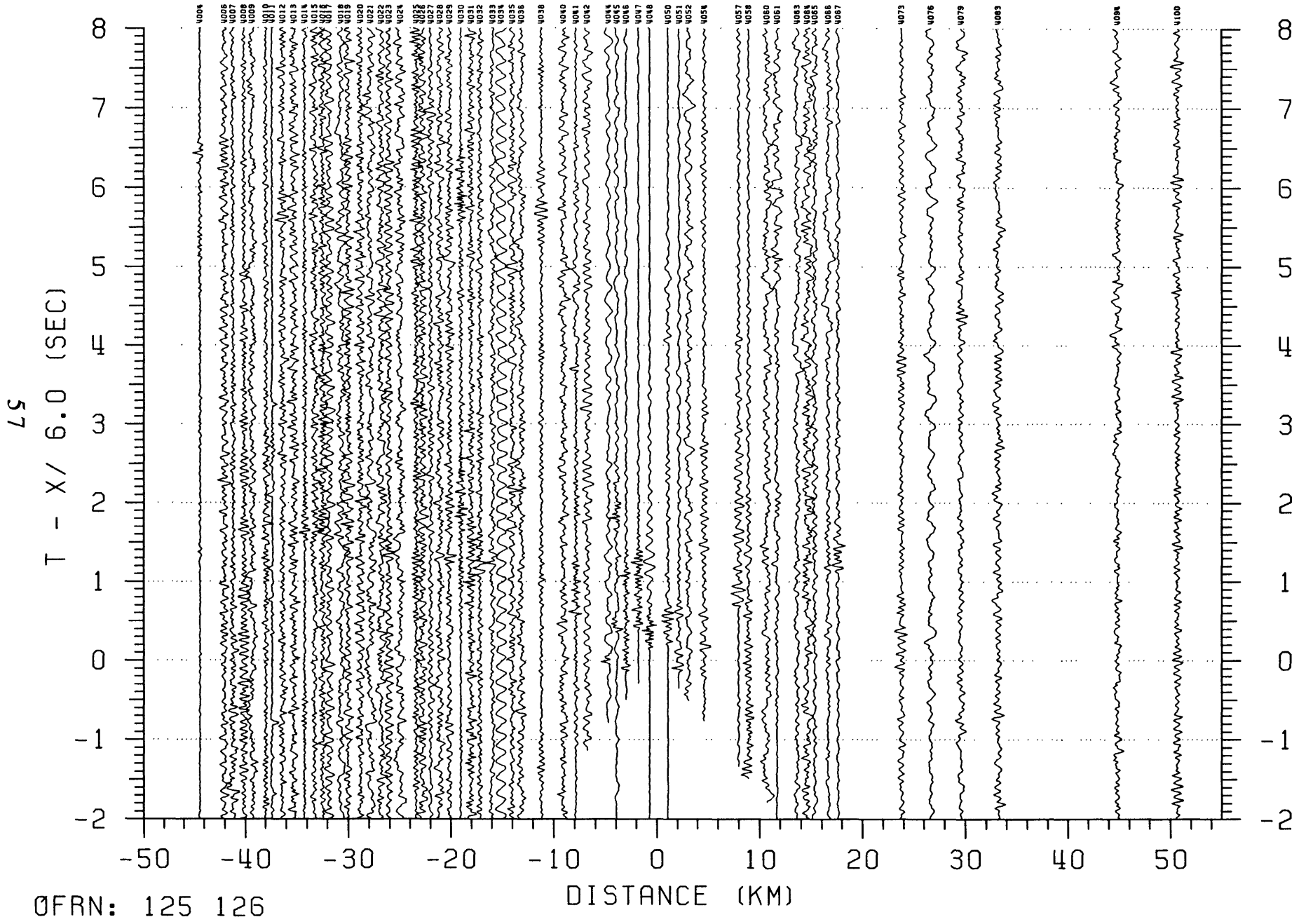


Figure D23: Cross line, Shot 4, Shotpoint 18, Vertical component of in-line traces.

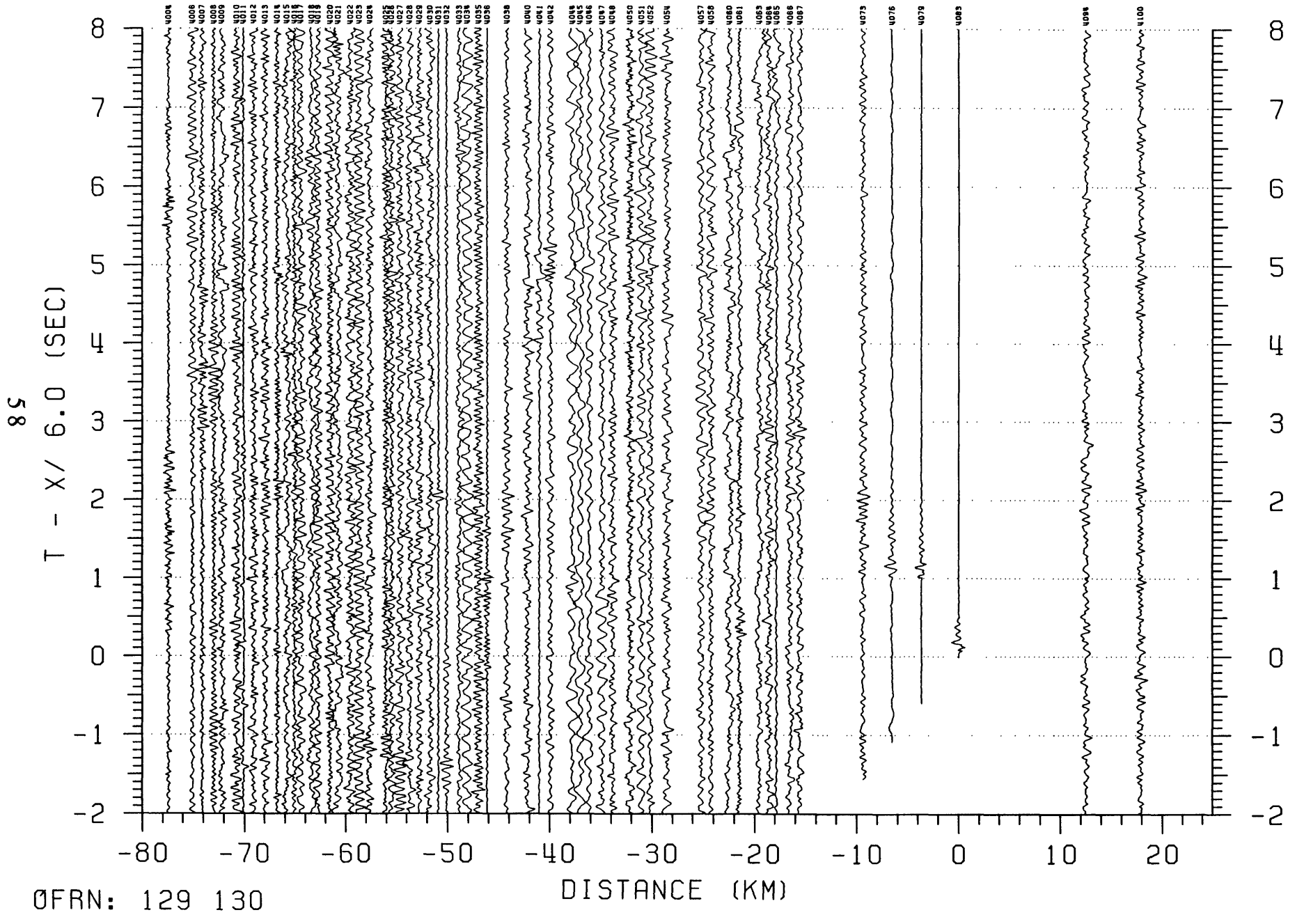


Figure D24: Cross line, Shot 5, Shotpoint 6, Vertical component of fan-shot traces.

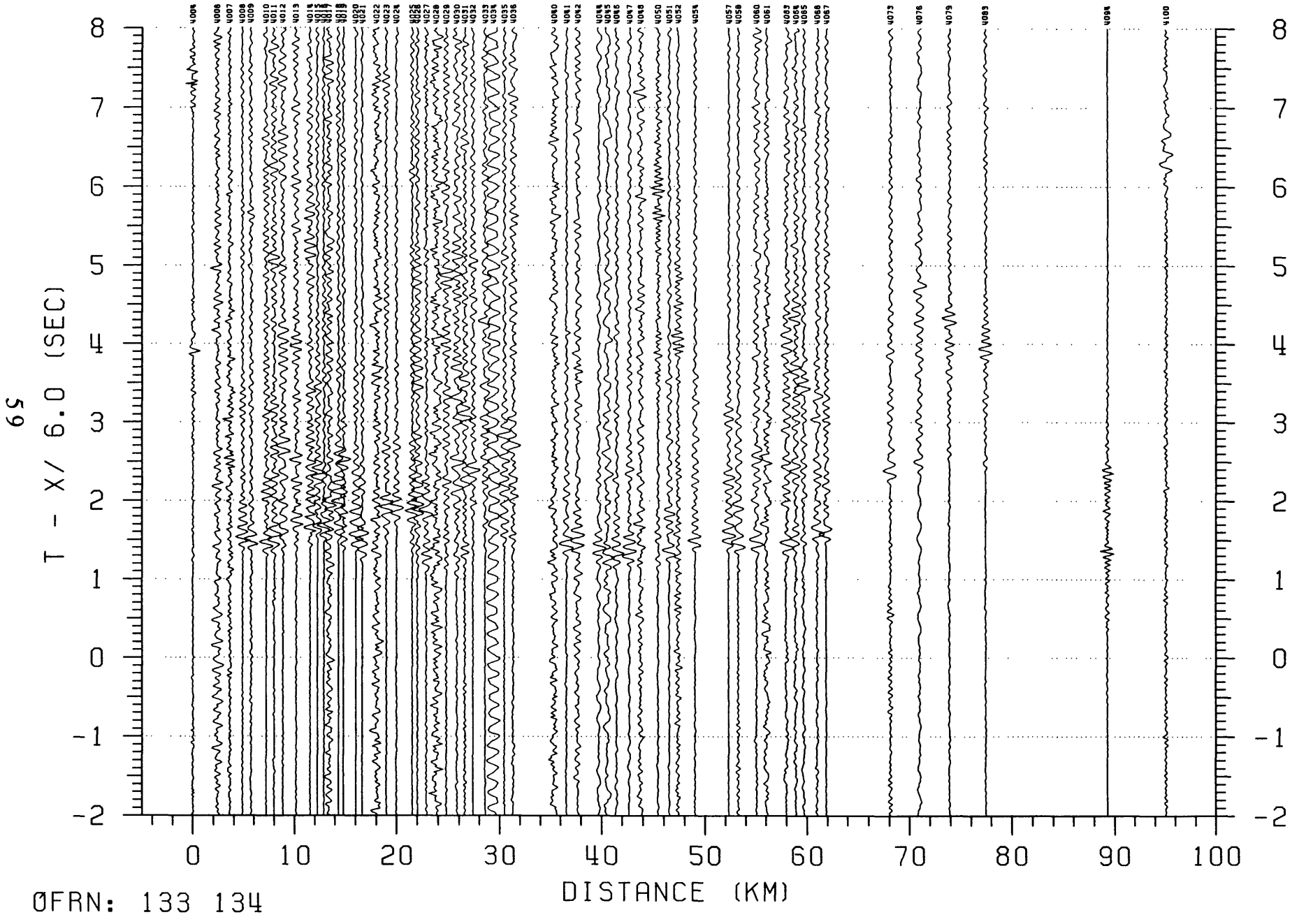
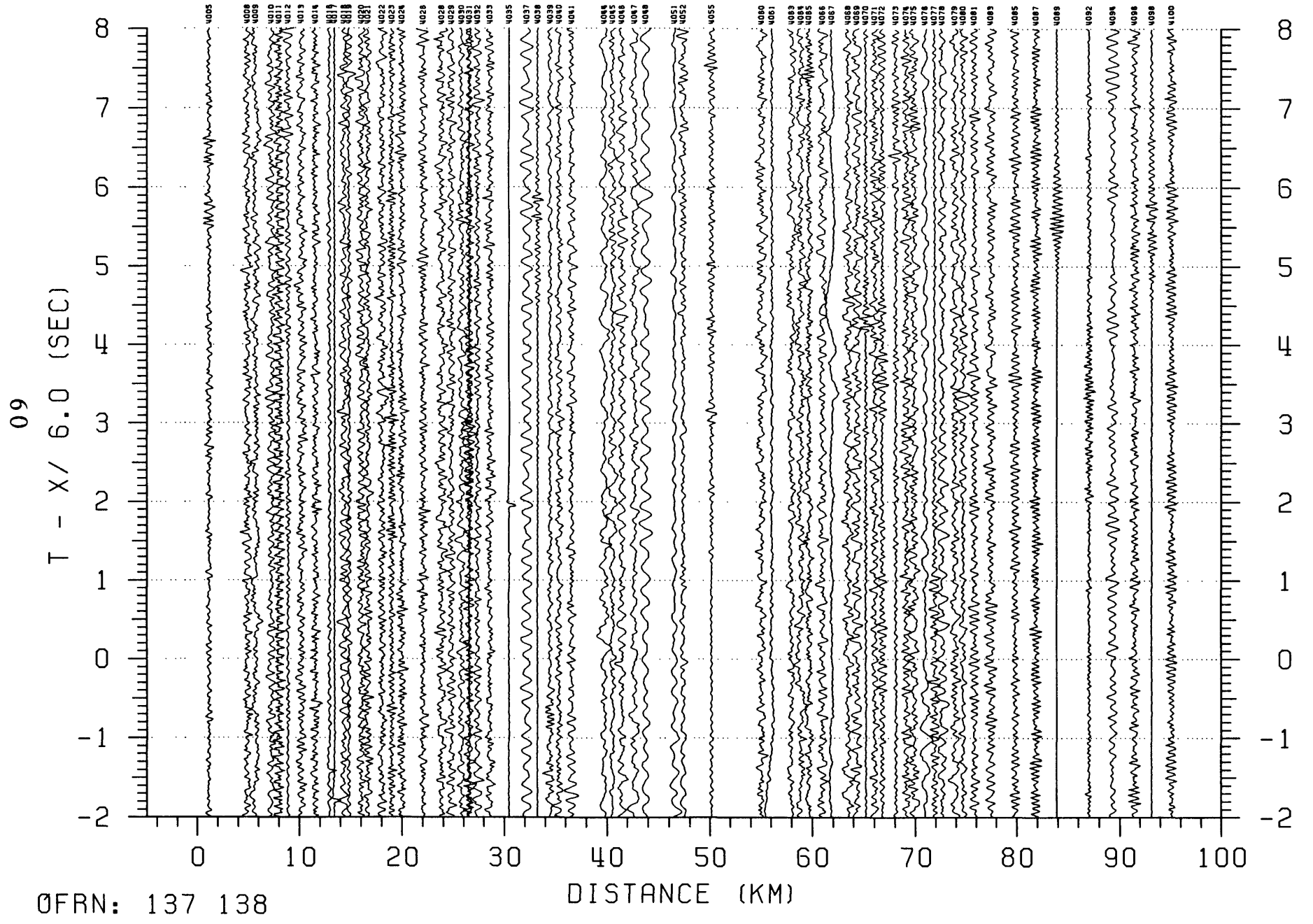


Figure D25: Cross line, Shot 6, Shotpoint 4, Vertical component of fan-shot traces.



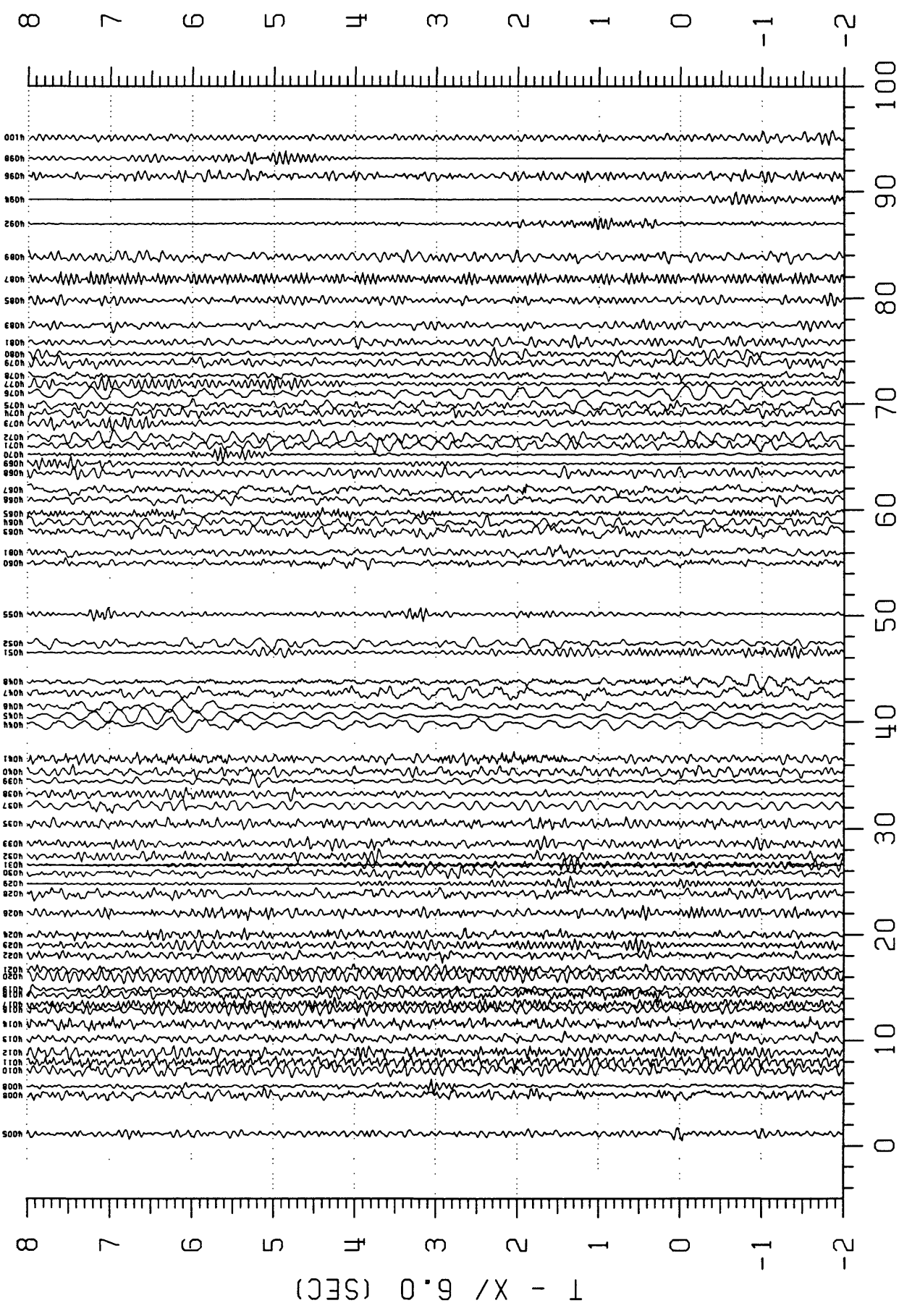


Figure D26: Cross line, Shot 7, Shotpoint 15, Vertical component of fan-shot traces.

Figure D27: Cross line, Shot 8, Shotpoint 3, Vertical component of in-line traces.

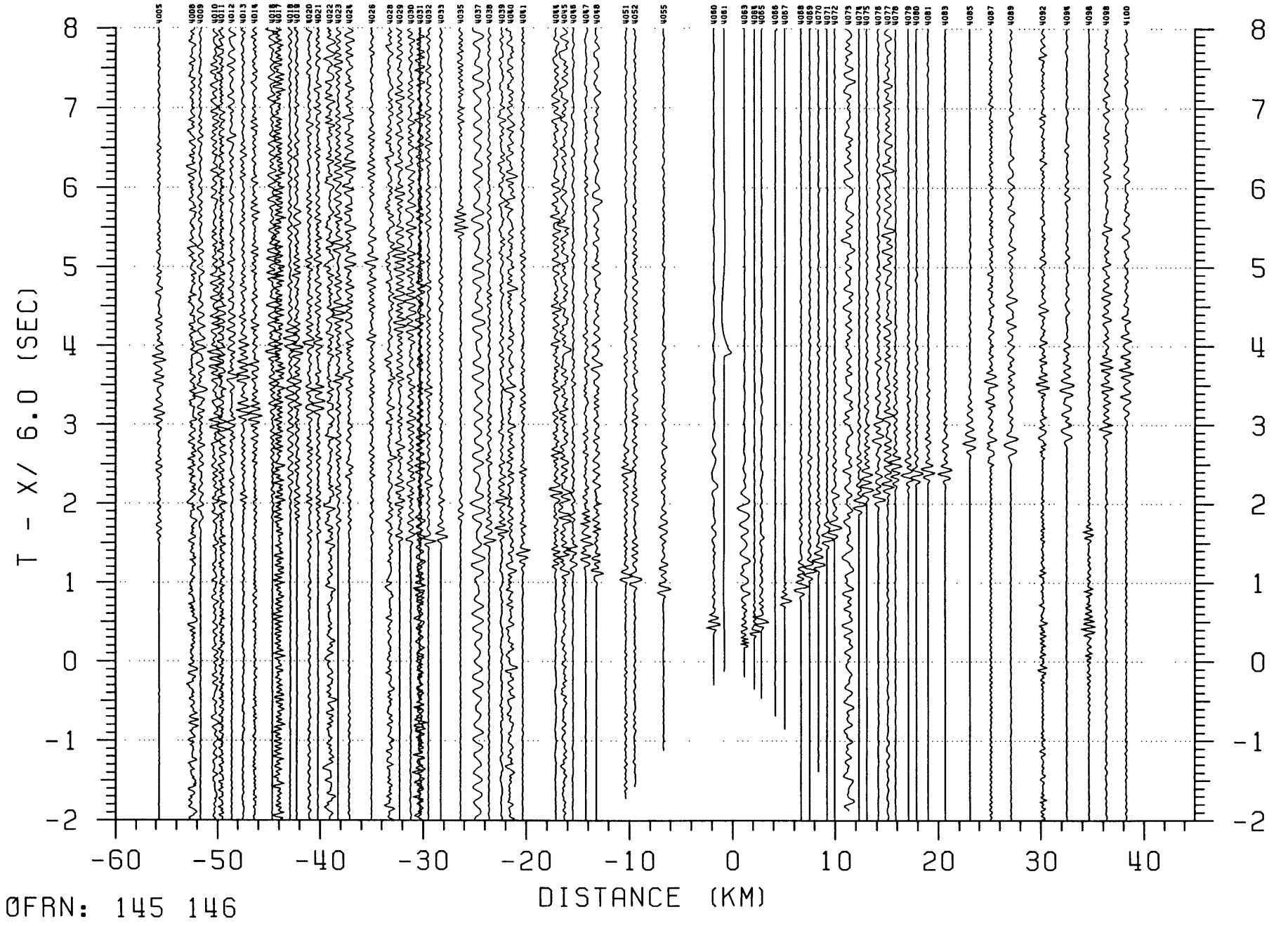


Figure D28: Cross line, Shot 9, Shotpoint 8, Vertical component of fan-shot traces.

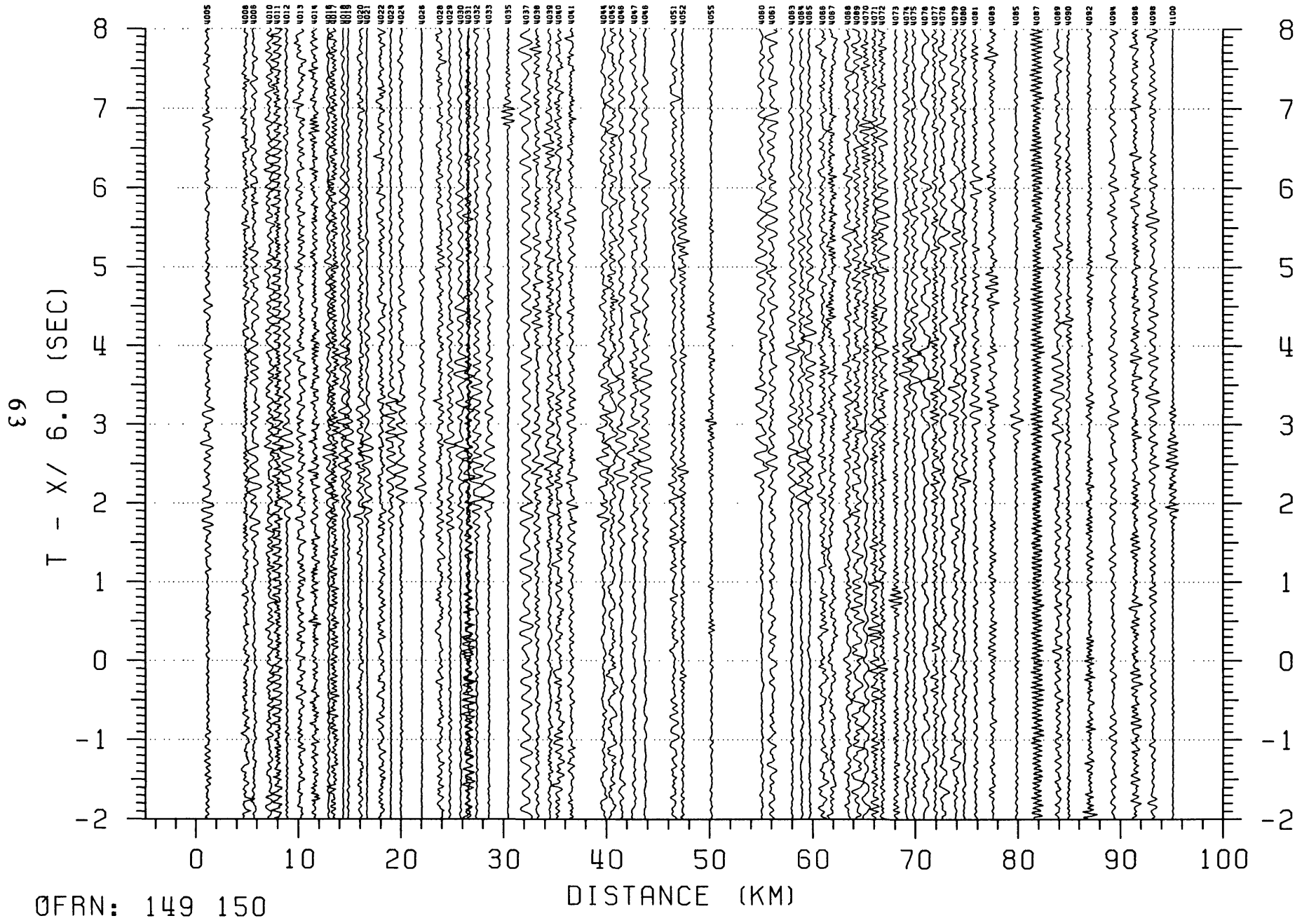


Figure D29: Cross line, Shot 10, Shotpoint 5, Vertical component of fan-shot traces.

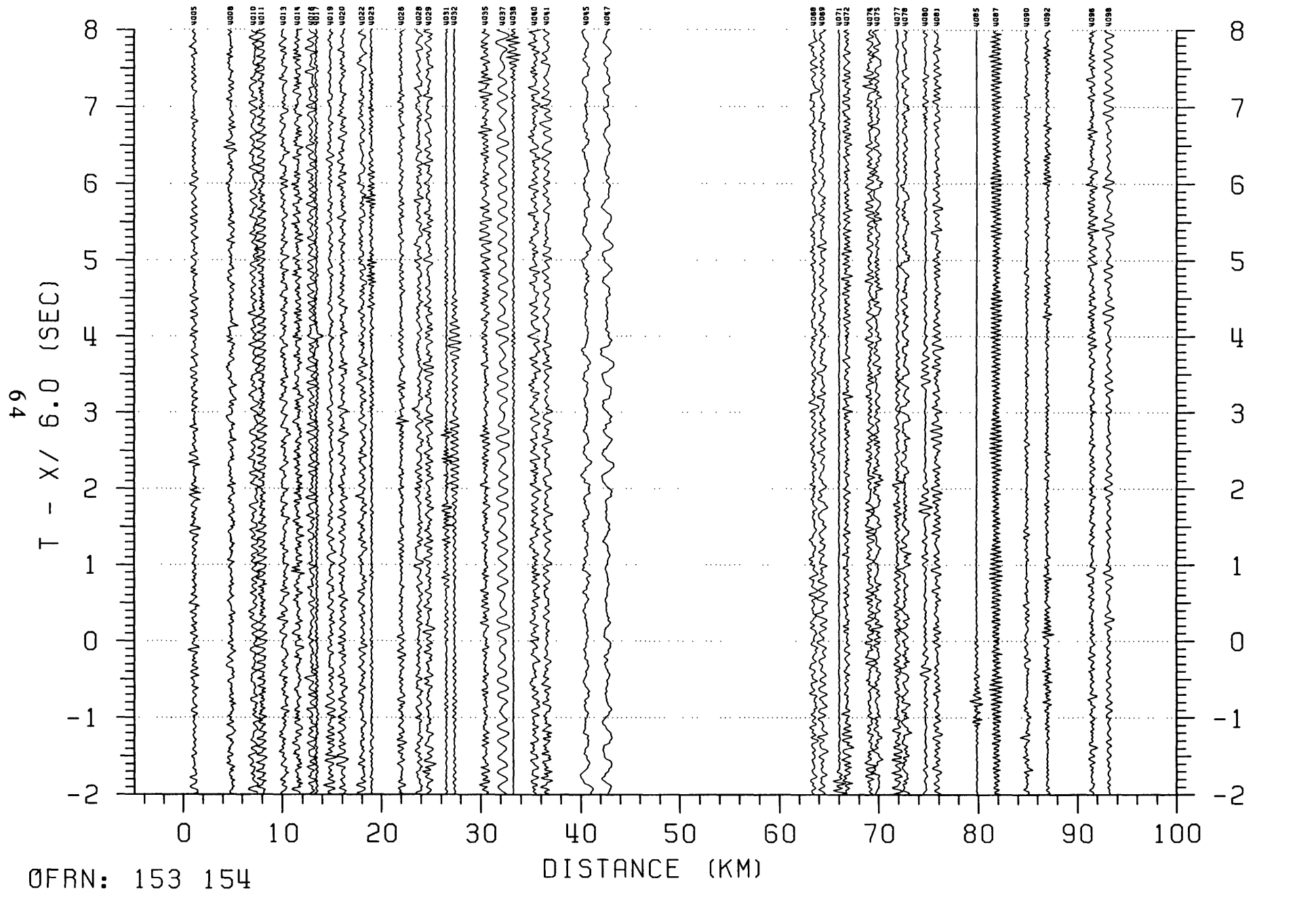
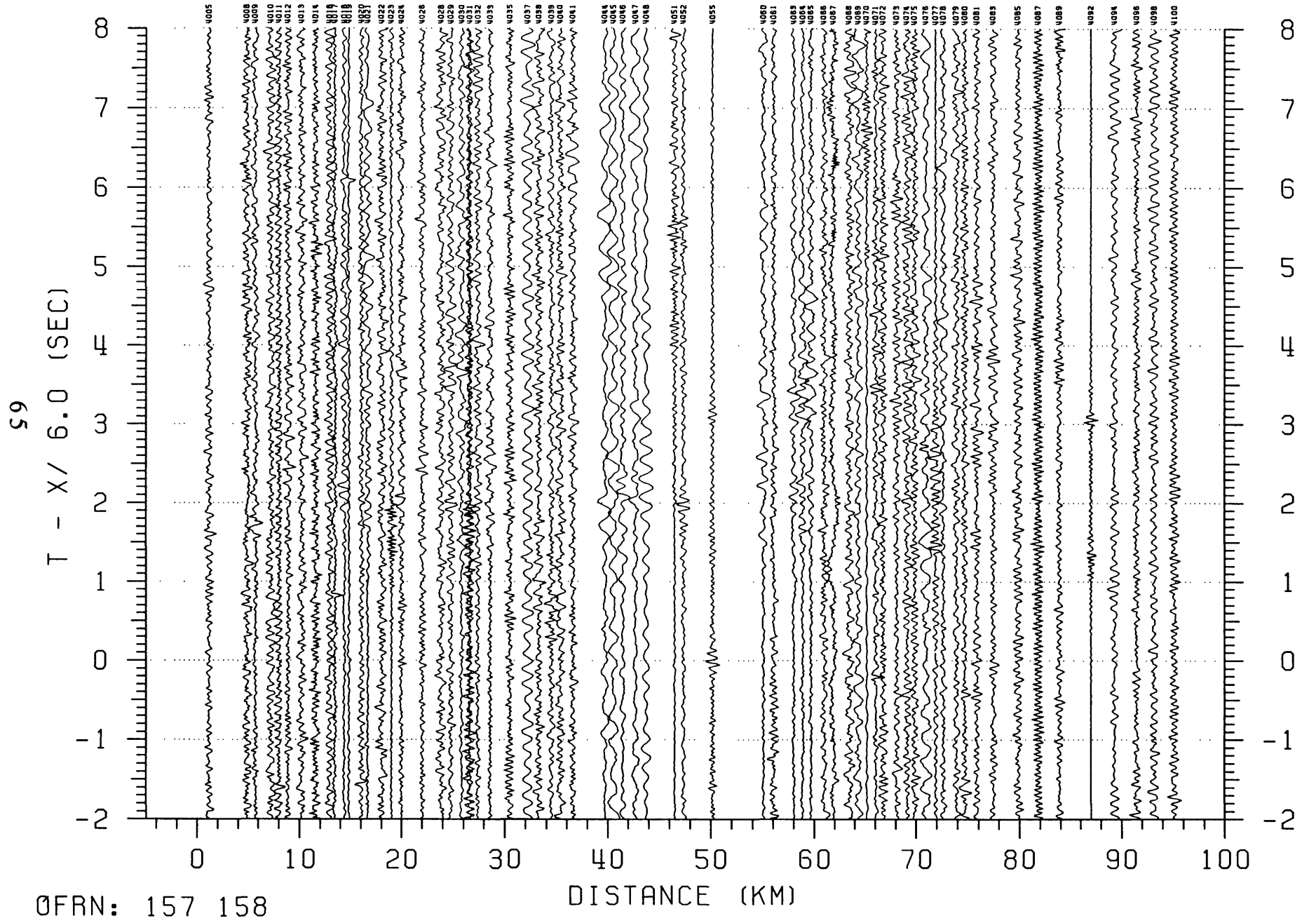


Figure D30: Cross line, Shot 11, Shotpoint 1, Vertical component of fan-shot traces.



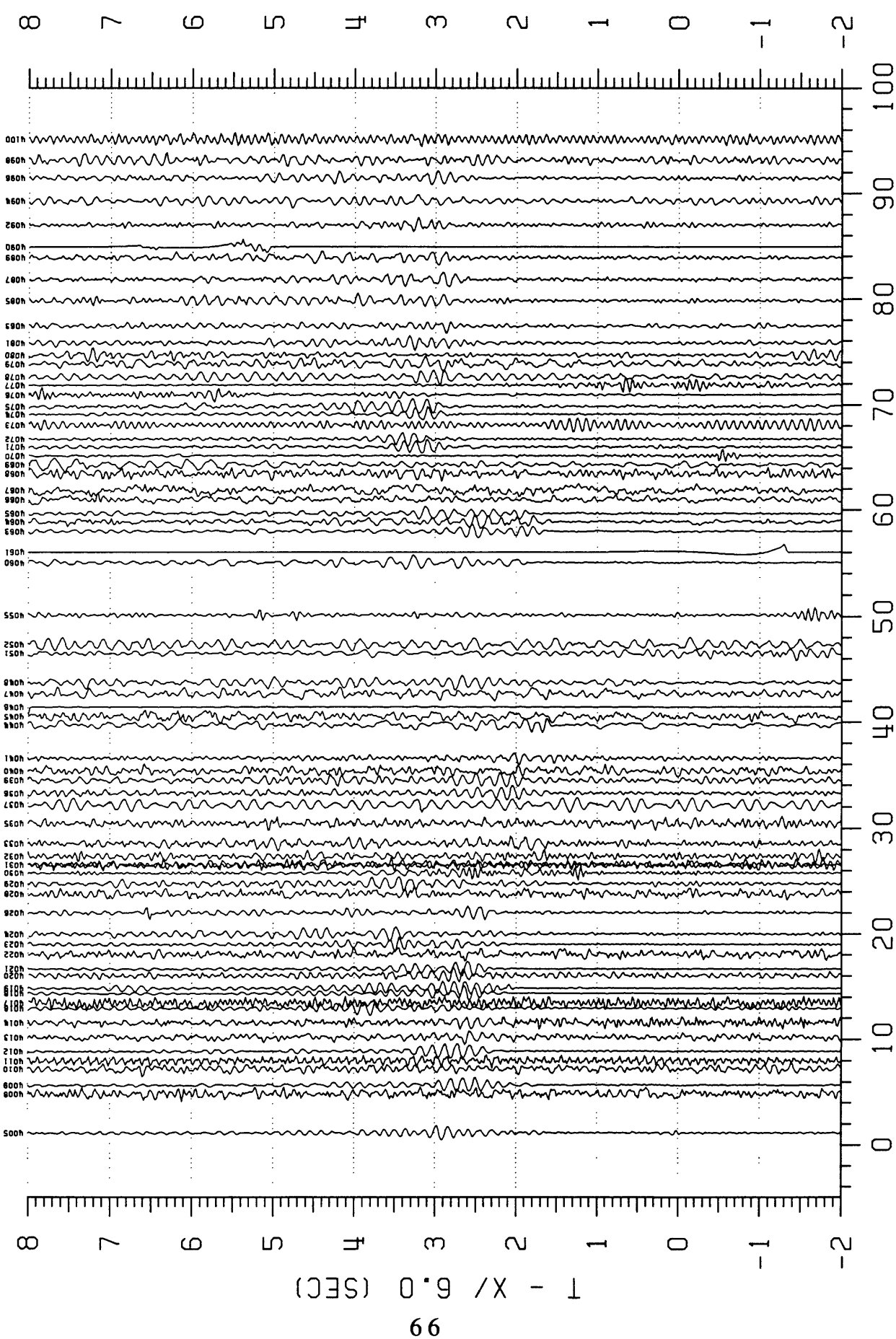


Figure D31: Cross line, Shot 12, Shotpoint 2, Vertical component of fan-shot traces.

Figure D32: Cross line, Shot 13, Shotpoint 13, Vertical component of fan-shot traces.

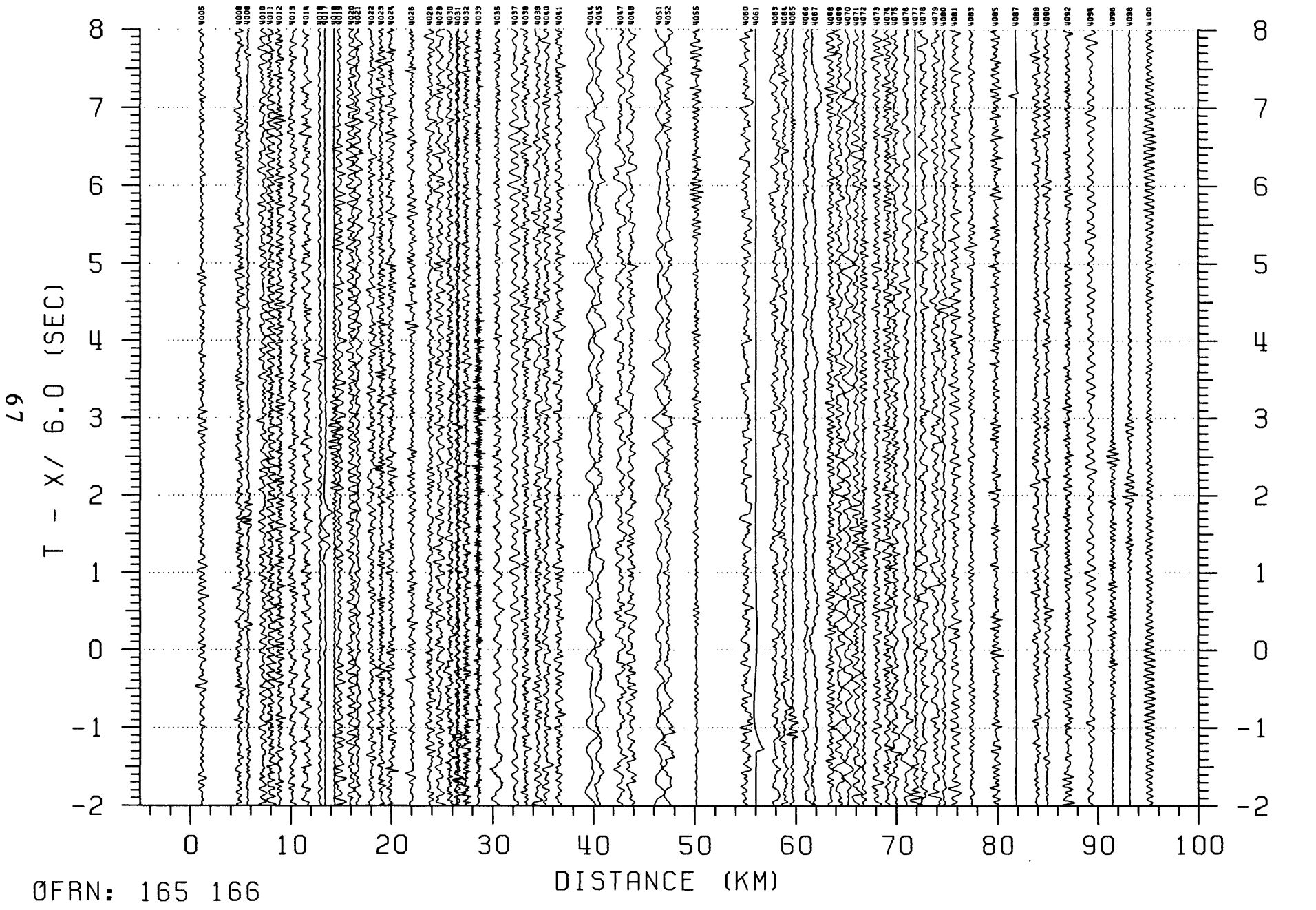


Figure D33: Cross line, Shot 14, Shotpoint 14, Vertical component of fan-shot traces.

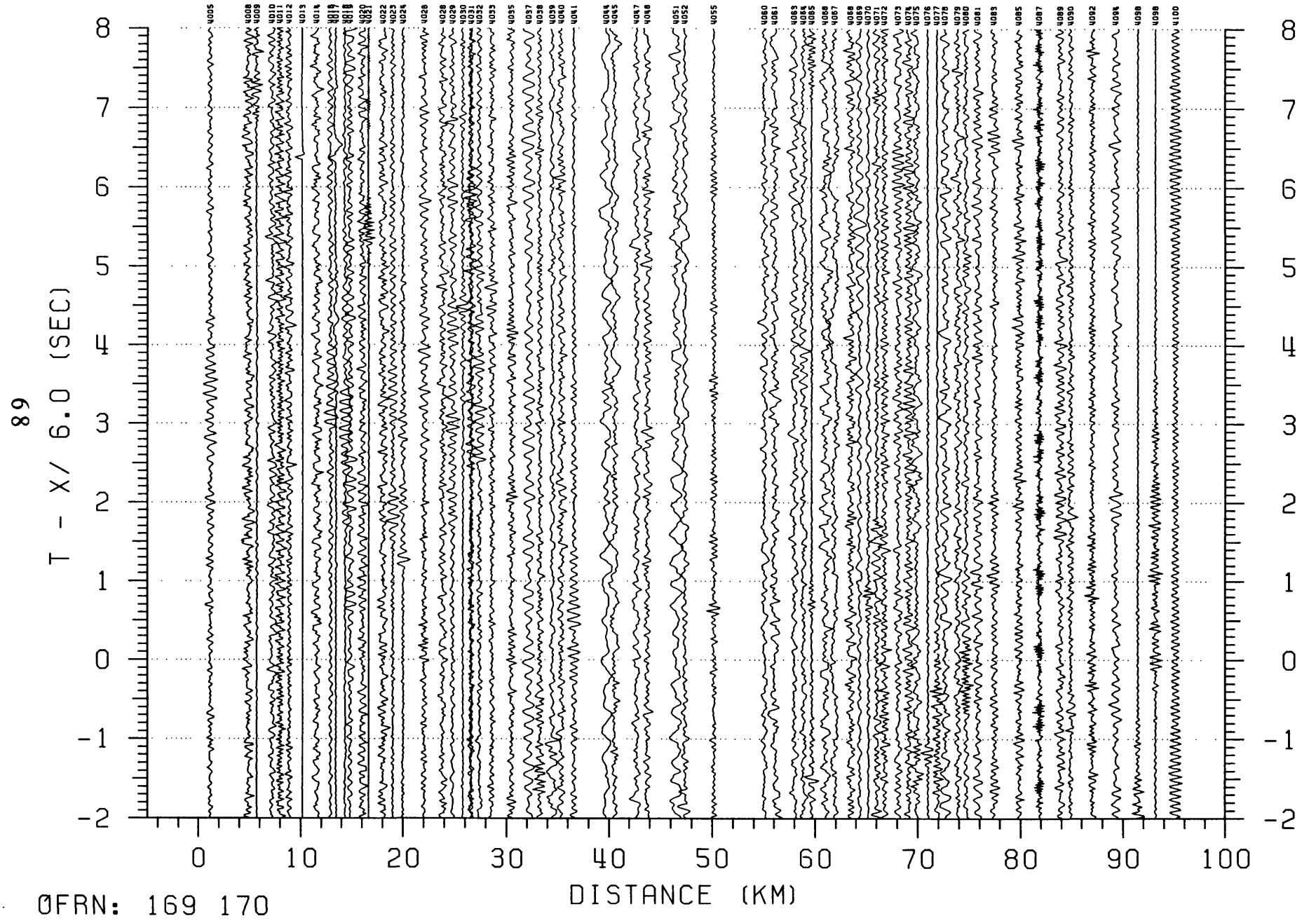


Figure D34: Cross line, Shot 15, Shotpoint 12, Vertical component of fan-shot traces.

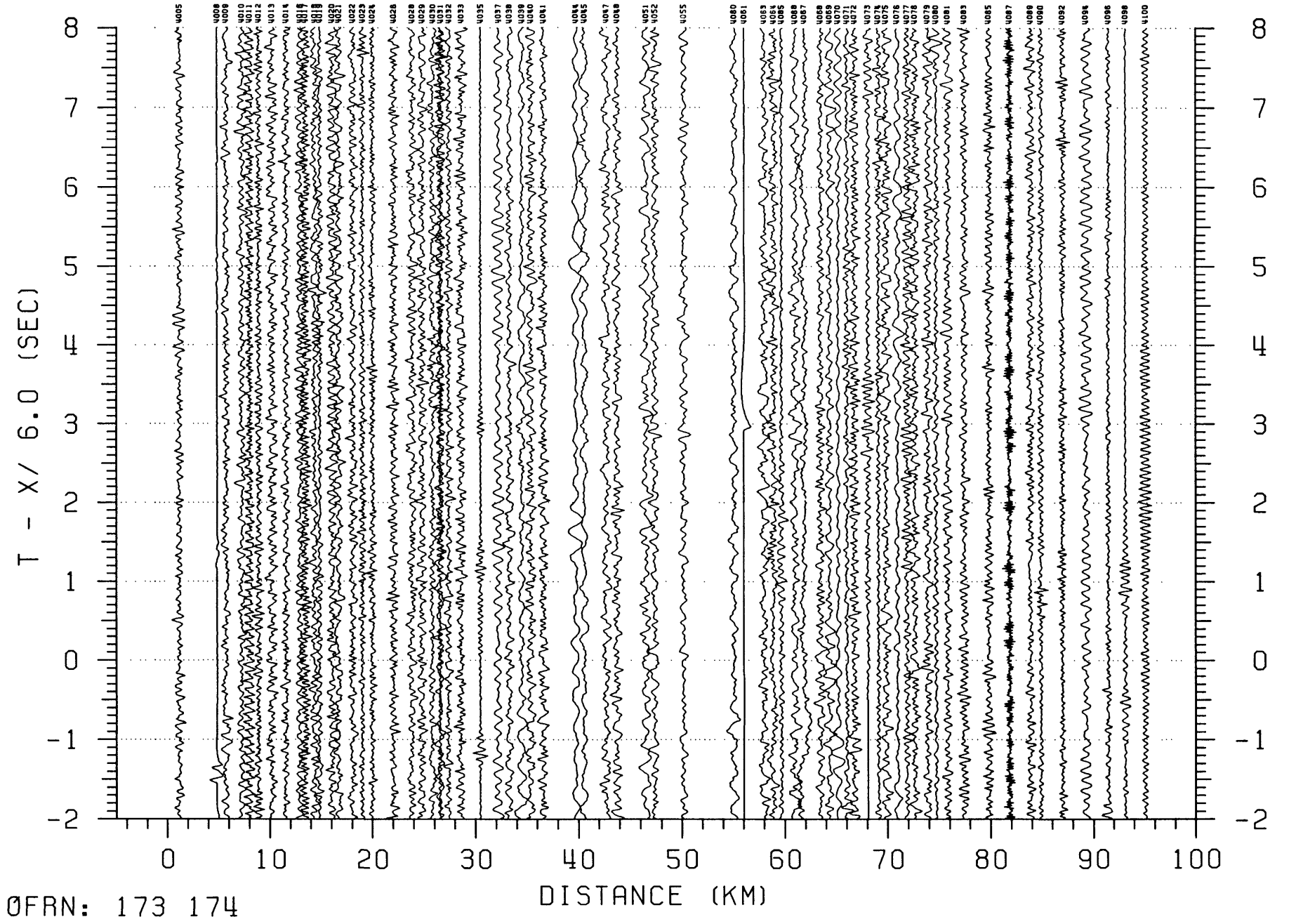


Figure D35: Cross line, Shot 16, Shotpoint 10, Vertical component of fan-shot traces.

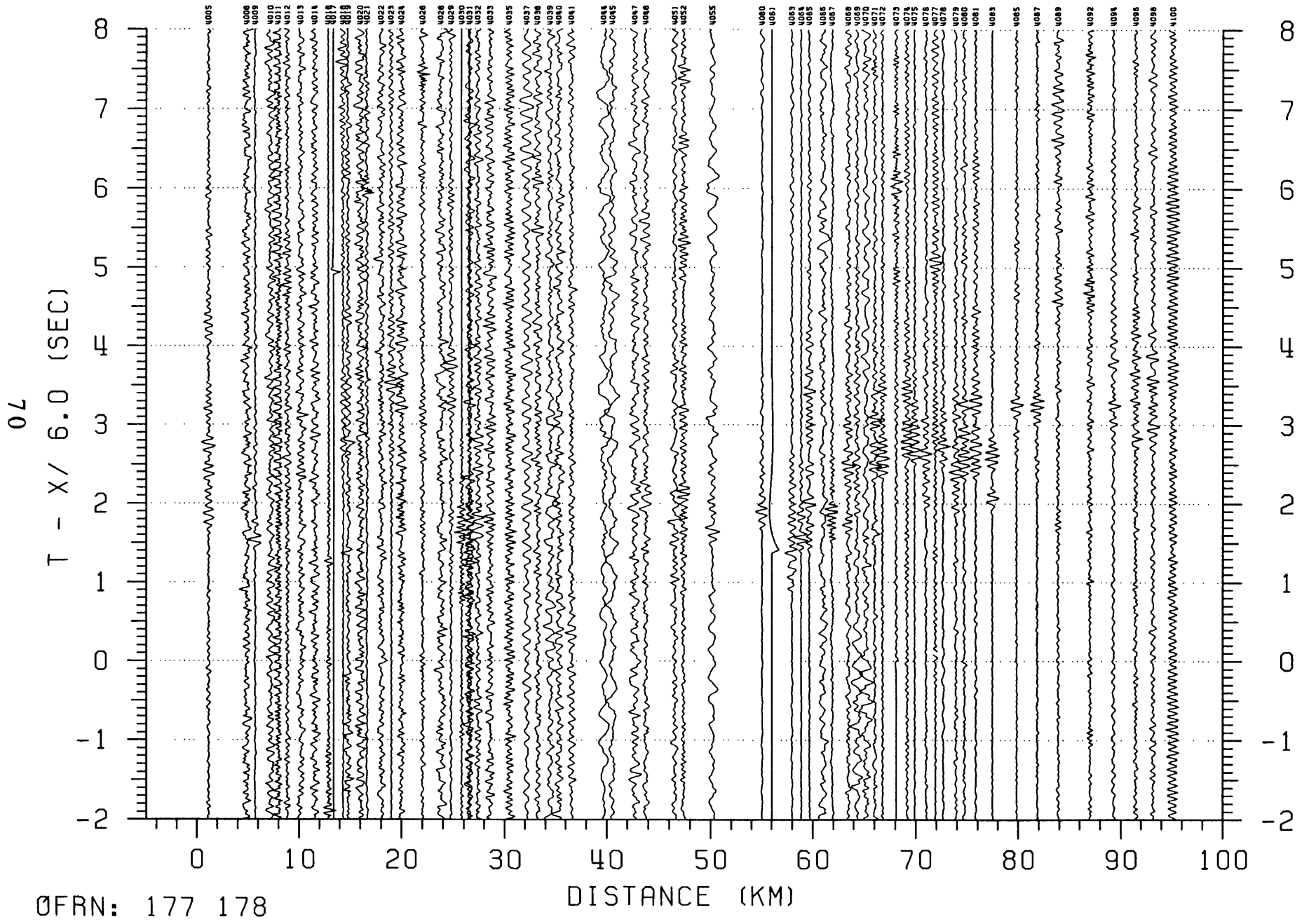


Figure D36: Cross line, Shot 17, Shotpoint 9, Vertical component of fan-shot traces