GSA Archive #### Reflection shot gathers from San Francisco Bay with 3D traveltime fits

Fig. 1 - Model of the San Andreas fault shown in depth contours.

Fig. 2 - Model of the Hayward fault shown in depth contours.

Fig. 3 - 1995 cable deployment 1 shot and receiver locations. The number labels correspond with gathers shown in Figs. 4-10.

Figs. 4-10. Shot gathers are shown from 1995 cable deployment 1 with modeled travel times superimposed. *These and all following gathers shown are not necessarily the highest quality data, but were chosen to span the geographic extent of the coverage.* To generate the traveltime curves the finite-difference algorithm of Vidale (1990) is extended to compute reflection travel times (Hole and Zelt, 1995). The technique was developed for use in three dimensions; the reflector positions are projected onto a plane for display. The reflecting interface is defined as a sampled function of the horizontal coordinate, and is allowed to vary smoothly in depth. To begin the procedure, first arrival travel times are computed from the point source to the reflecting interface. Velocities below the reflector are defined to be equal to, or less than, velocities above in order to prevent waves transmitted through the interface from arriving as first arrivals at the reflector. The computed times at the reflecting interface are thus the times of the incident down-going wave. To allow a smooth reflector to exist between grid nodes in depth, the computed incident times at the grid nodes immediately above the reflector are used to analytically compute reflected times at the same nodes. Travel times to shallower grid nodes are replaced with large dummy values. This sampled travel time field is input into the finite-difference algorithm and travel times are computed upward from the base of the model. Previously computed times (in particular the large dummy values) are replaced by upgoing times if the upgoing times are earlier. In this manner, the incident travel times on the reflecting interface are used as a source to propagate the reflected wave upwards through the model.

Fig. 11 - 1995 cable deployment 2 shot and receiver locations. The number labels correspond with gathers shown in Figs. 12-15.

Figs. 12-15. Shot gathers are shown from 1995 cable deployment 2 with modeled travel times superimposed.

Fig. 16 - 1997 cable deployment 3 shot and receiver locations. The number labels correspond with gathers shown in Figs. 17-26.

Figs. 17-26. Shot gathers are shown from 1997 cable deployment 3 with modeled travel times superimposed.

Fig. 27 - 1997 cable deployment 4 shot and receiver locations. The number labels correspond with gathers shown in Figs. 28-38.

Figs. 28-38. Shot gathers are shown from 1997 cable deployment 4 with modeled travel times superimposed.

Fig. 39. Locations of 1995 land shots on San Francisco Peninsula shown in Figs. 40-44 and tectonic setting of the San Francisco Bay region. Much of the plate boundary slip is accommodated by right-lateral motion on the San Andreas, Hayward, and Calaveras faults. The Salinian terrane is separated from the Franciscan terrane by the Pilarcitos fault on San Francisco Peninsula. The shot points (sp) are marked with an asterisk (*) and the receiver array is indicated by the northeast trending gray line.

Figs. 40-44. Shot gathers are shown from 1995 land deployment with modeled travel times superimposed.

REFERENCE CITED

Vidale, J. E., 1990, Finite-difference calculation of traveltimes in three dimensions: Geophysics, v. 55, p. 521-526.

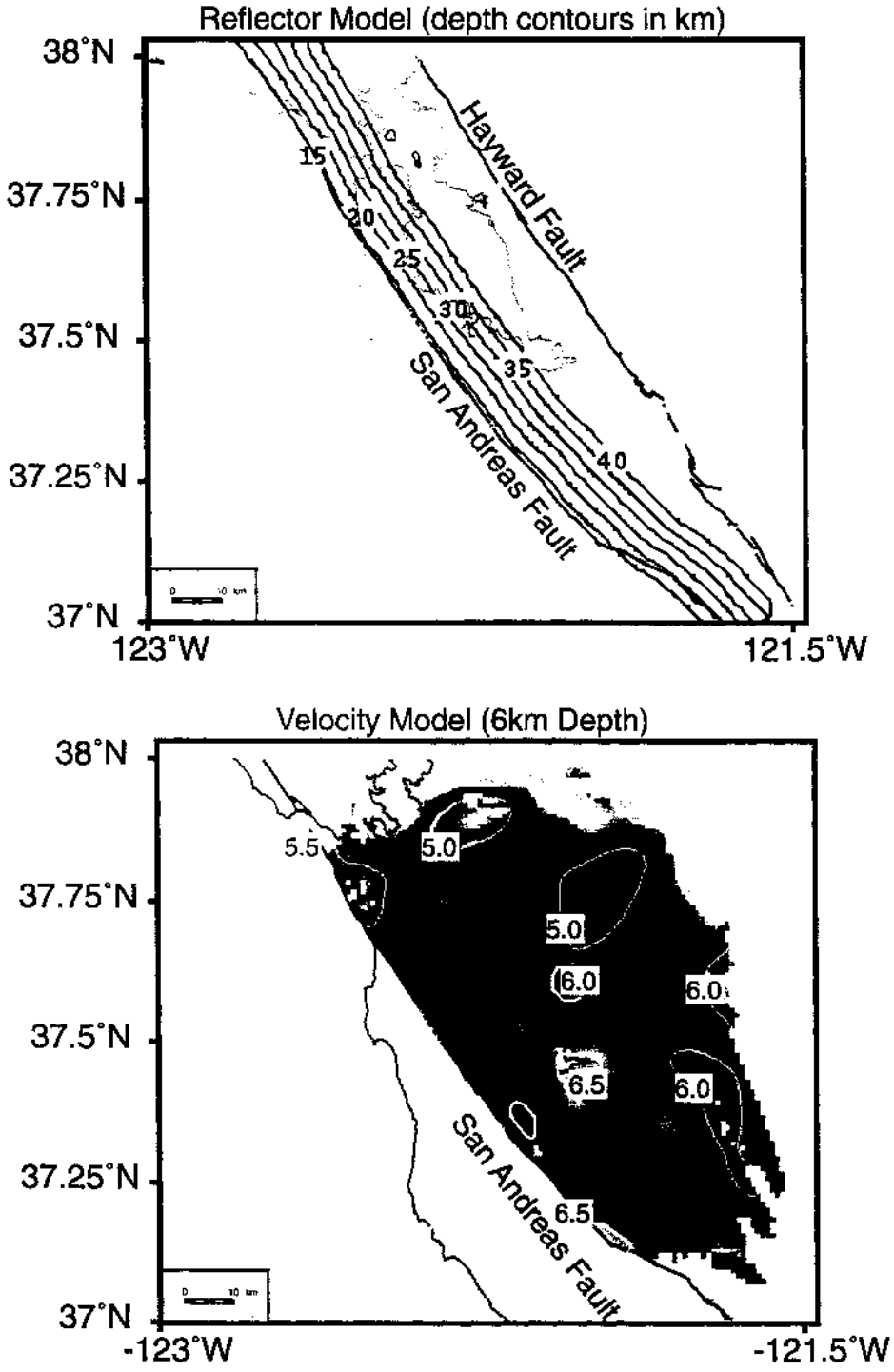
Reflector Model (depth contours in km)
38°N
37.75°N
37.5°N
37.25°N
37°N
123°W
121.5°W
Hayward Fault
San Andreas Fault
15
20
25
30
35
40
Velocity Model (6km Depth)
38°N
37.75°N
37.5°N
37.25°N
37°N
-123°W
-121.5°W
San Andreas Fault
5.5
5.0
5.0
6.0
6.0
6.5
6.0
6.5

Figure 1

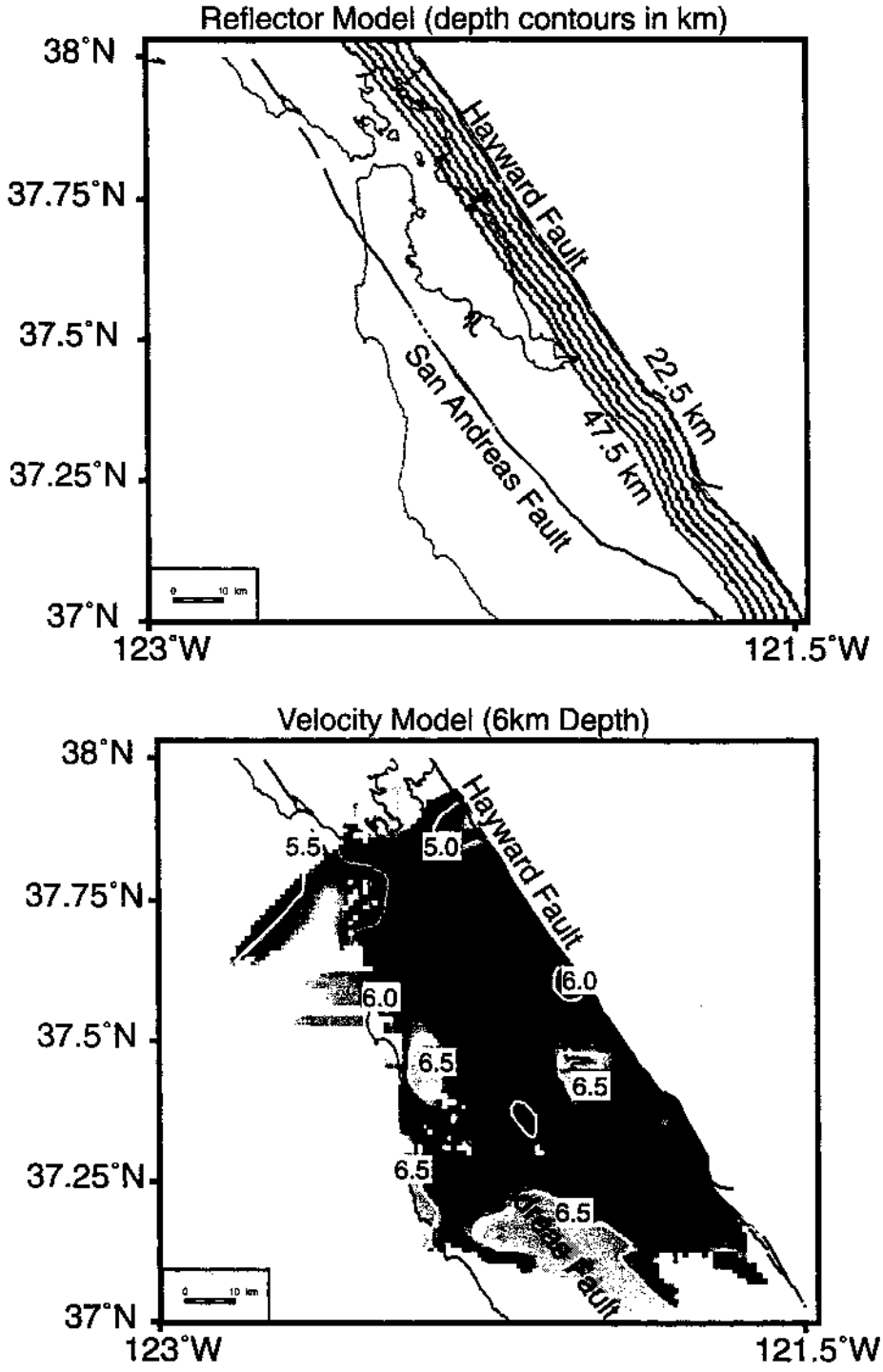
Reflector Model (depth contours in km)
38°N
37.75°N
37.5°N
37.25°N
37°N
123°W
121.5°W
Hayward Fault
San Andreas Fault
22.5 km
47.5 km
Velocity Model (6km Depth)
5.5
5.0
6.0
6.5
6.5
6.5
6.5
6.0
Hayward Fault
San Andreas Fault

Figure 2

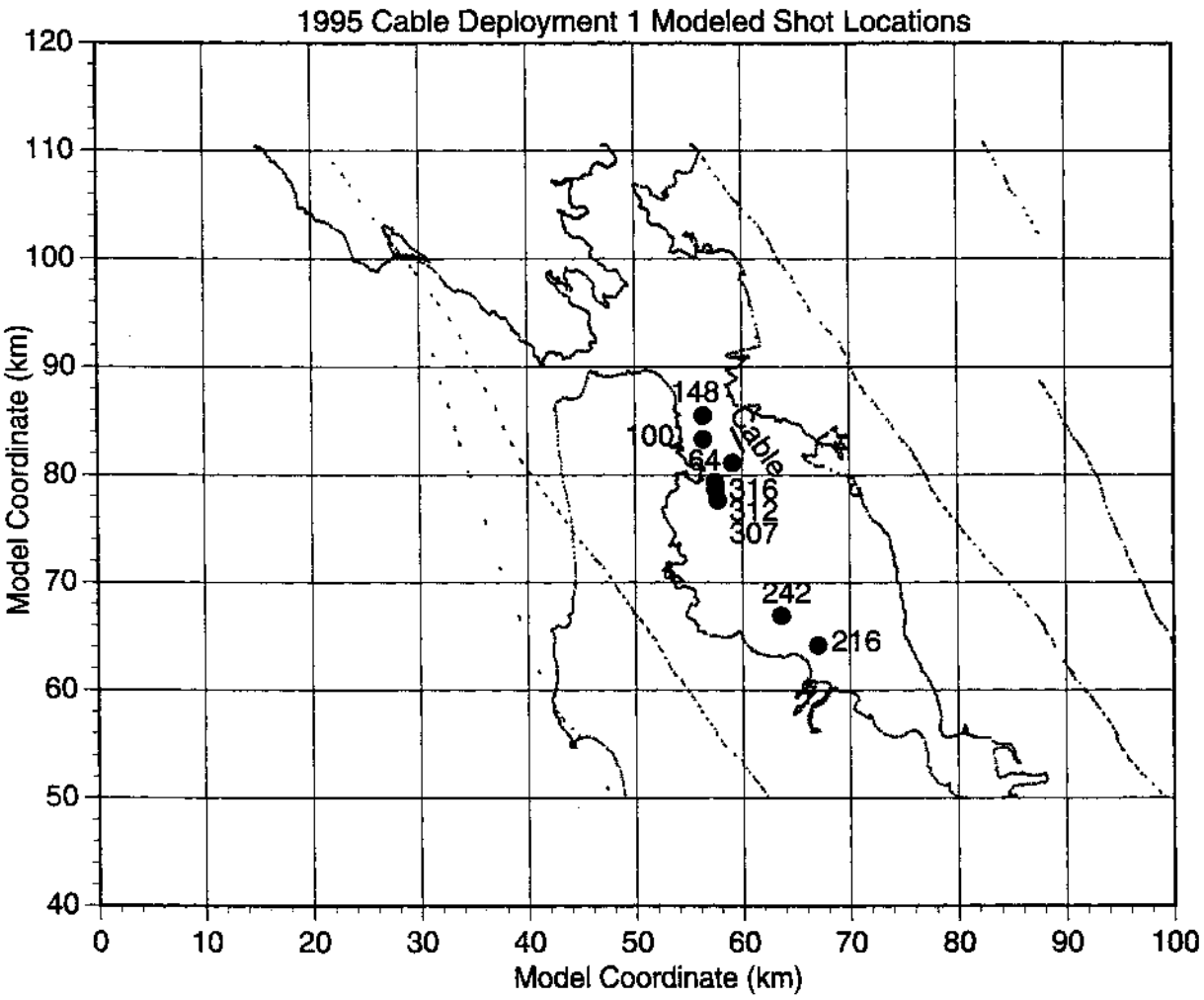
1995 Cable Deployment 1 Modeled Shot Locations
Model Coordinate (km)
Model Coordinate (km)
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100
148
100
64
316
312
307
242
216
Cable

Figure 3

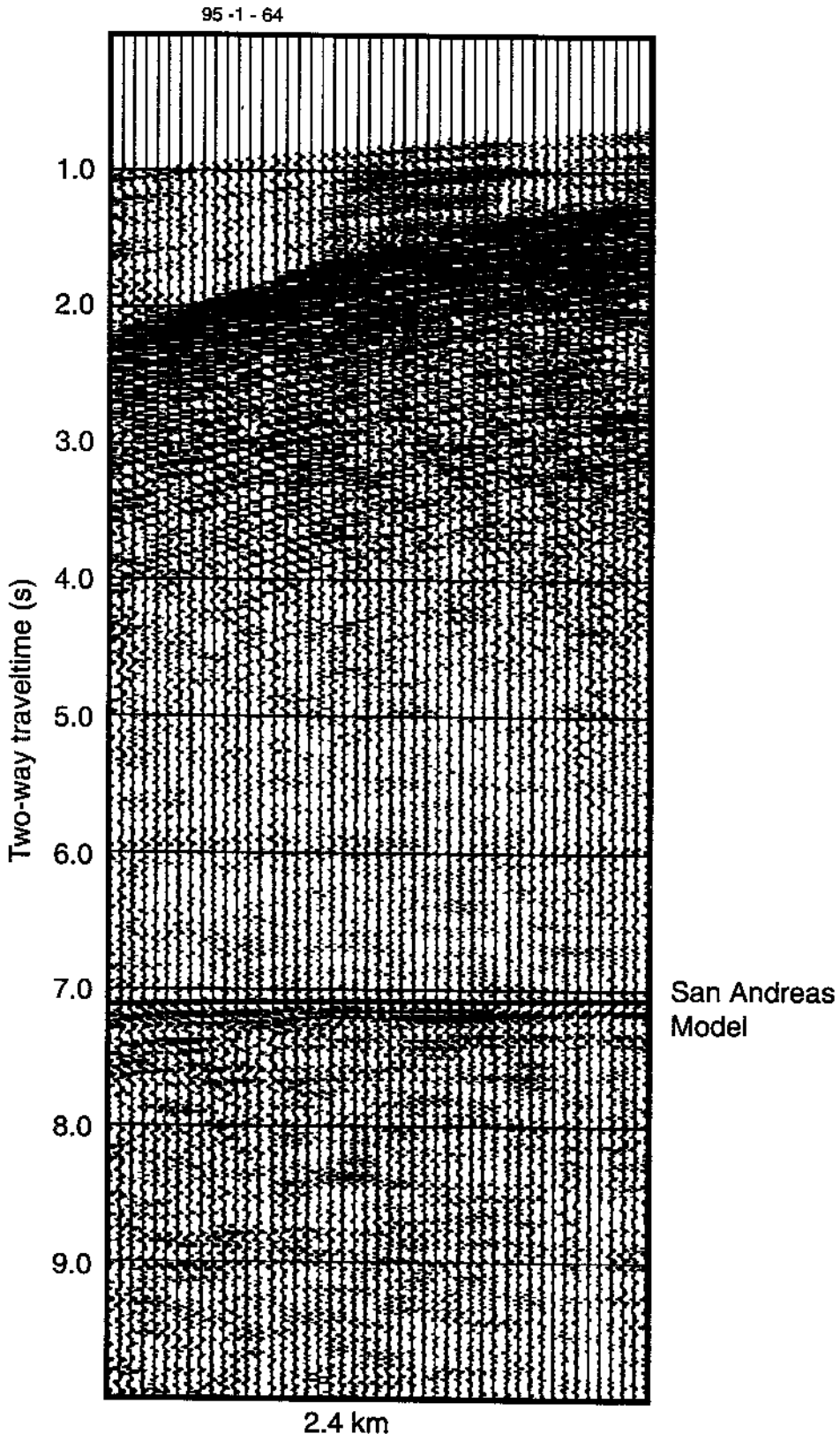
95 -1 - 64
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 4

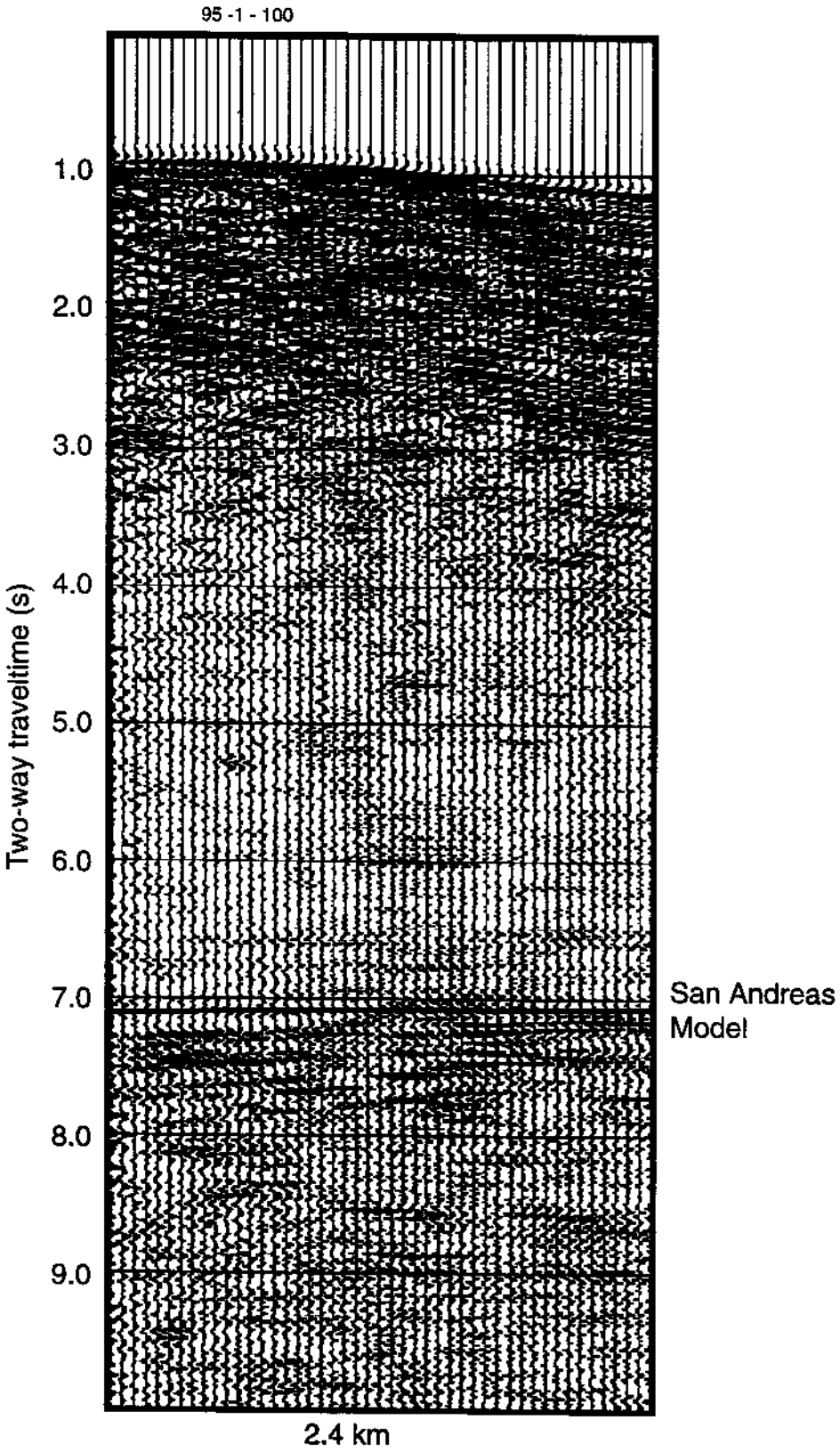
95 -1 - 100
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 5

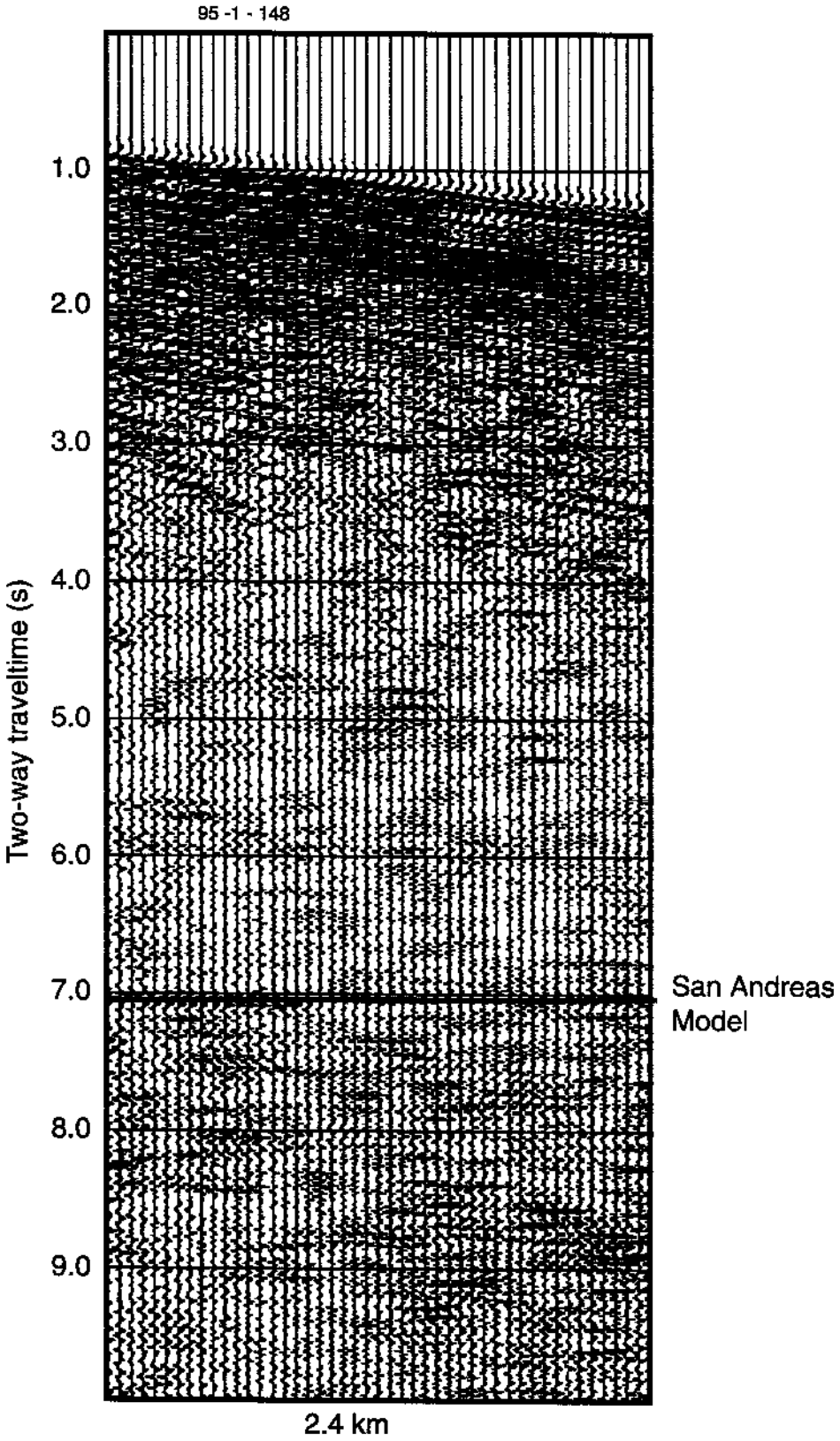
95 -1 - 148
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 6

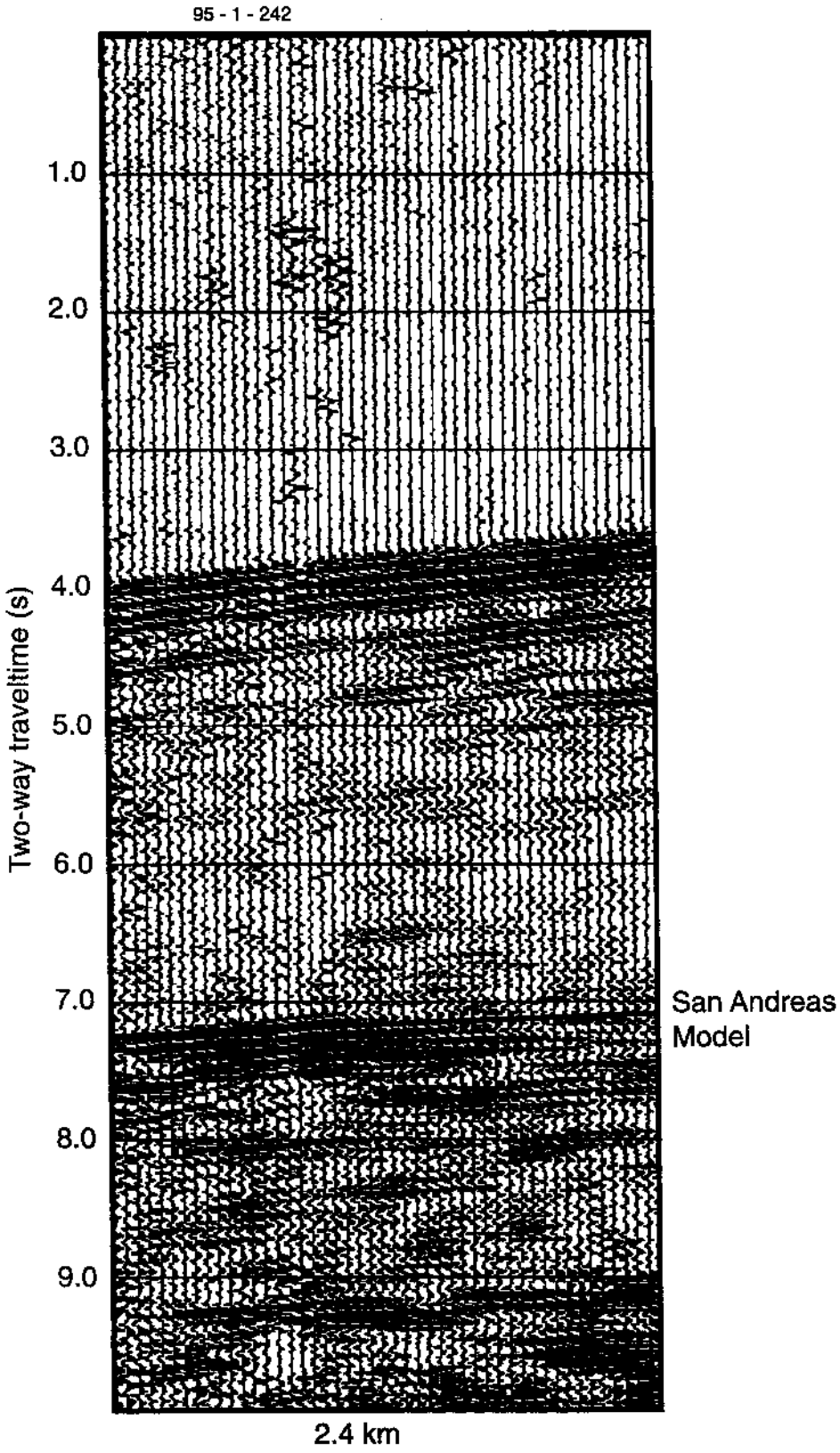
95 - 1 - 242
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 7

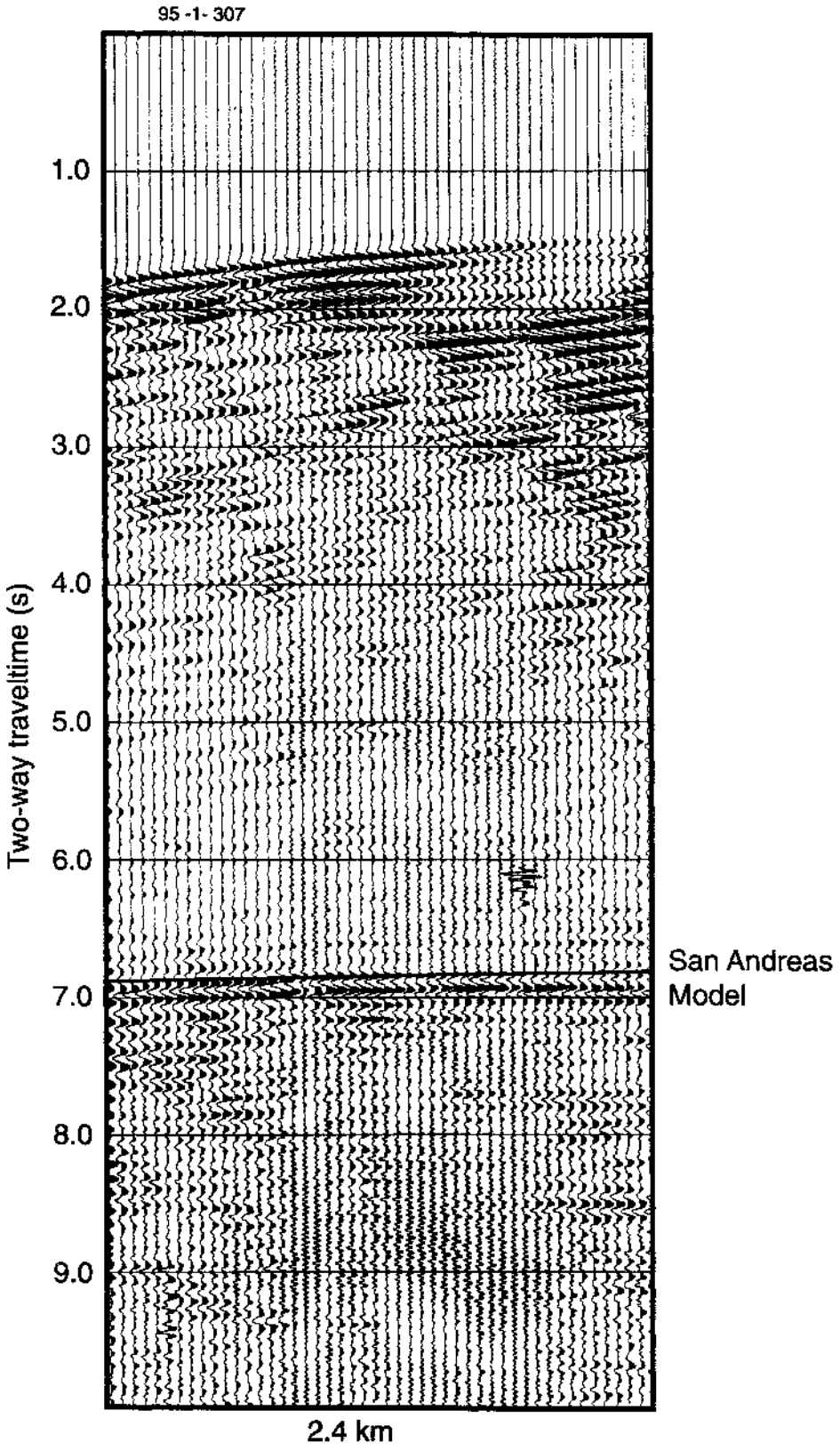
95 -1- 307
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 8

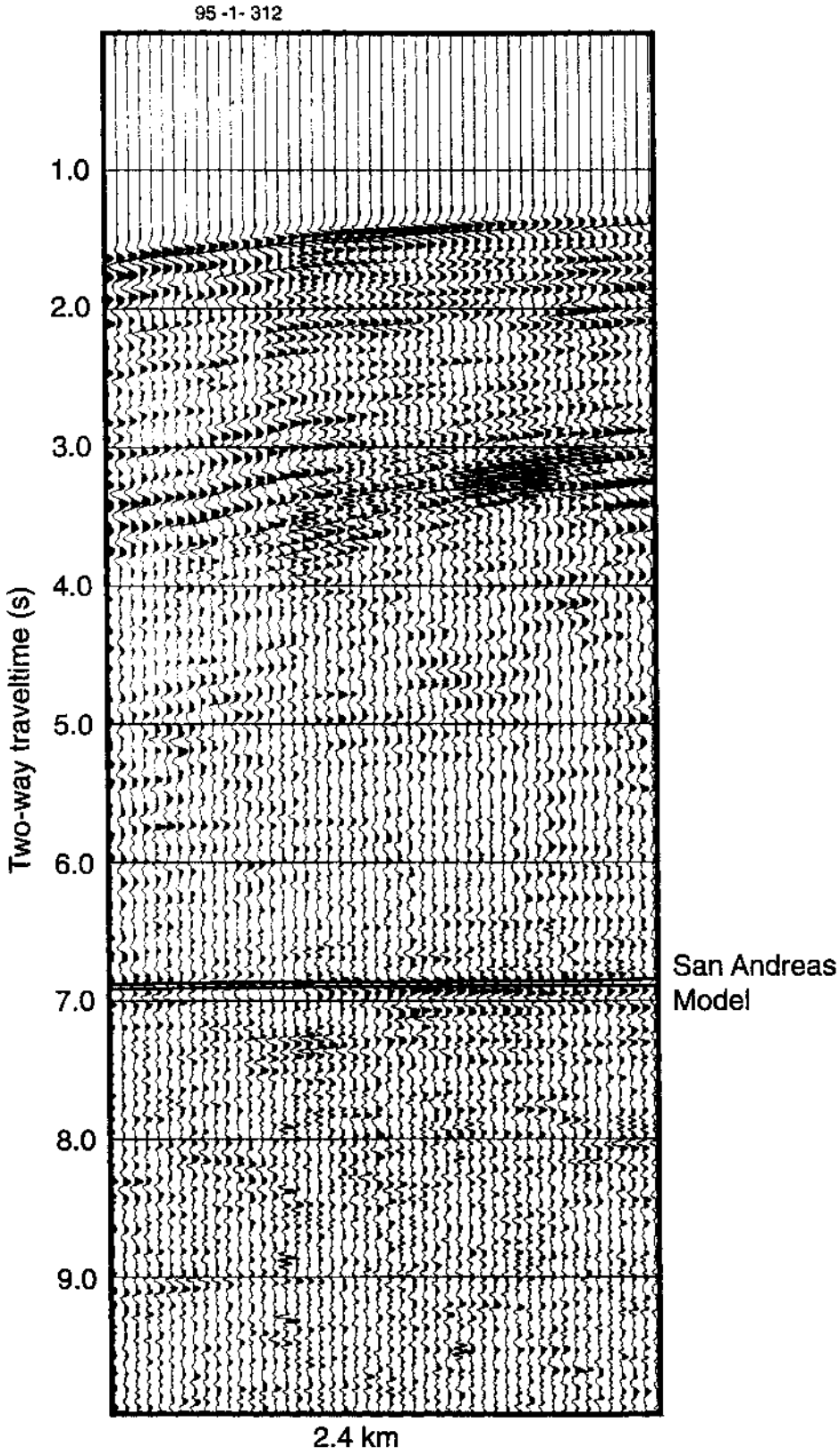
95-1-312
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 9

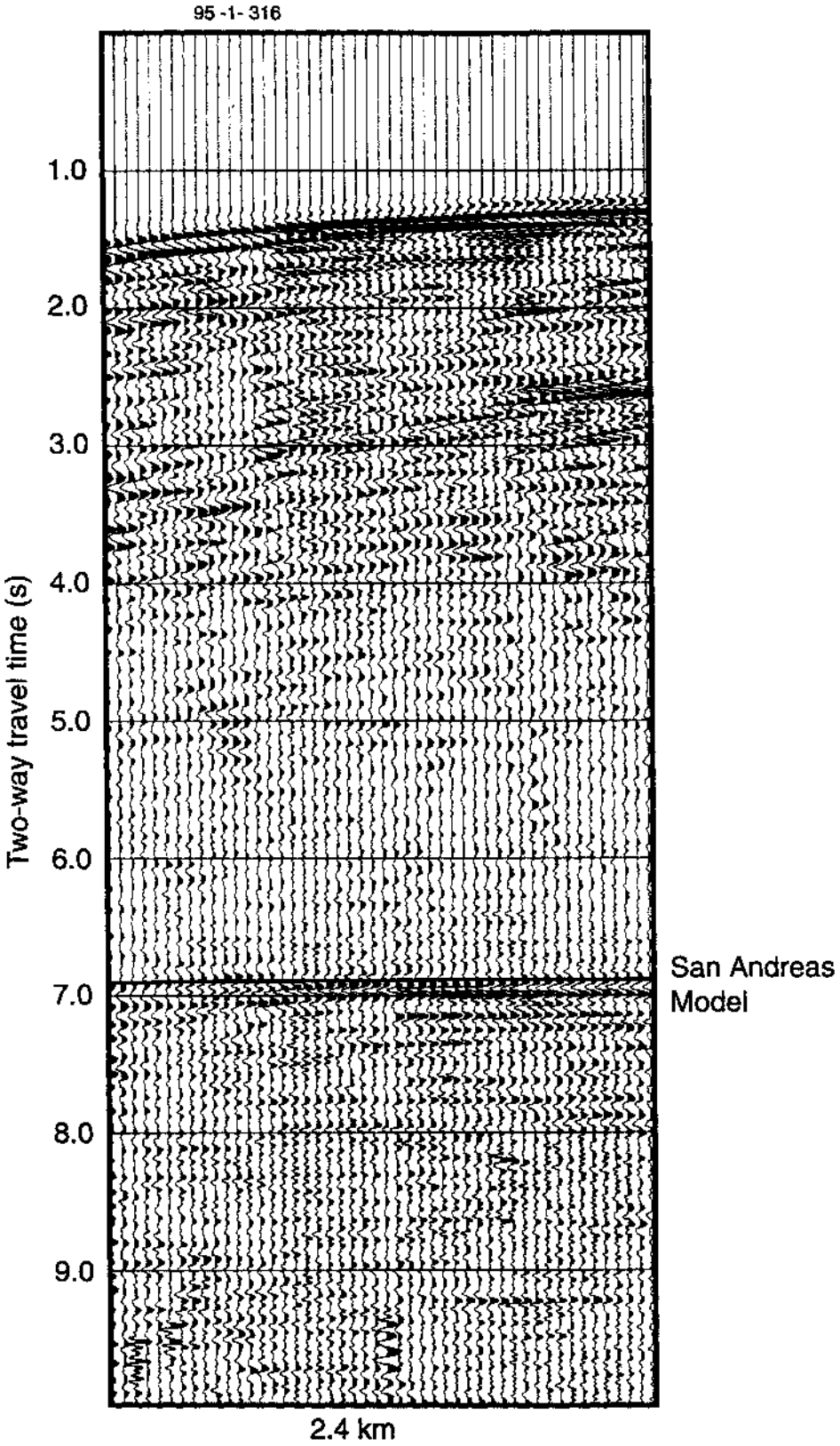
95-1-316
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way travel time (s)
San Andreas
Model
2.4 km

Figure 10

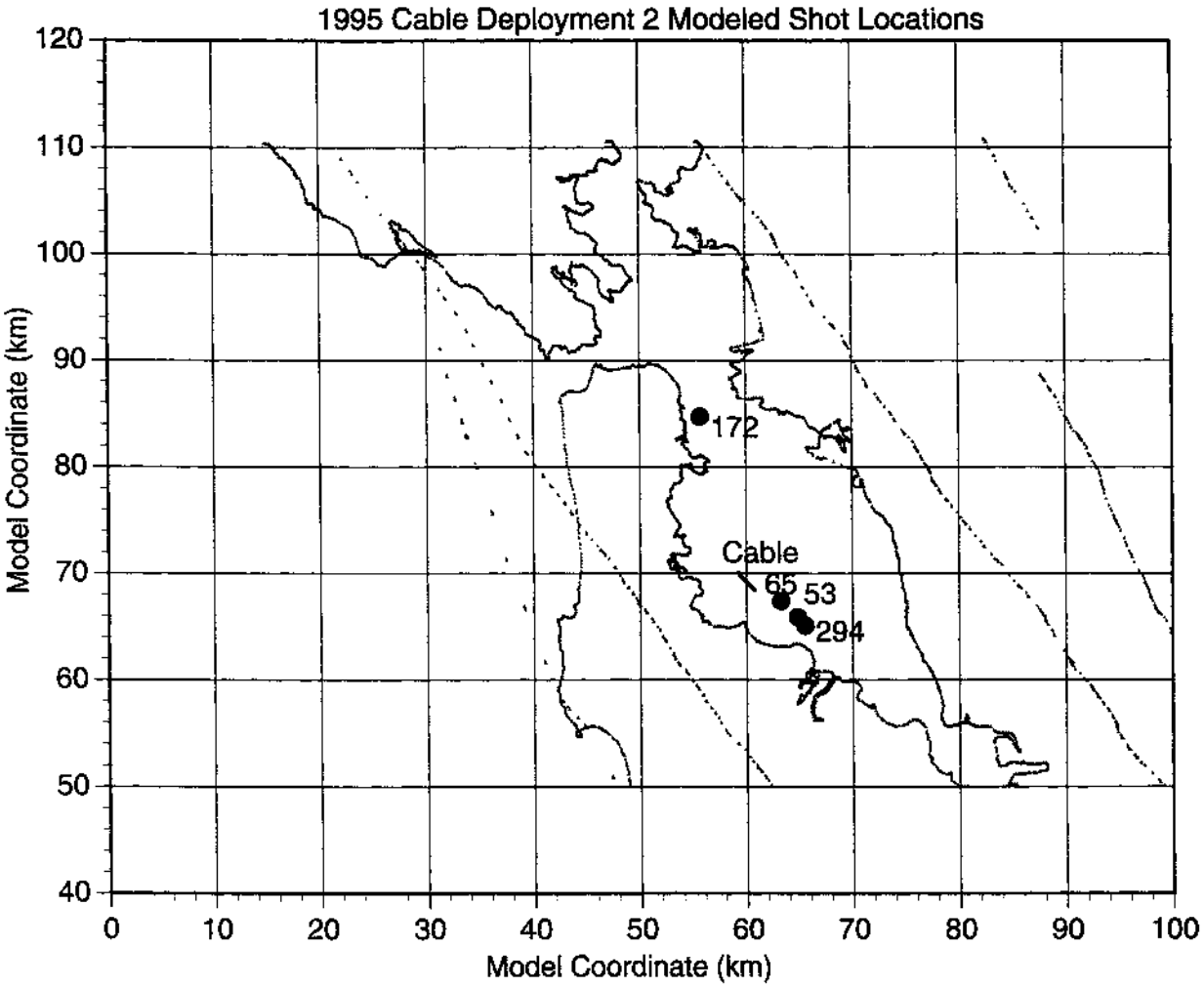
1995 Cable Deployment 2 Modeled Shot Locations
Model Coordinate (km)
Model Coordinate (km)
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100
172
Cable
65
53
294

Figure 11

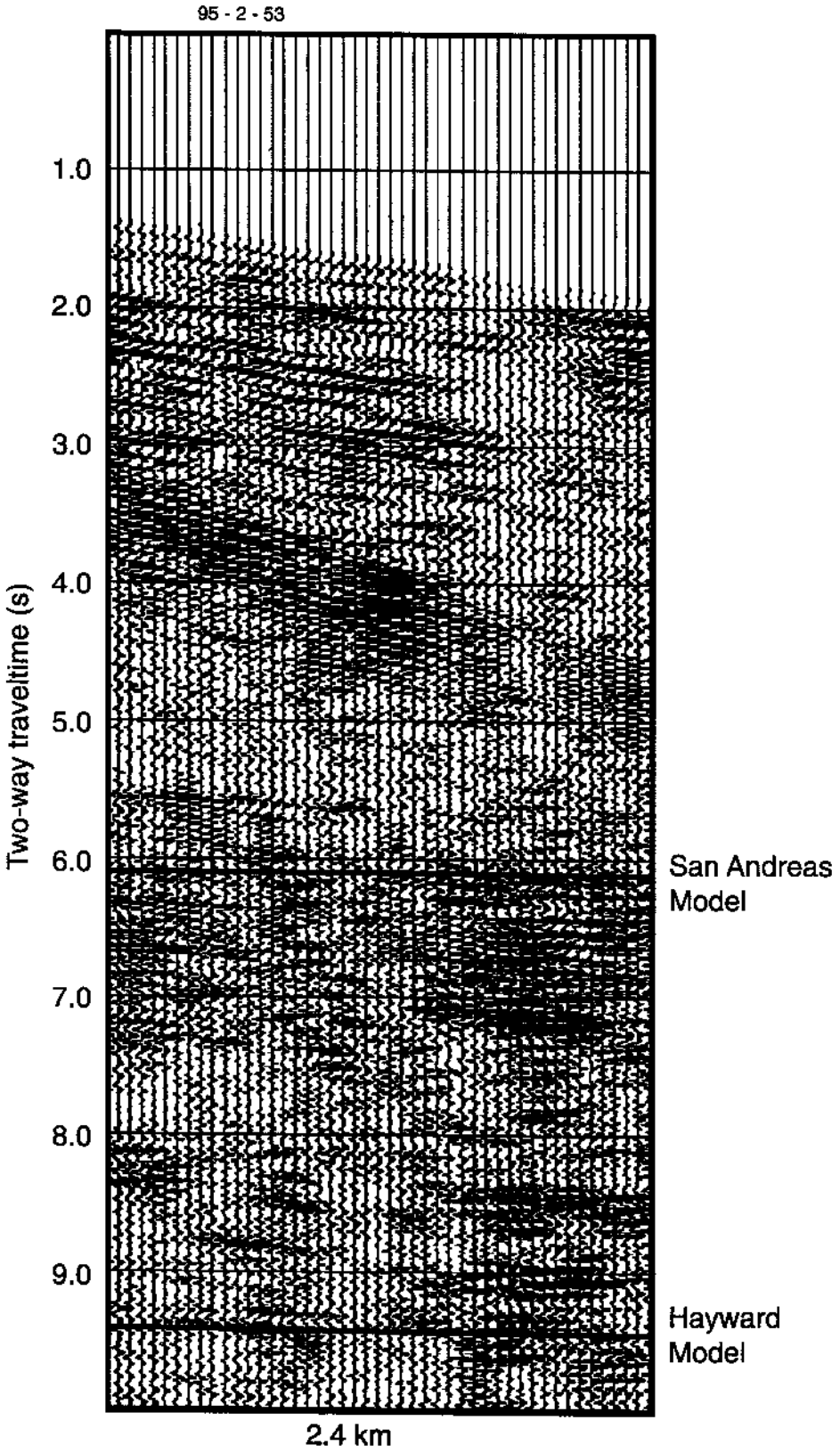
95 - 2 - 53
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas Model
Hayward Model
2.4 km

Figure 12

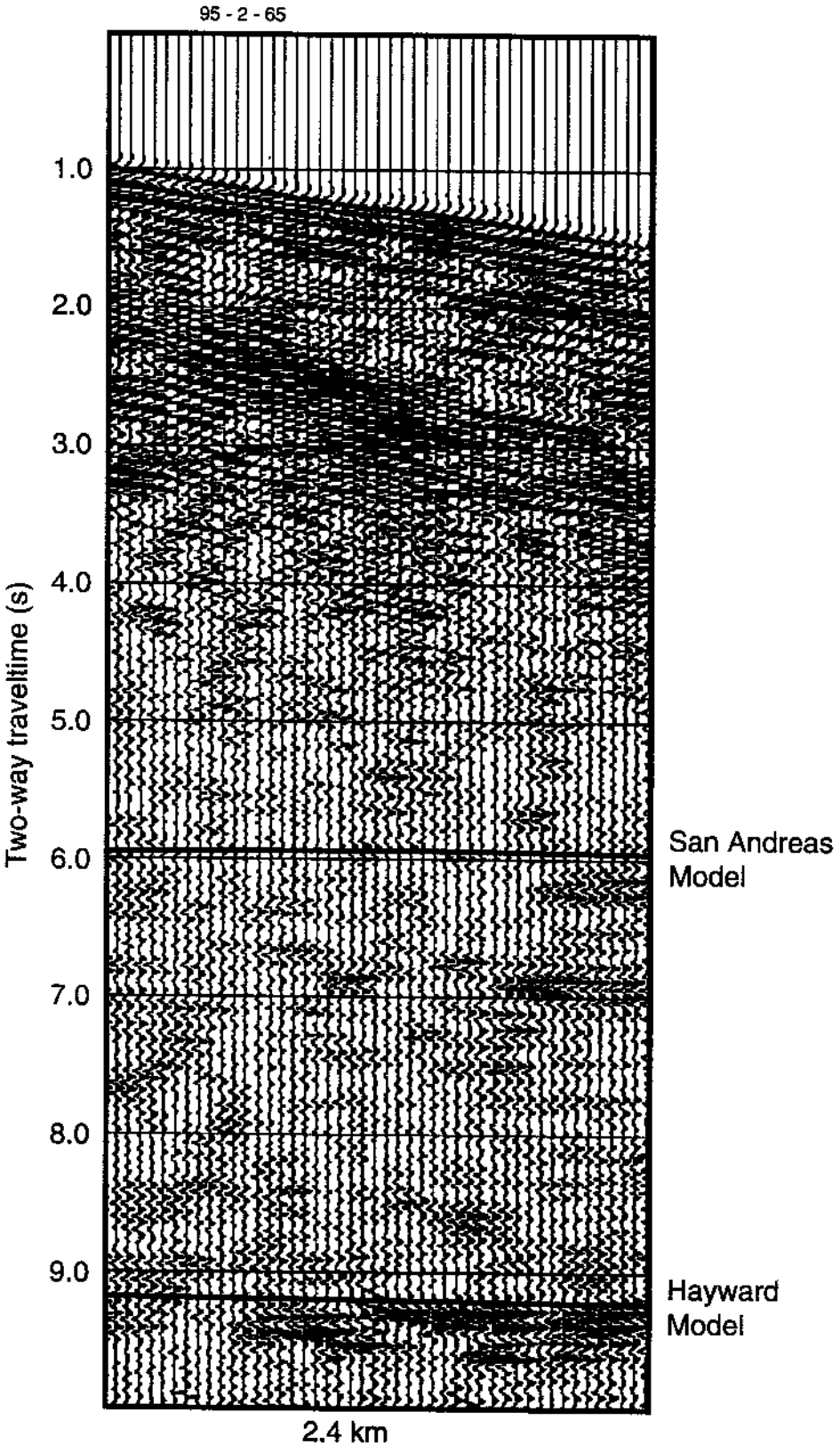
95 - 2 - 65
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas Model
Hayward Model
2.4 km

Figure 13

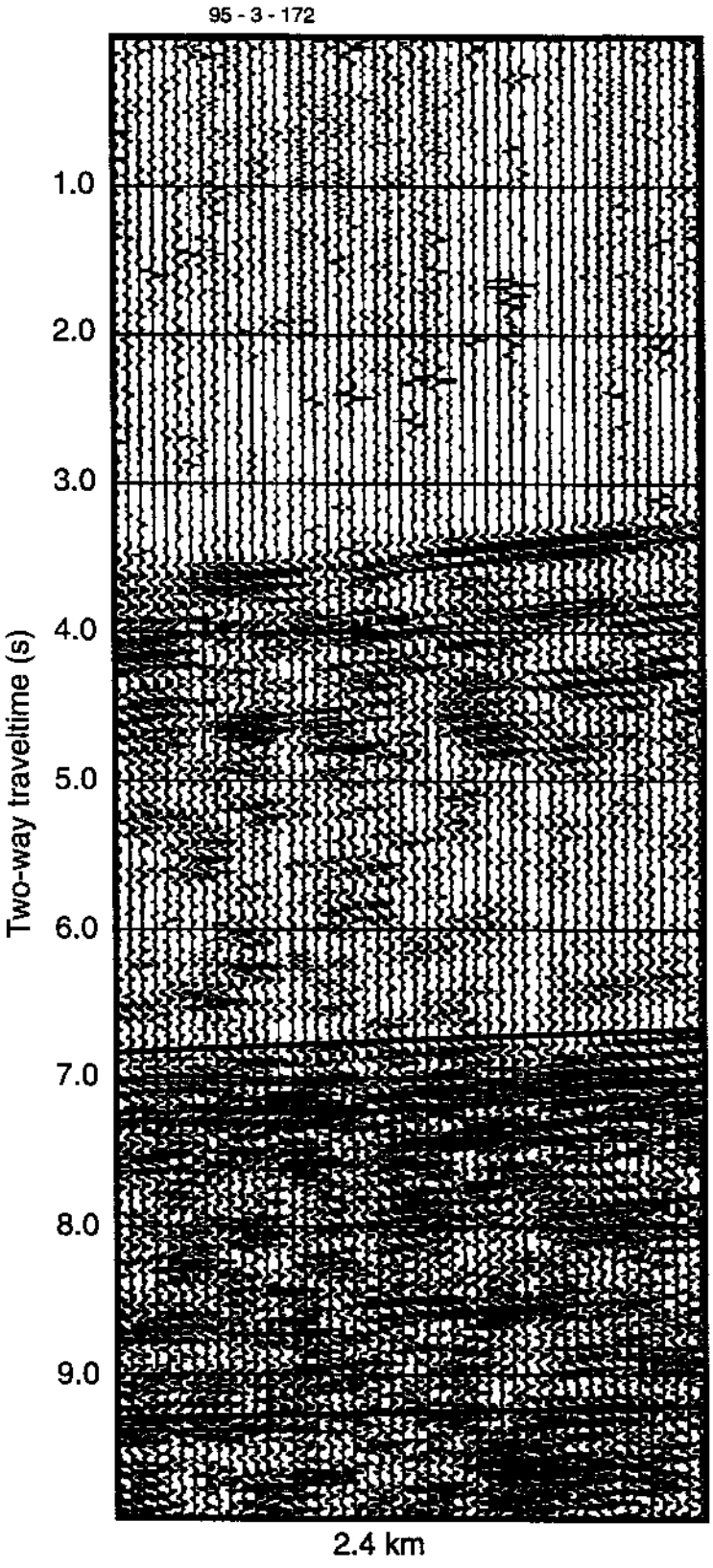

Figure 14

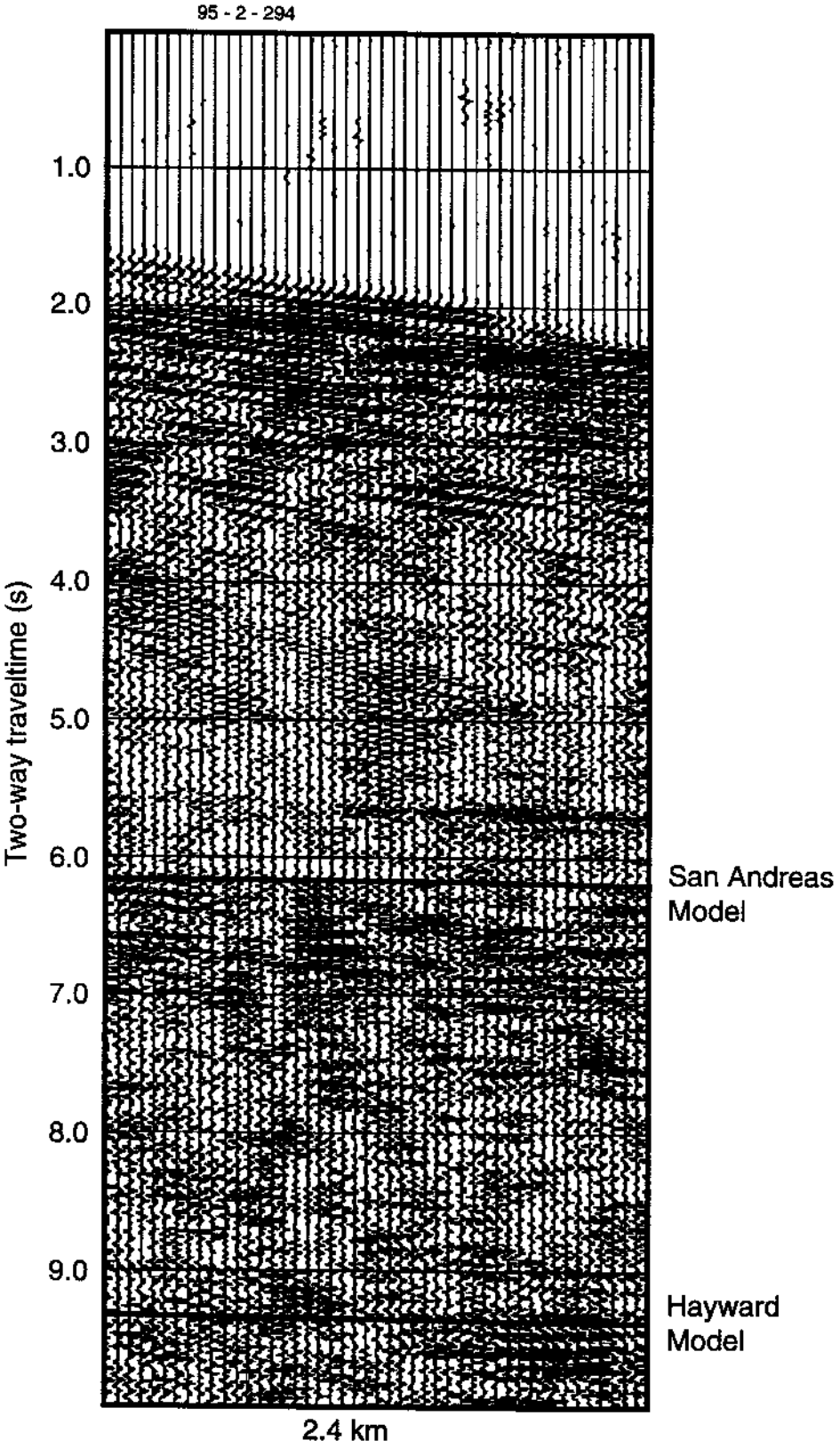
95 - 2 - 294
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas Model
Hayward Model
2.4 km

Figure 15

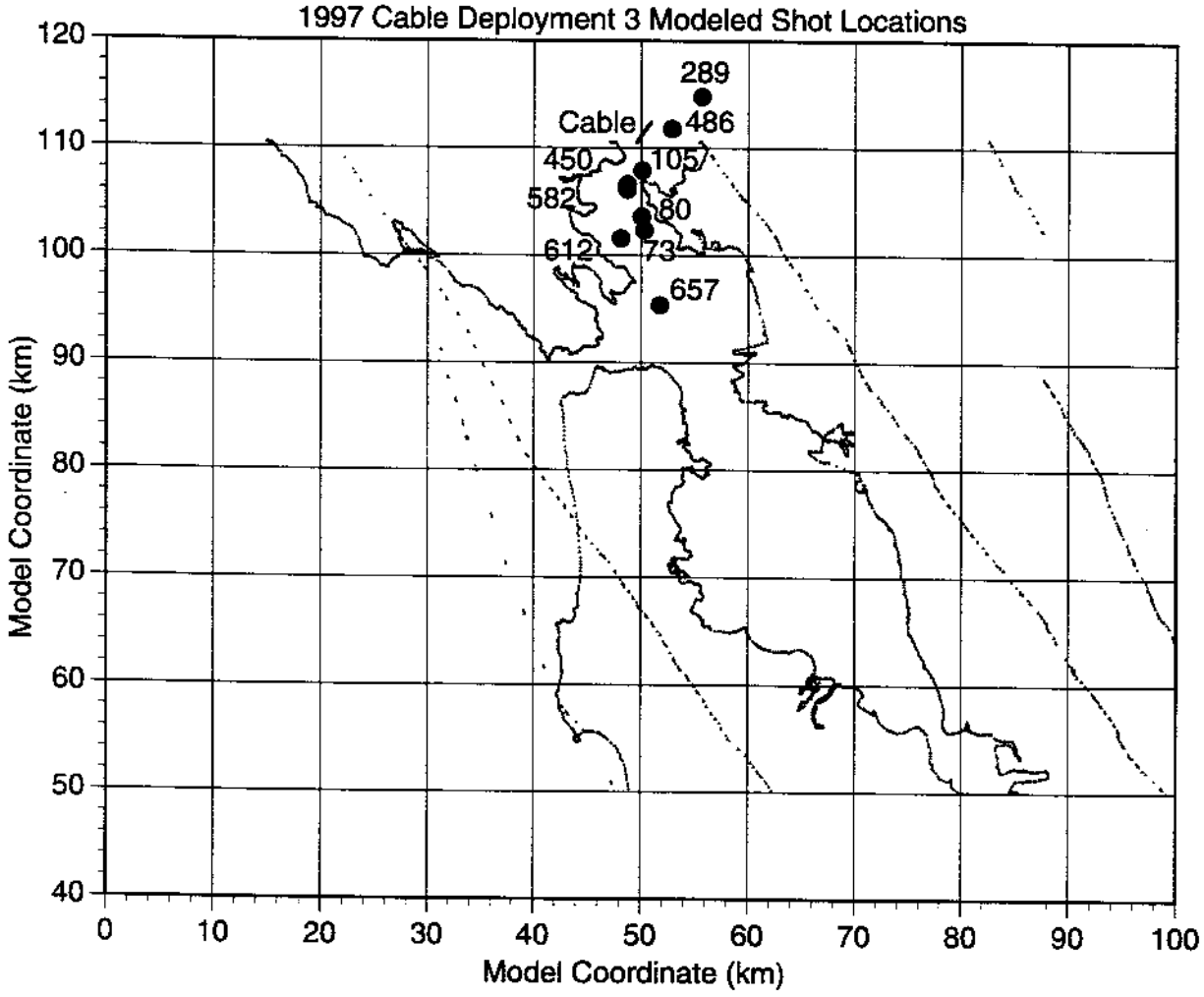
1997 Cable Deployment 3 Modeled Shot Locations
289
Cable
486
450
105
582
80
612
73
657
Model Coordinate (km)
Model Coordinate (km)
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100

Figure 16

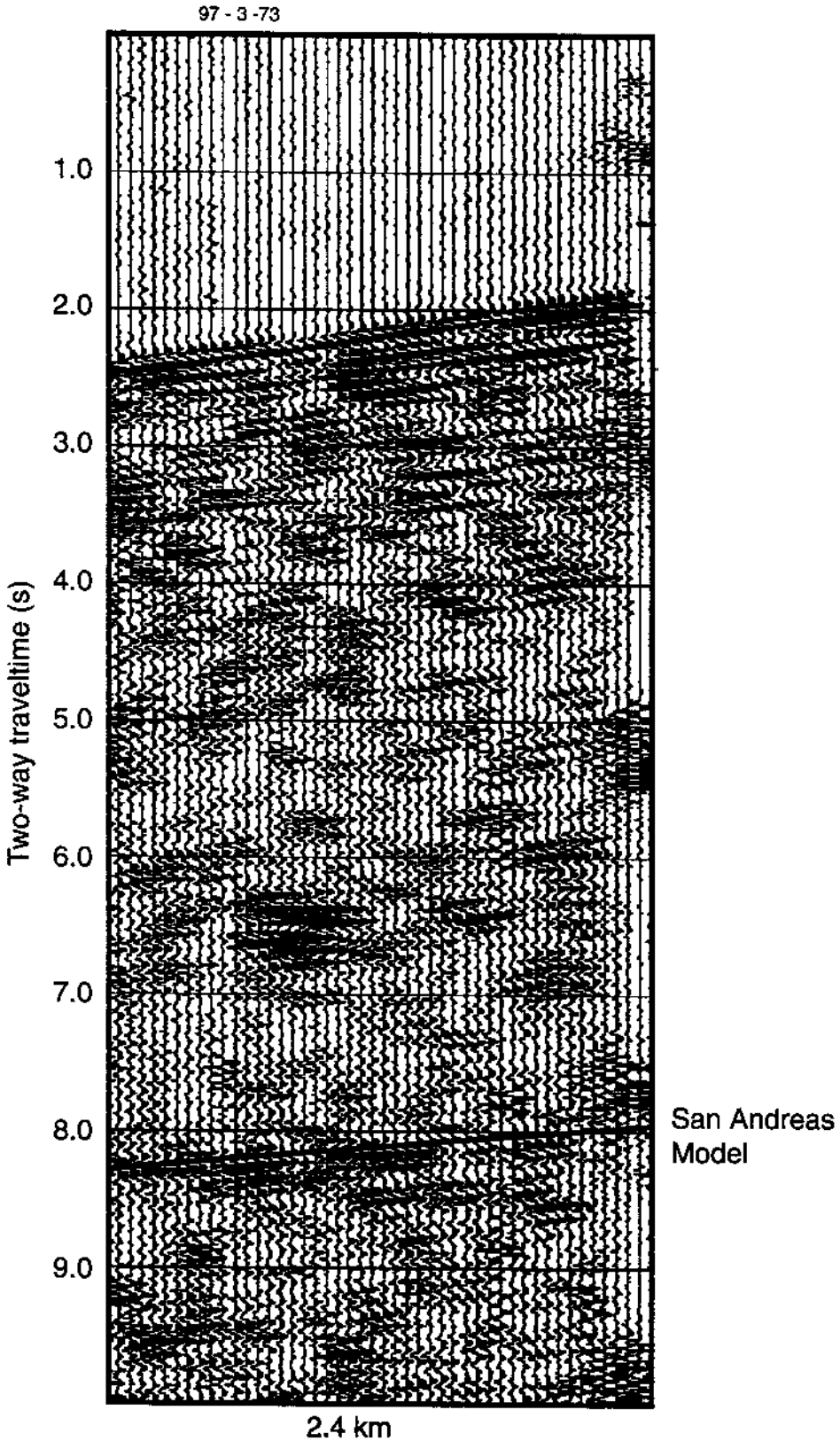
97 - 3 -73
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
2.4 km
San Andreas
Model

Figure 17

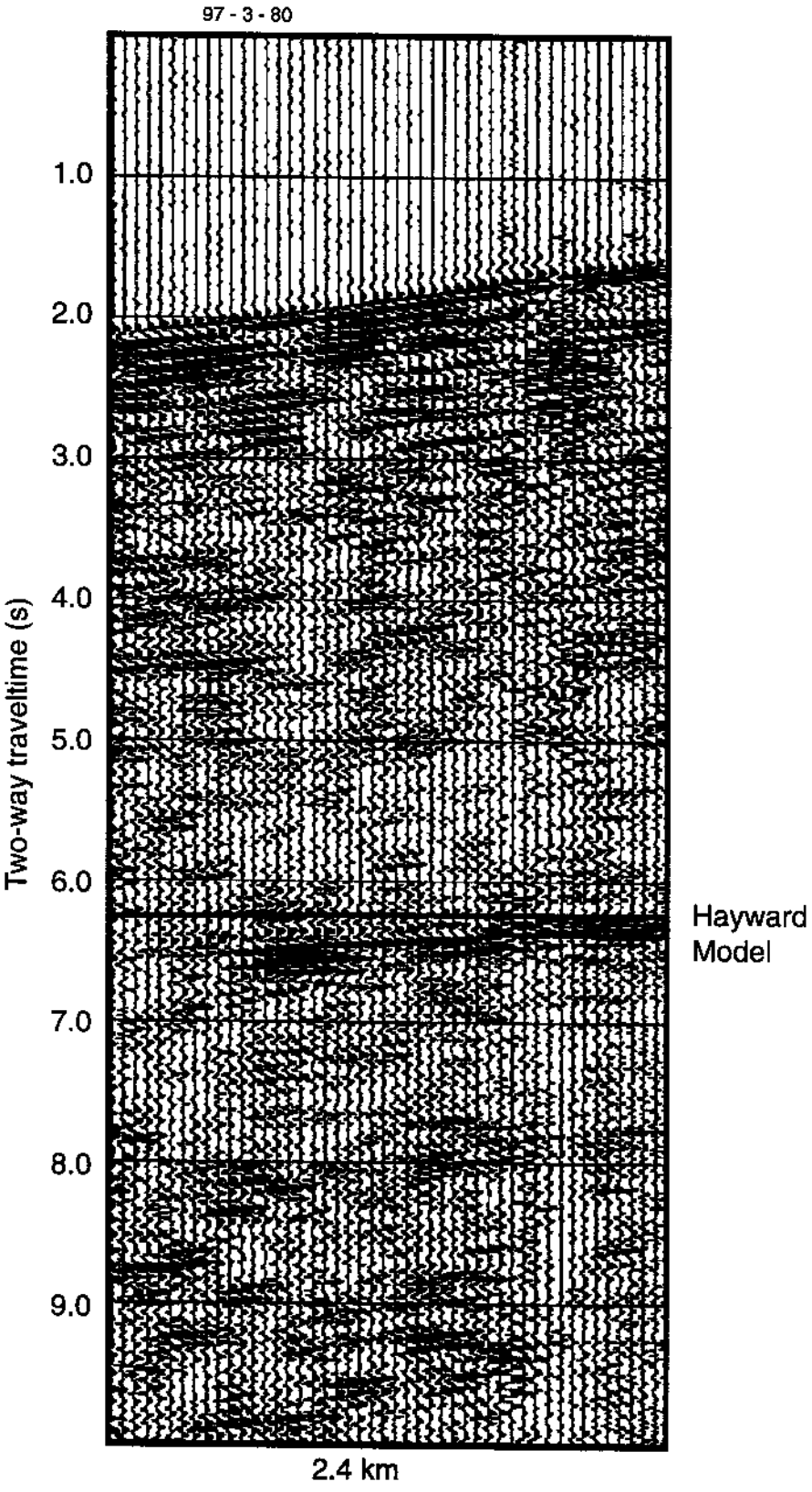
97 - 3 - 80
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
Hayward
Model
2.4 km

Figure 18

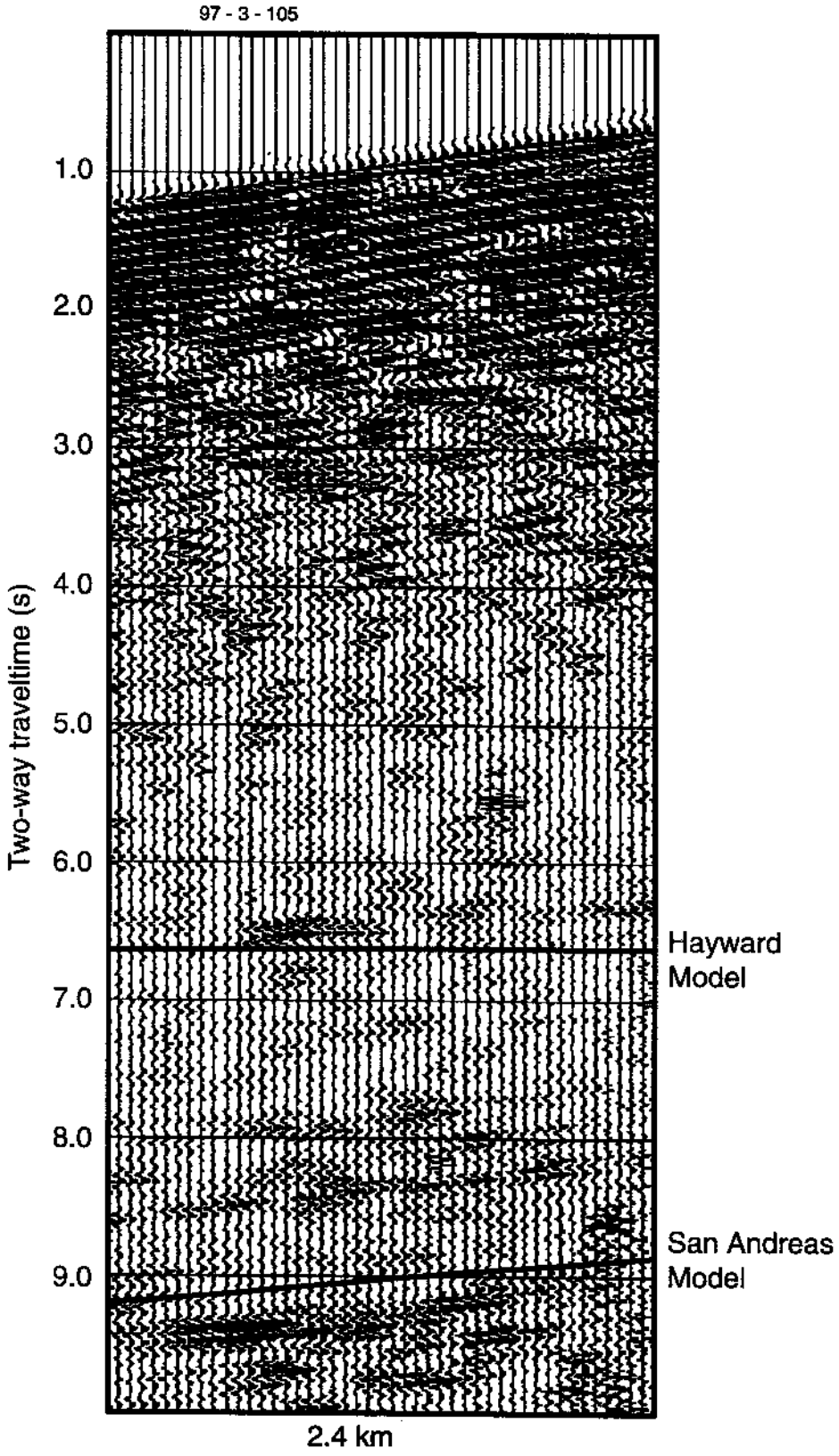
97 - 3 - 105
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
Hayward
Model
San Andreas
Model
2.4 km

Figure 19

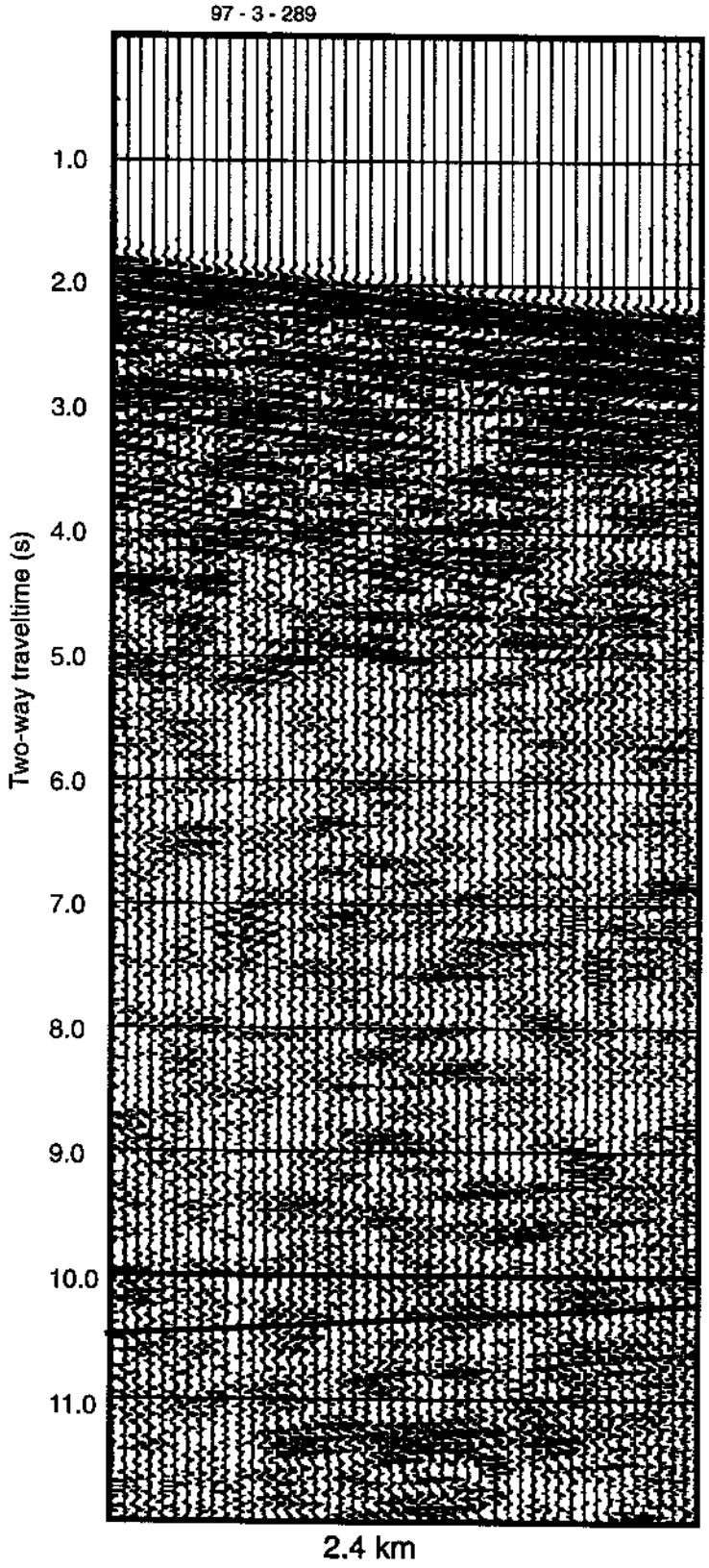
97 - 3 - 289
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
Two-way traveltime (s)
2.4 km
San Andreas
Model

Figure 20

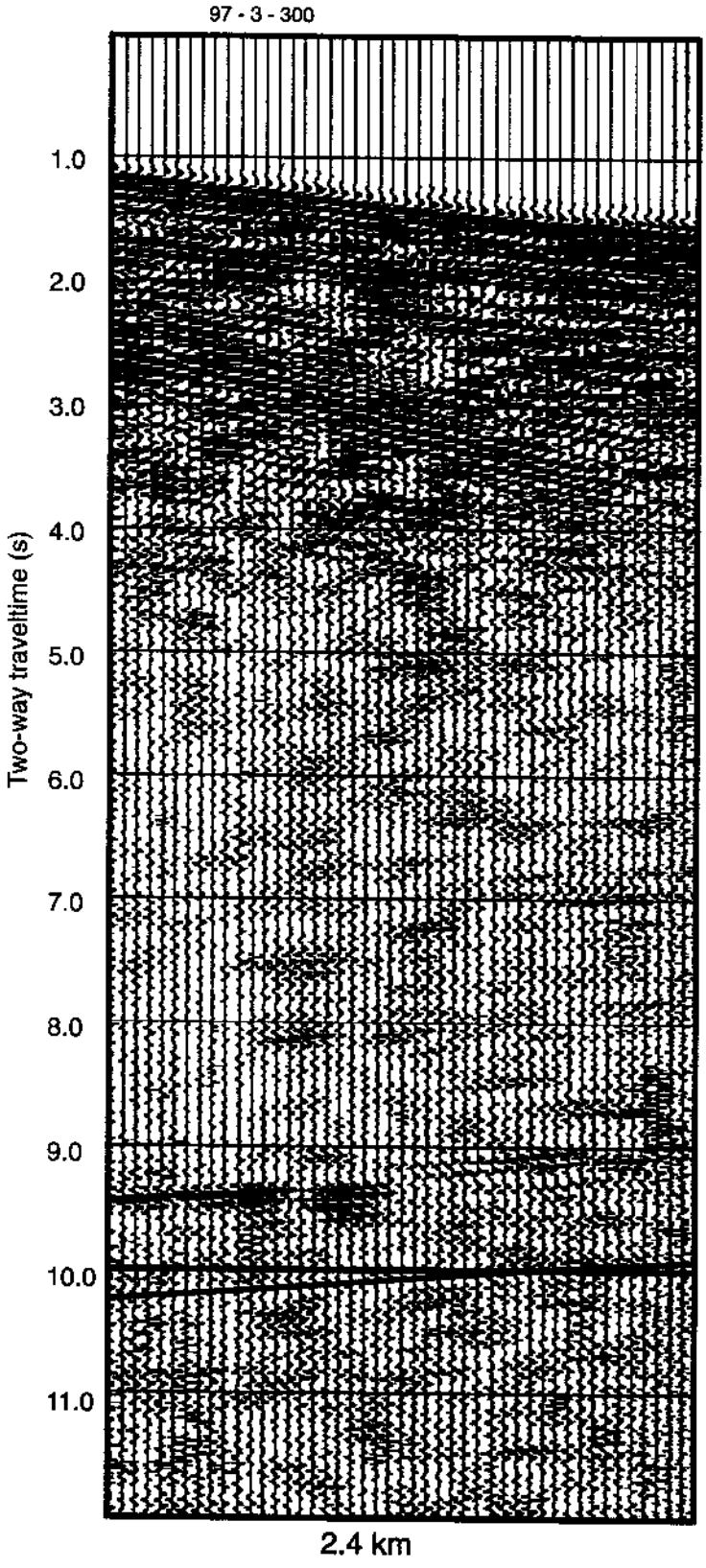
97 - 3 - 300
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 21

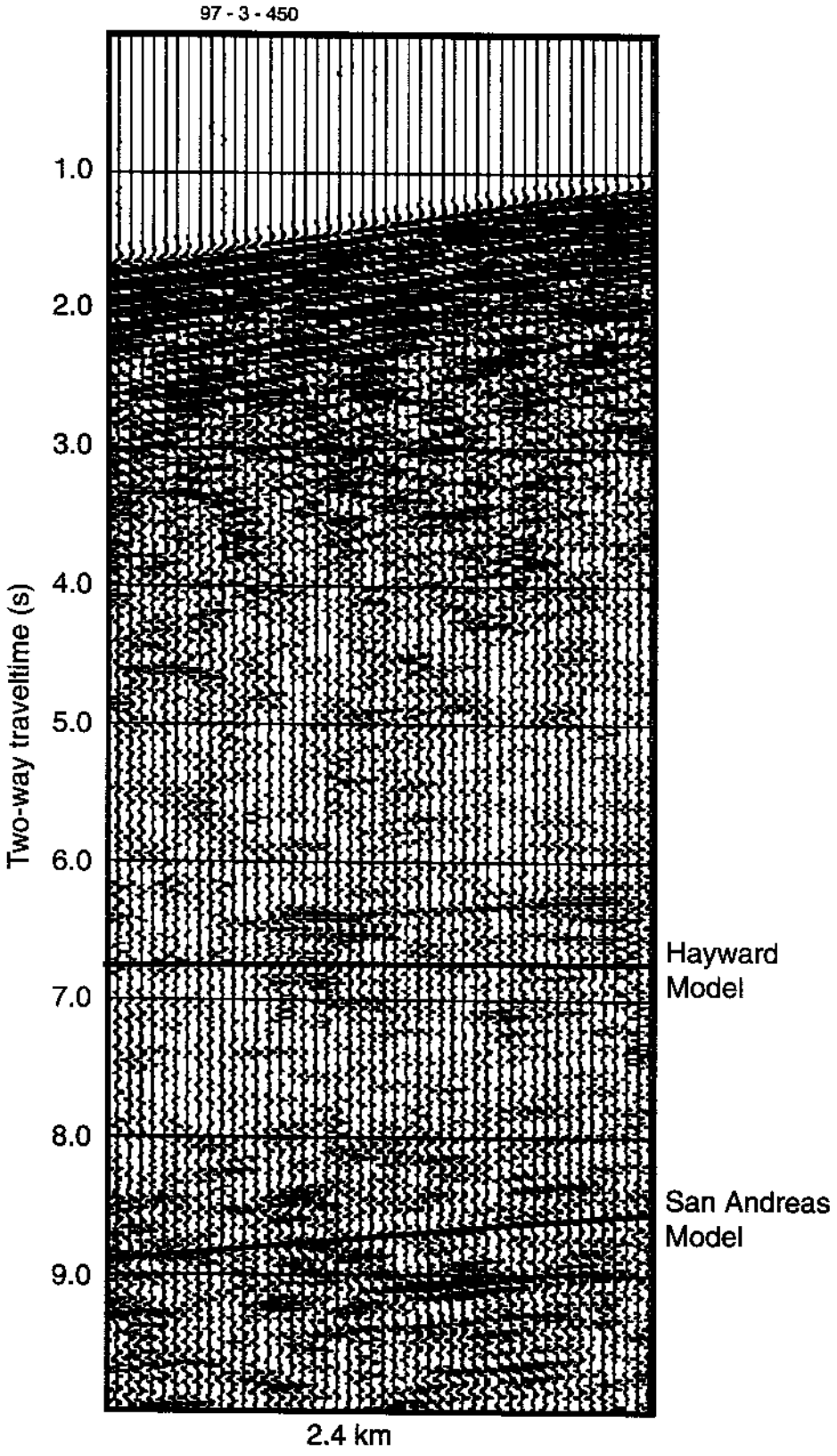
97 - 3 - 450
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
Hayward
Model
San Andreas
Model
2.4 km

Figure 22

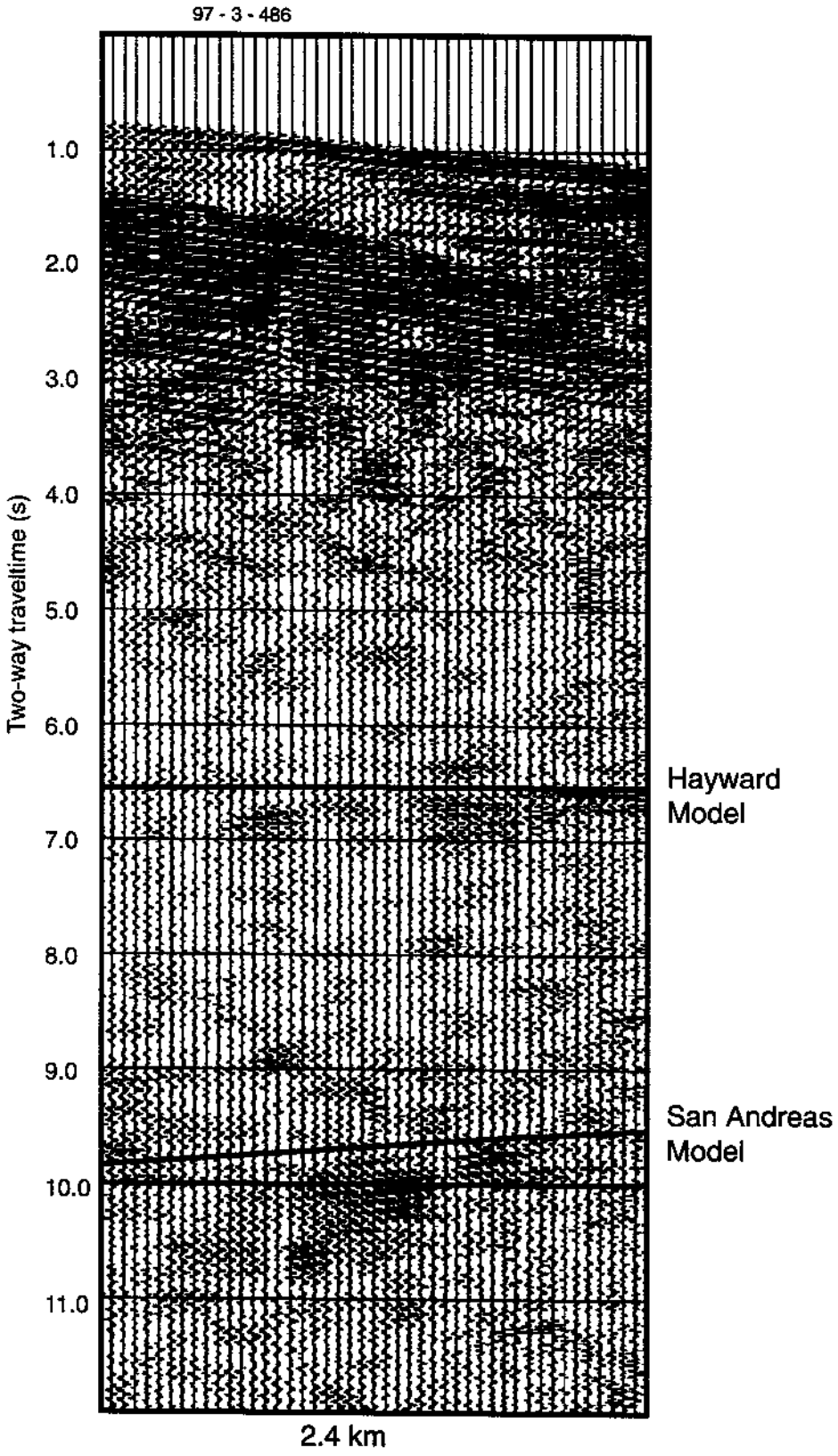
97 - 3 - 486
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
Two-way traveltime (s)
Hayward
Model
San Andreas
Model
2.4 km

Figure 23

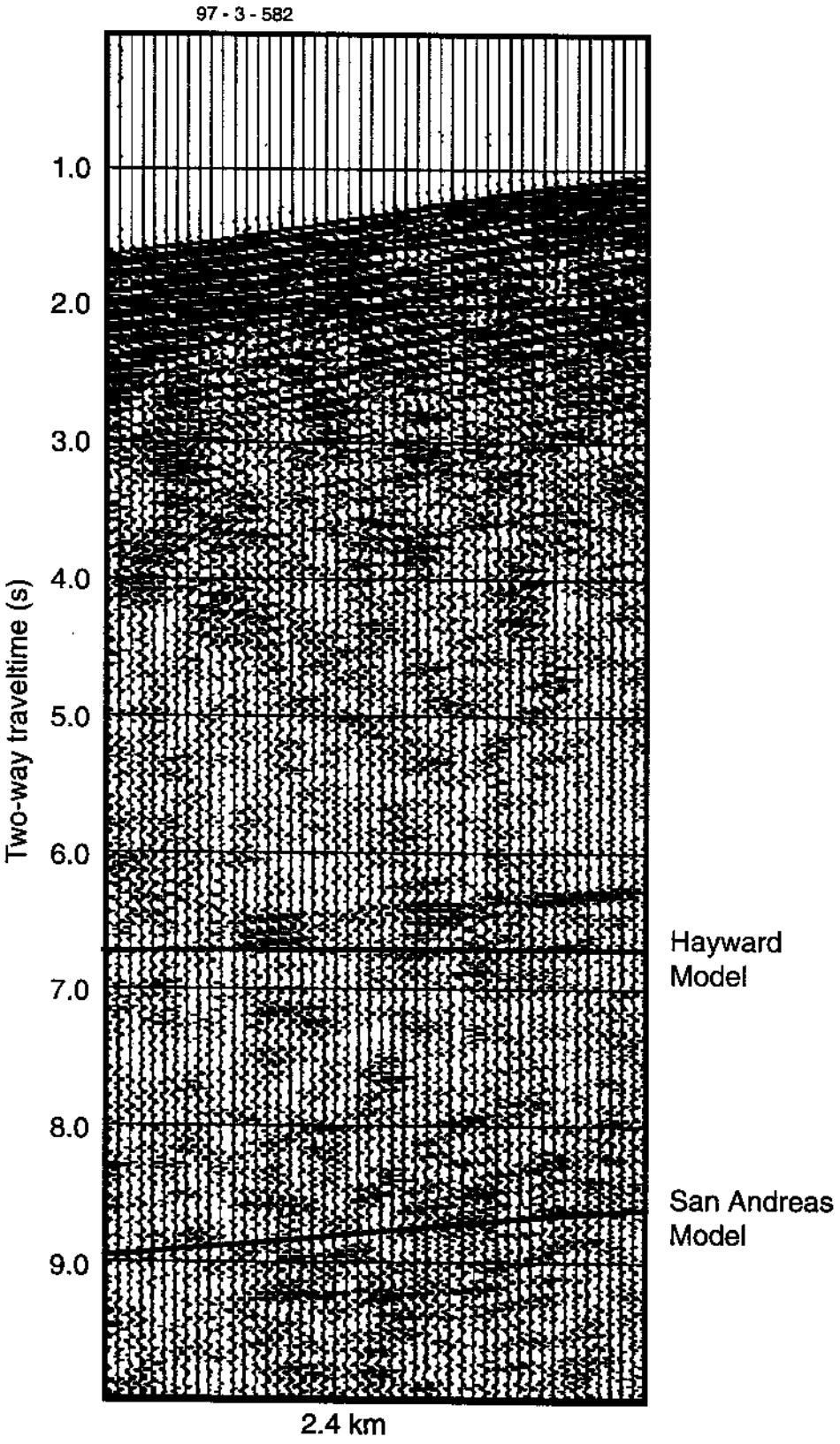
97 - 3 - 582
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
Hayward
Model
San Andreas
Model
2.4 km

Figure 24

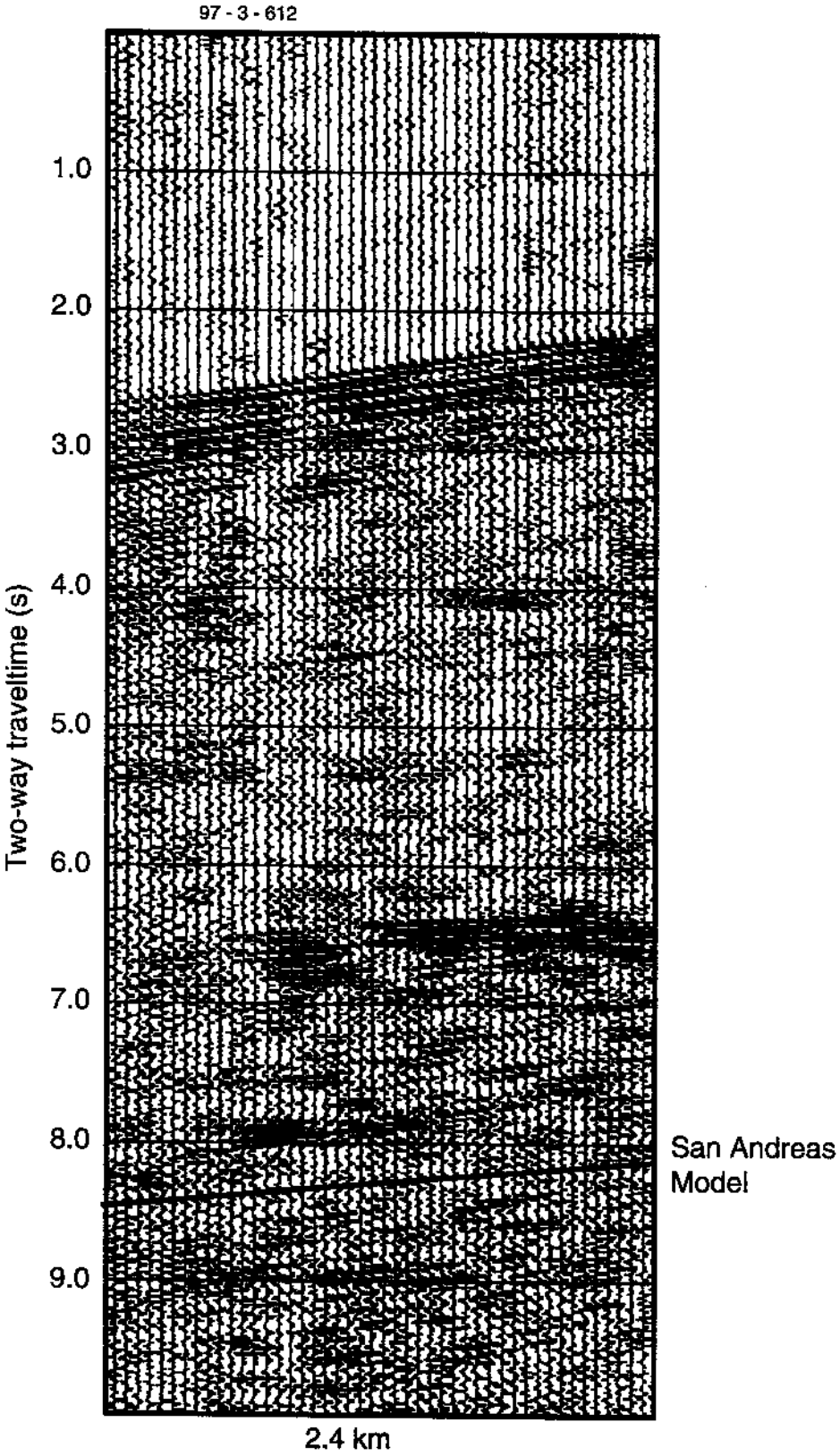
97 - 3 - 612
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 25

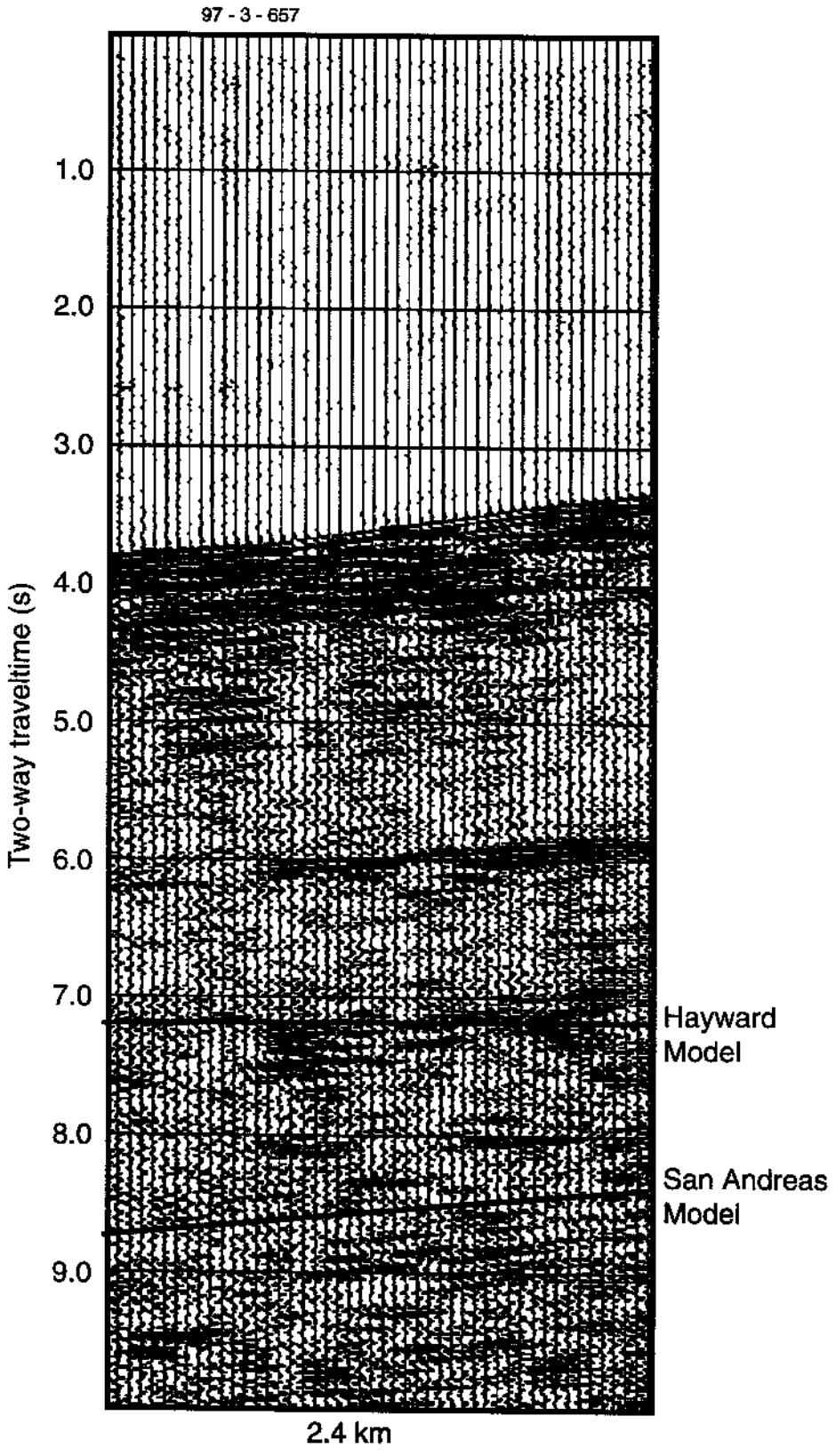
97 - 3 - 657
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
Hayward
Model
San Andreas
Model
2.4 km

Figure 26

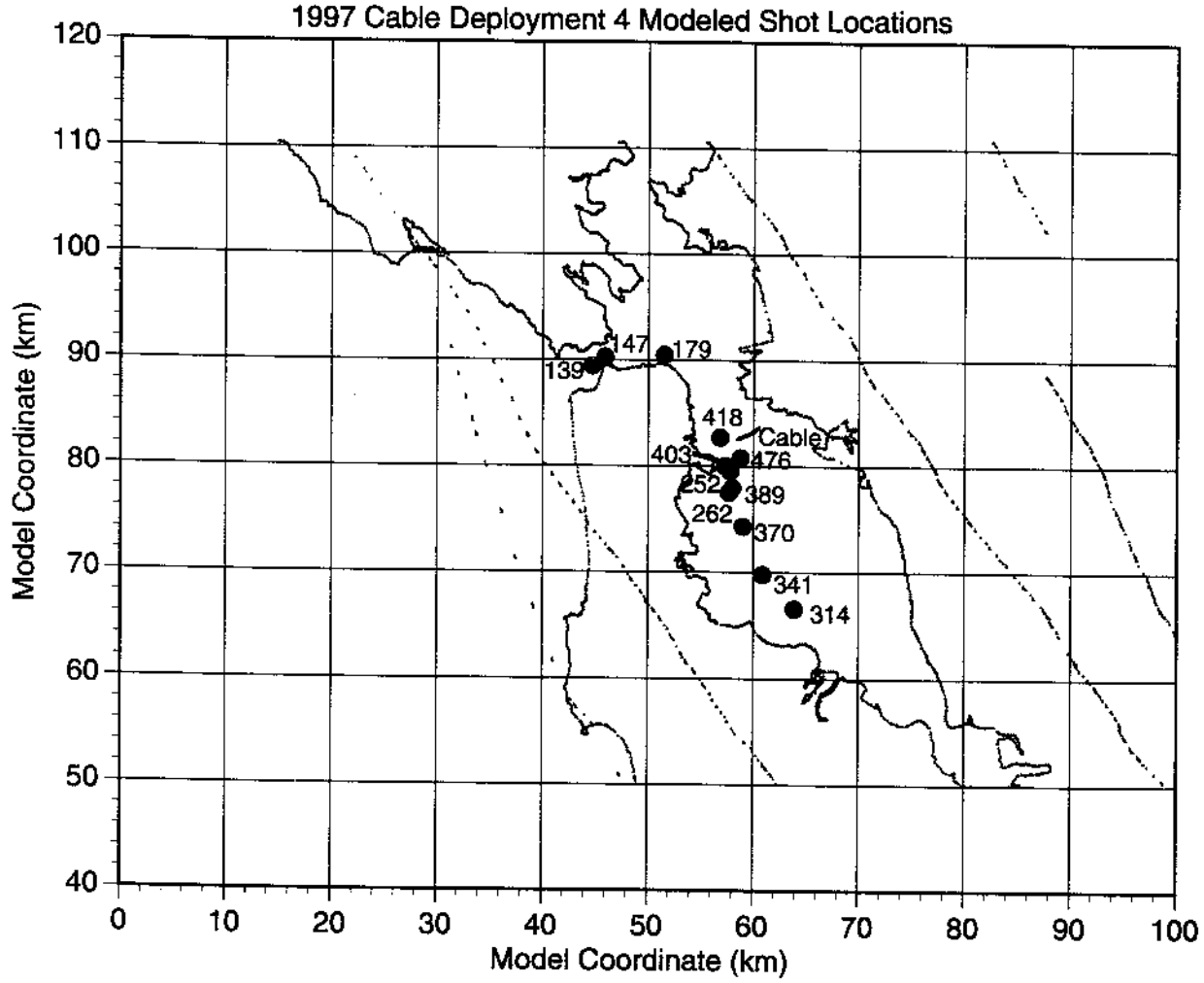
1997 Cable Deployment 4 Modeled Shot Locations
Model Coordinate (km)
Model Coordinate (km)
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100
147
179
139
418
Cable
403
476
252
389
262
370
341
314

Figure 27

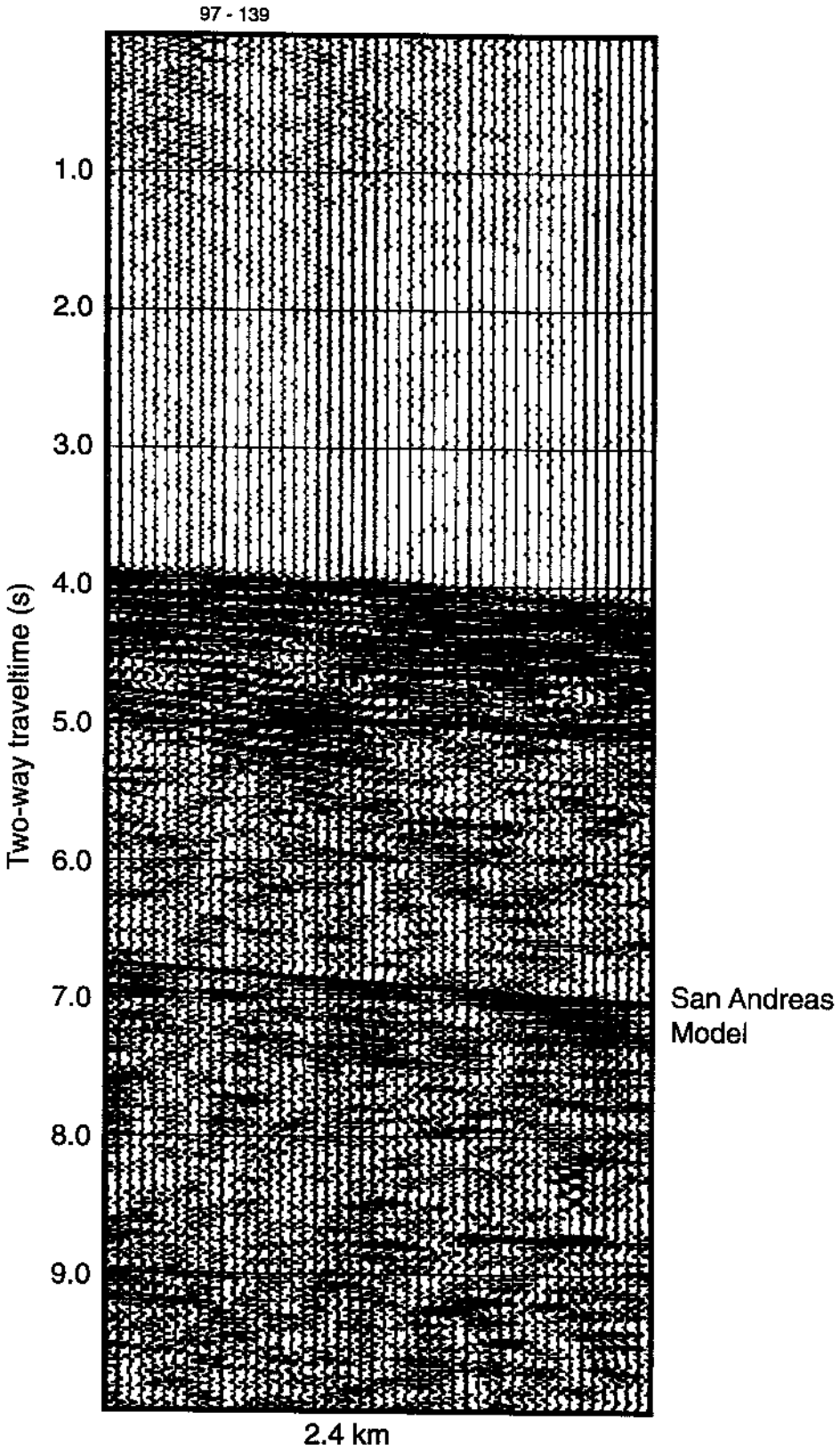
97 - 139
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 28

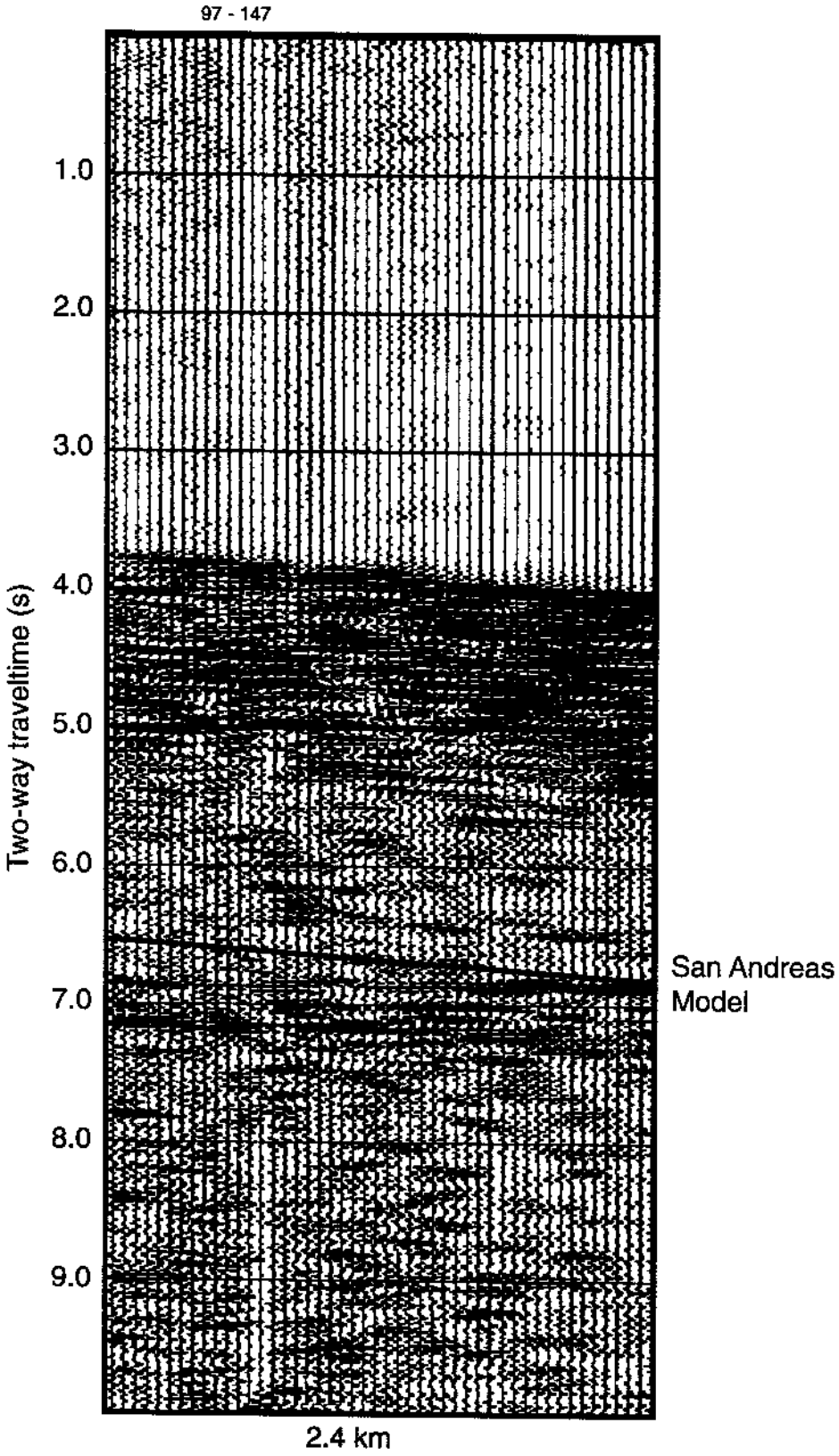
97 - 147
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 29

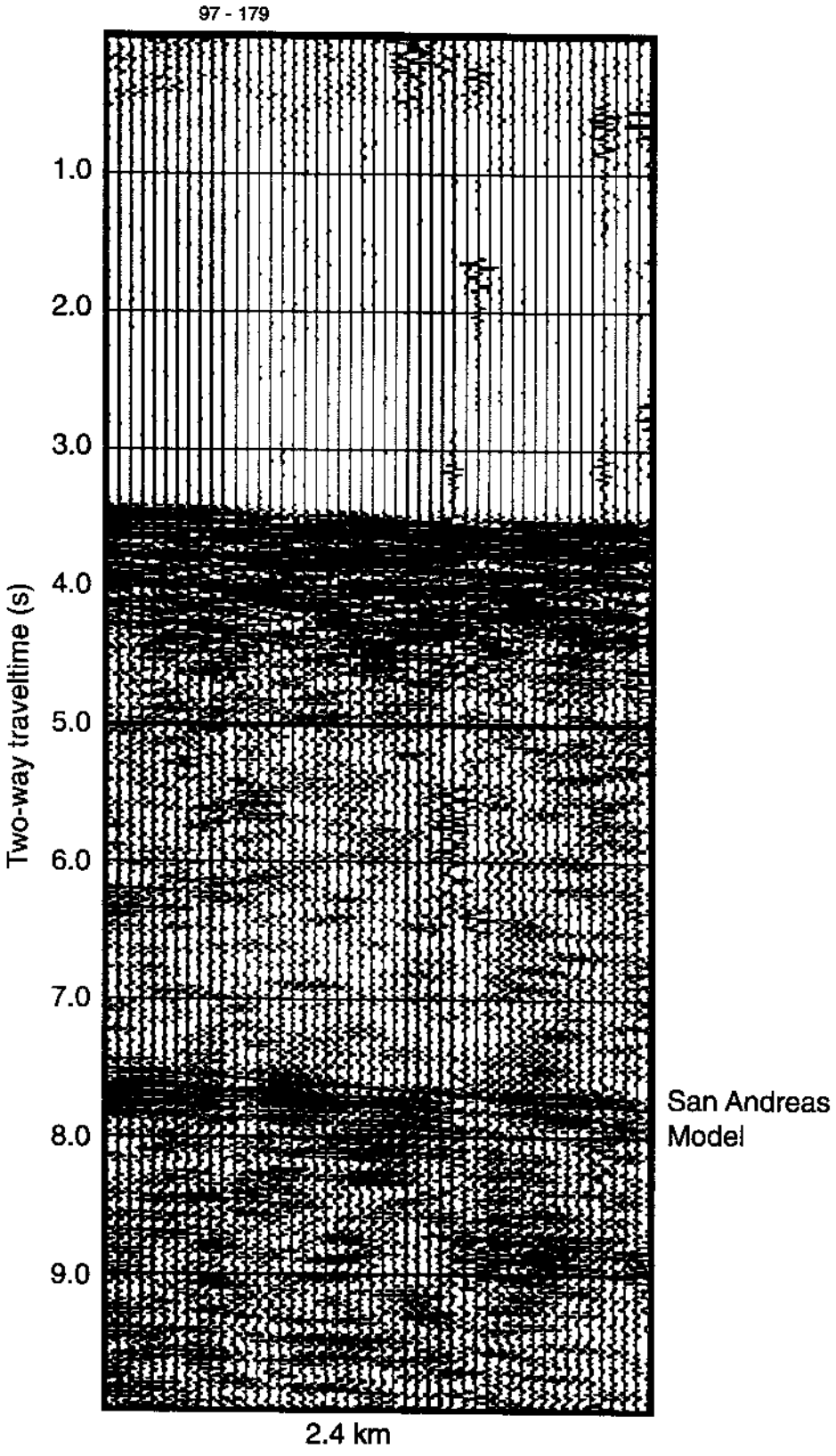
97 - 179
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 30

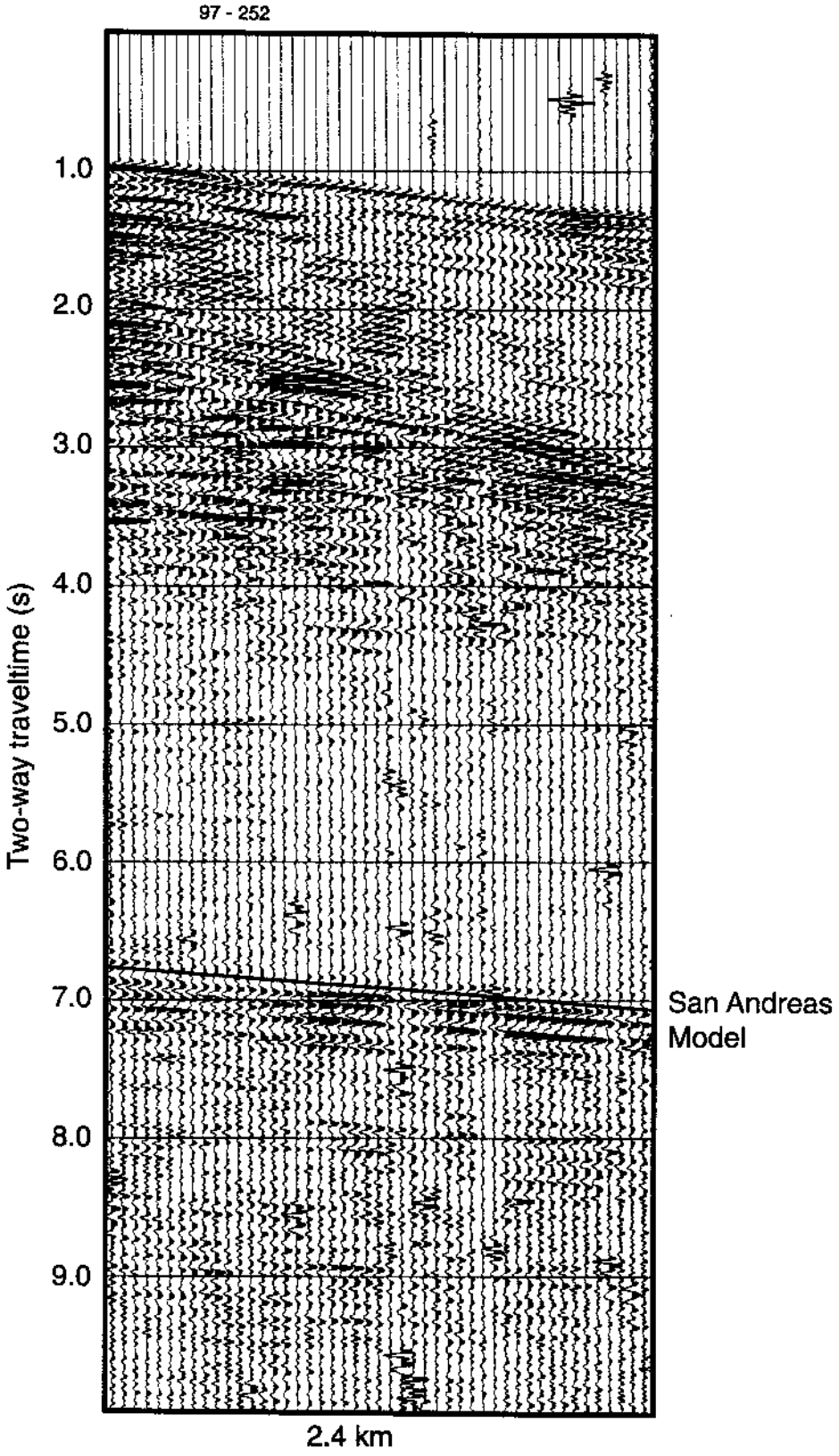
97 - 252
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 31

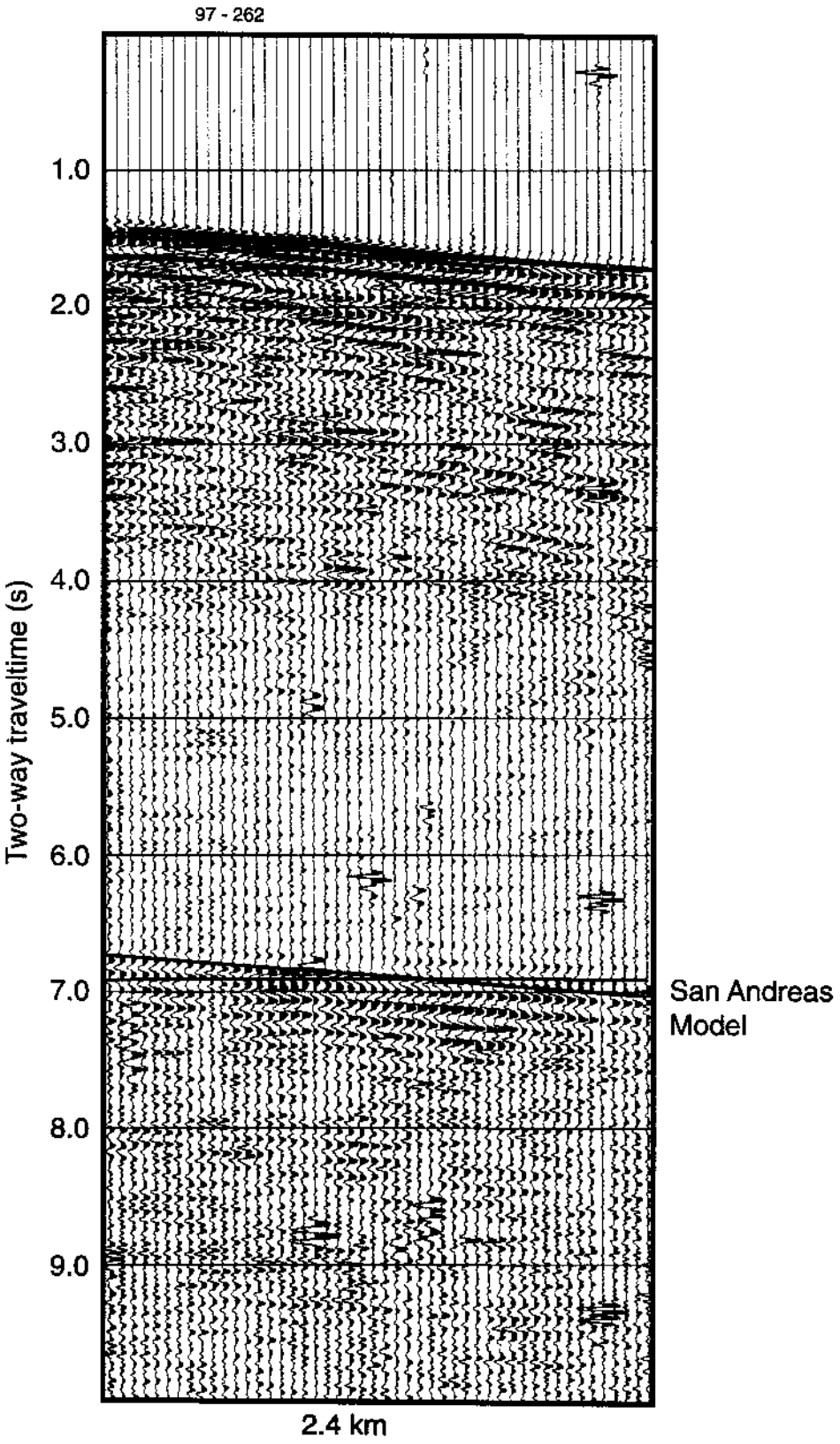
97 - 262
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 32

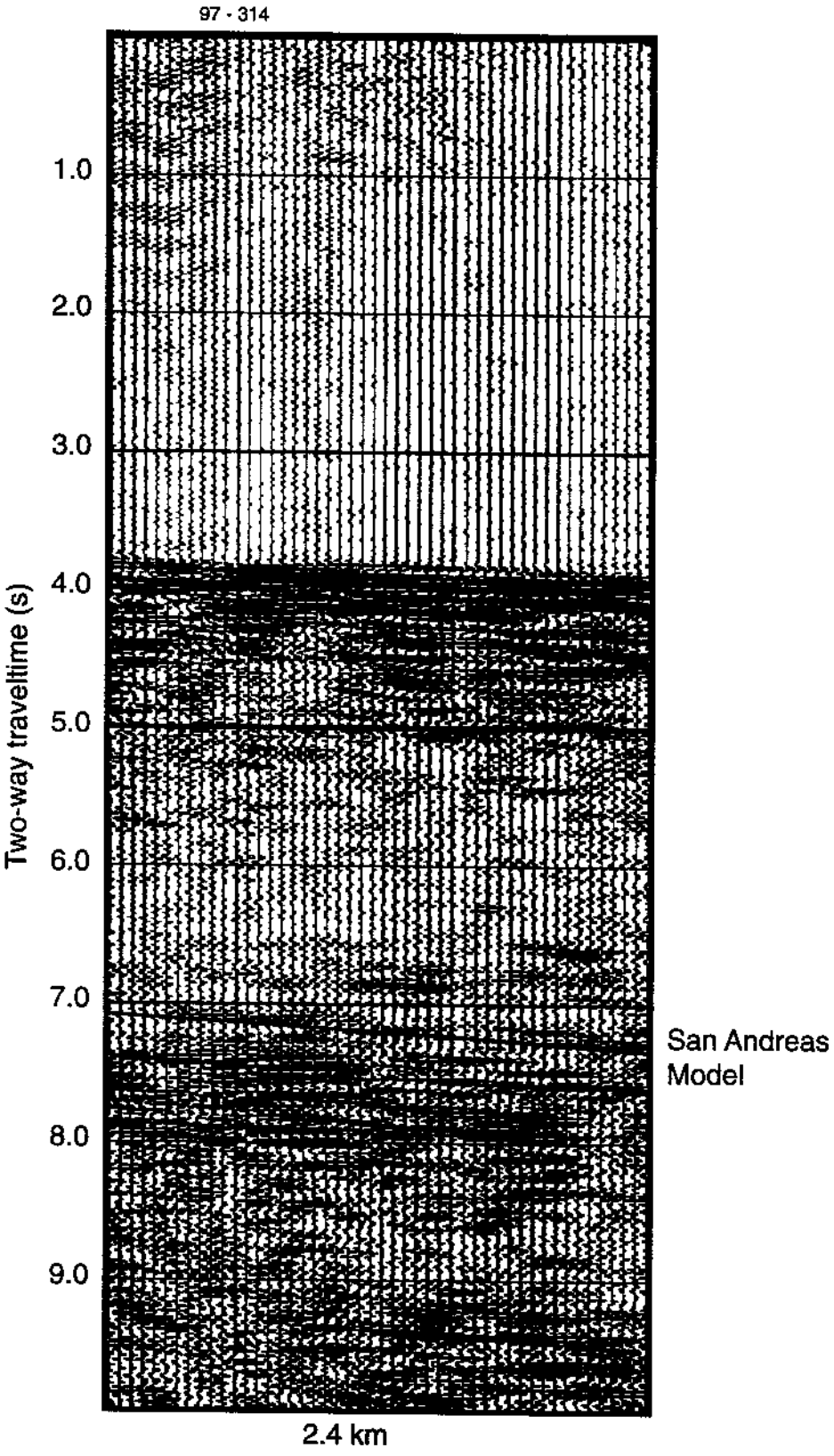
97 - 314
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 33

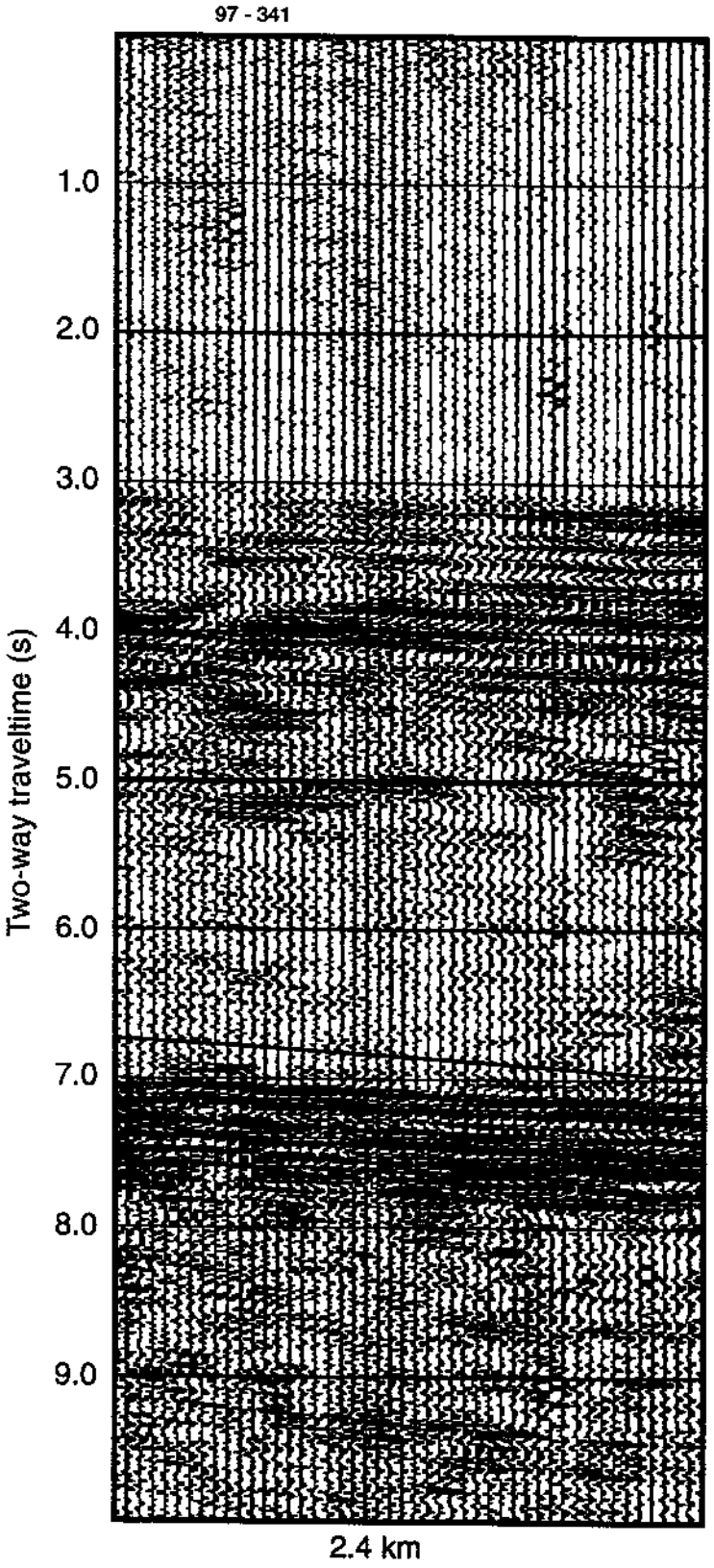
97 - 341
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
2.4 km
San Andreas
Model

Figure 34

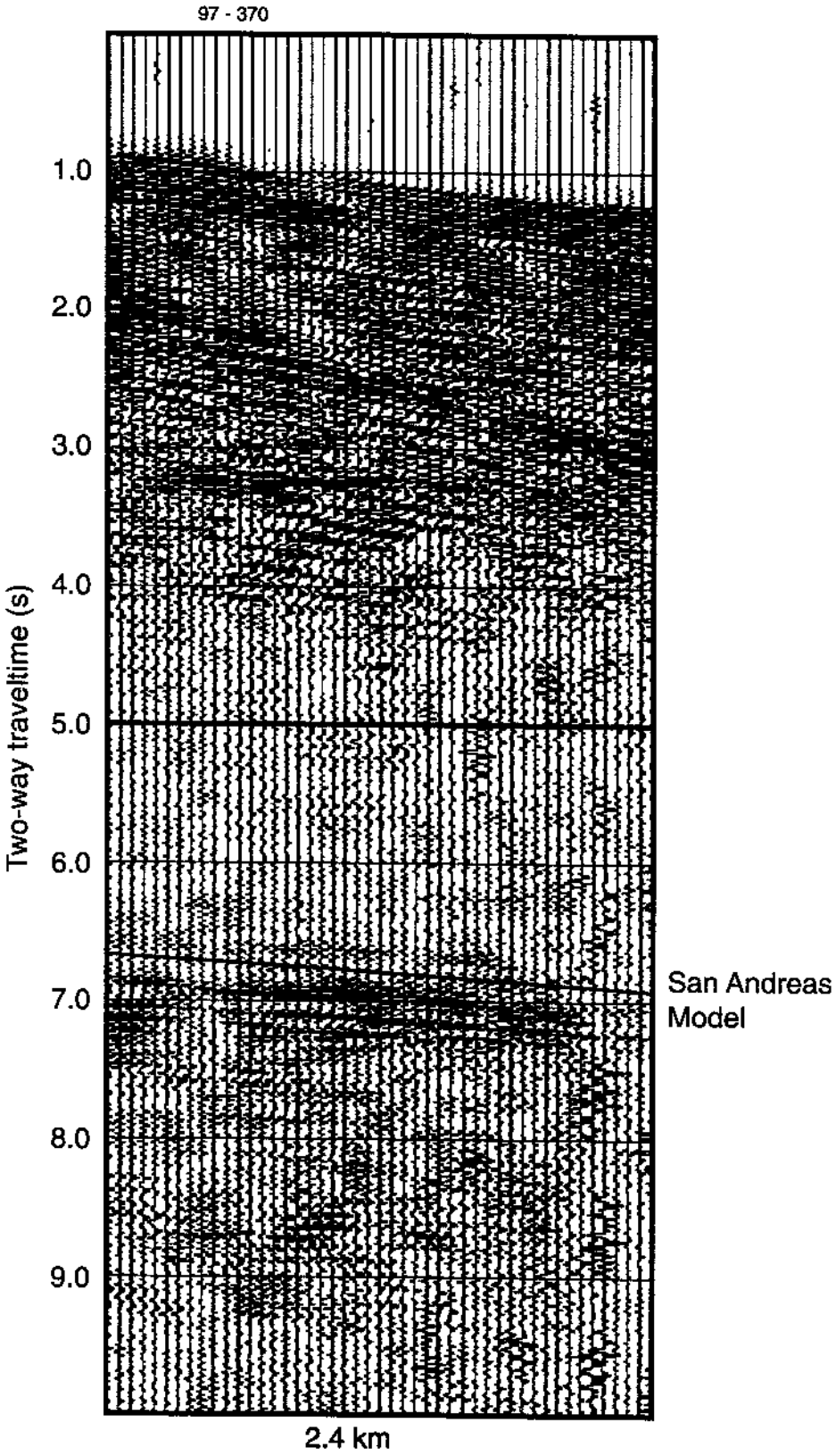
97 - 370
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 35

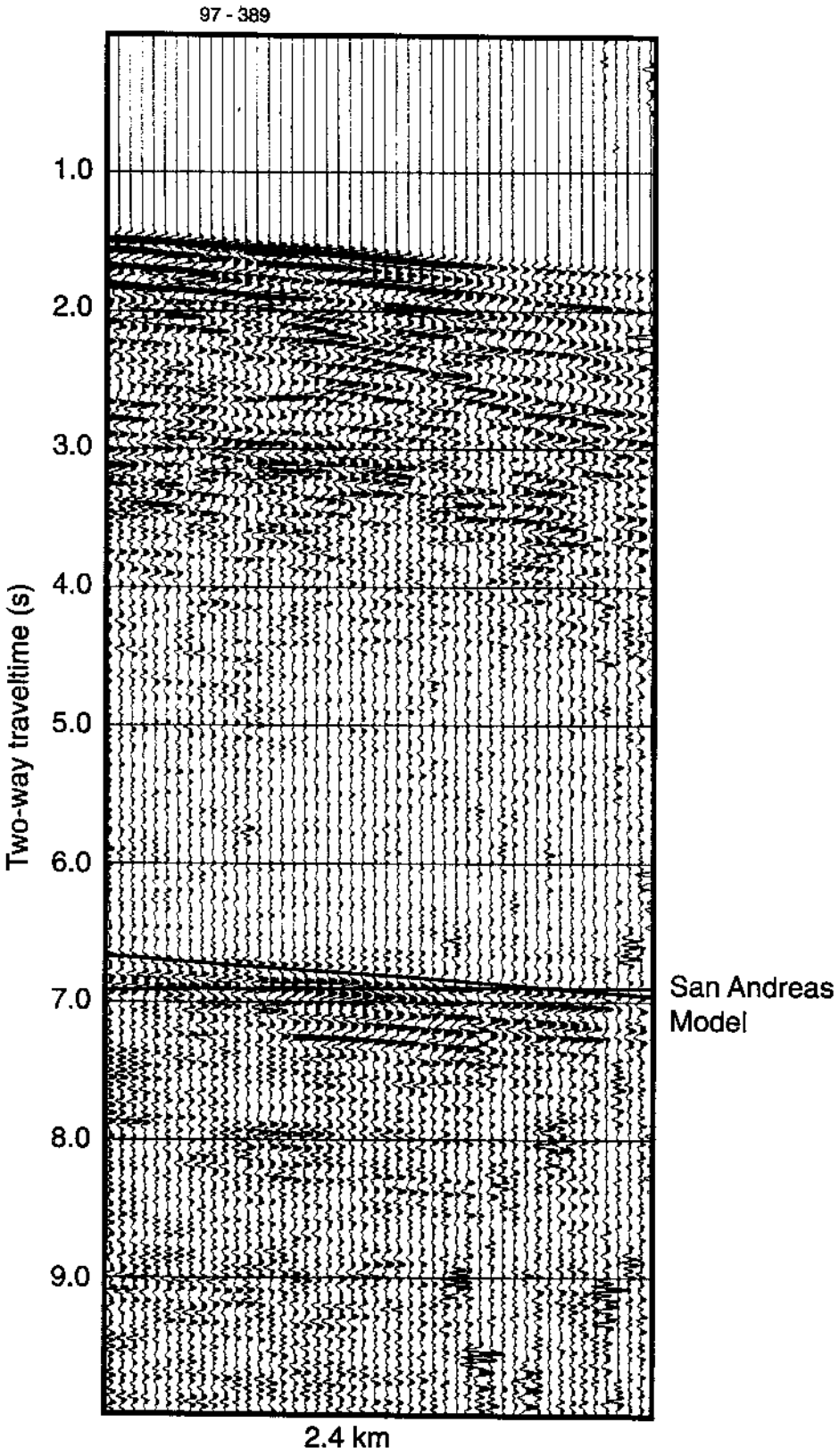
97 - 389
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 36

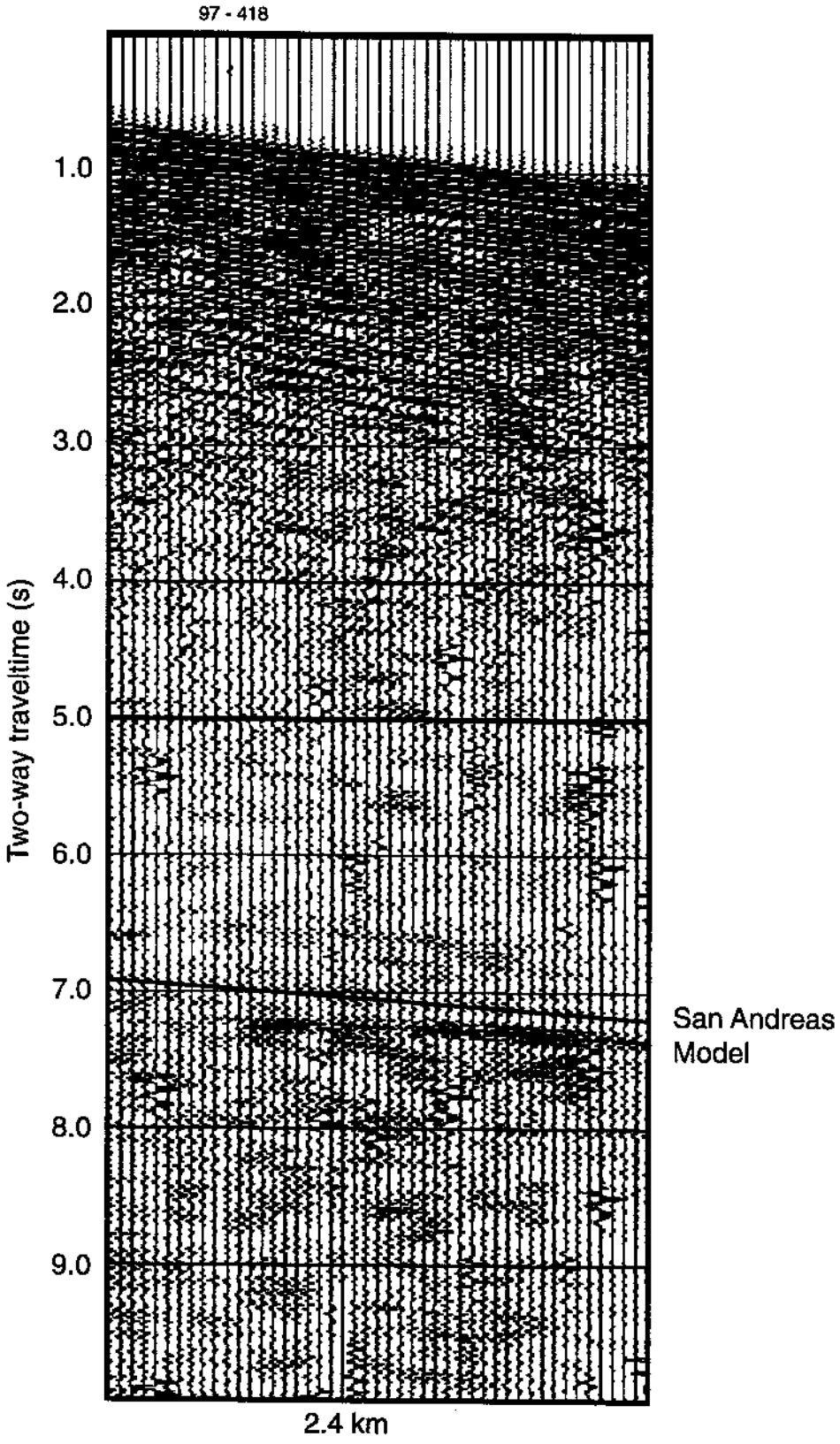
97 - 418
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 37

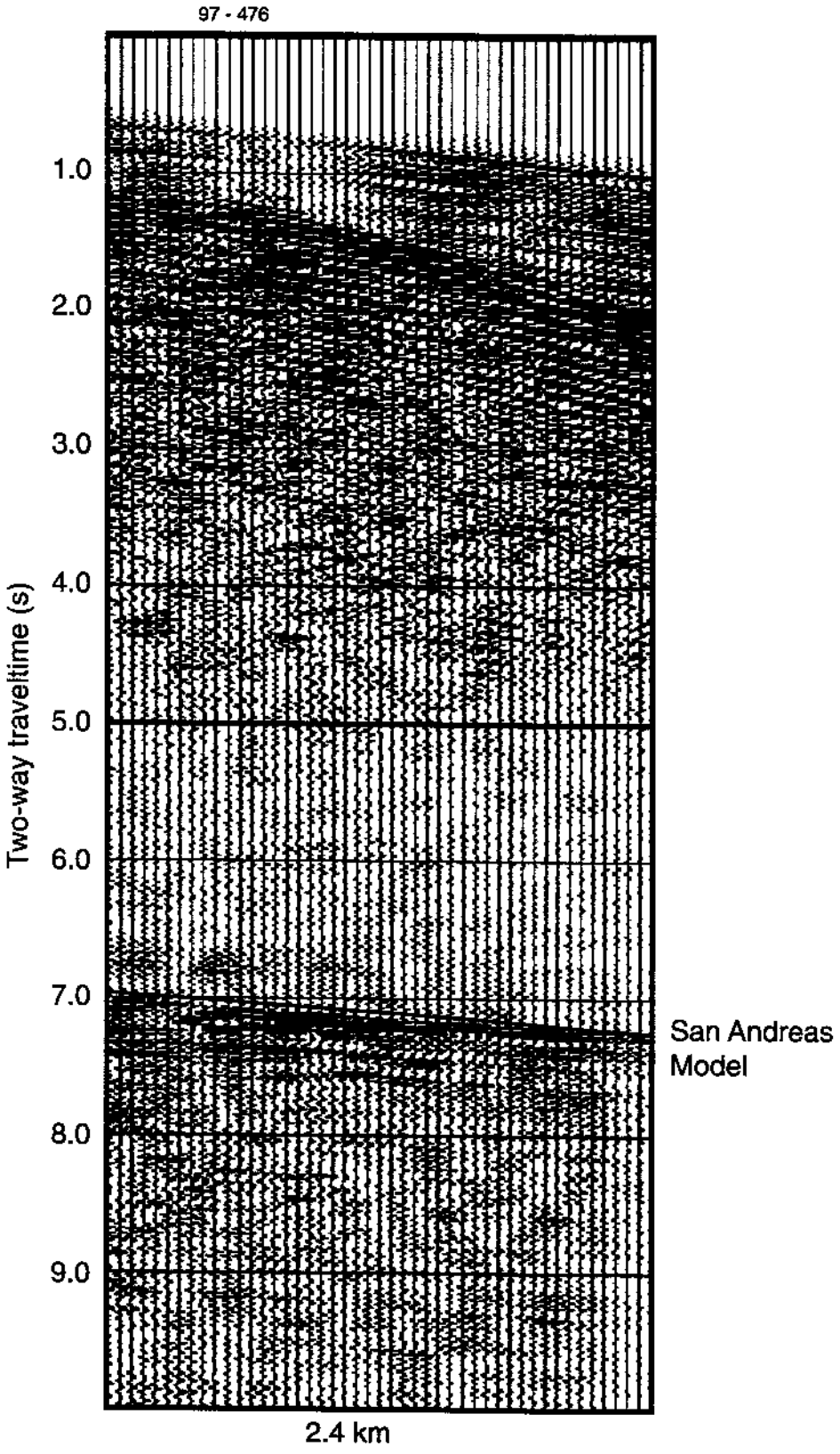
97 - 476
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Two-way traveltime (s)
San Andreas
Model
2.4 km

Figure 38

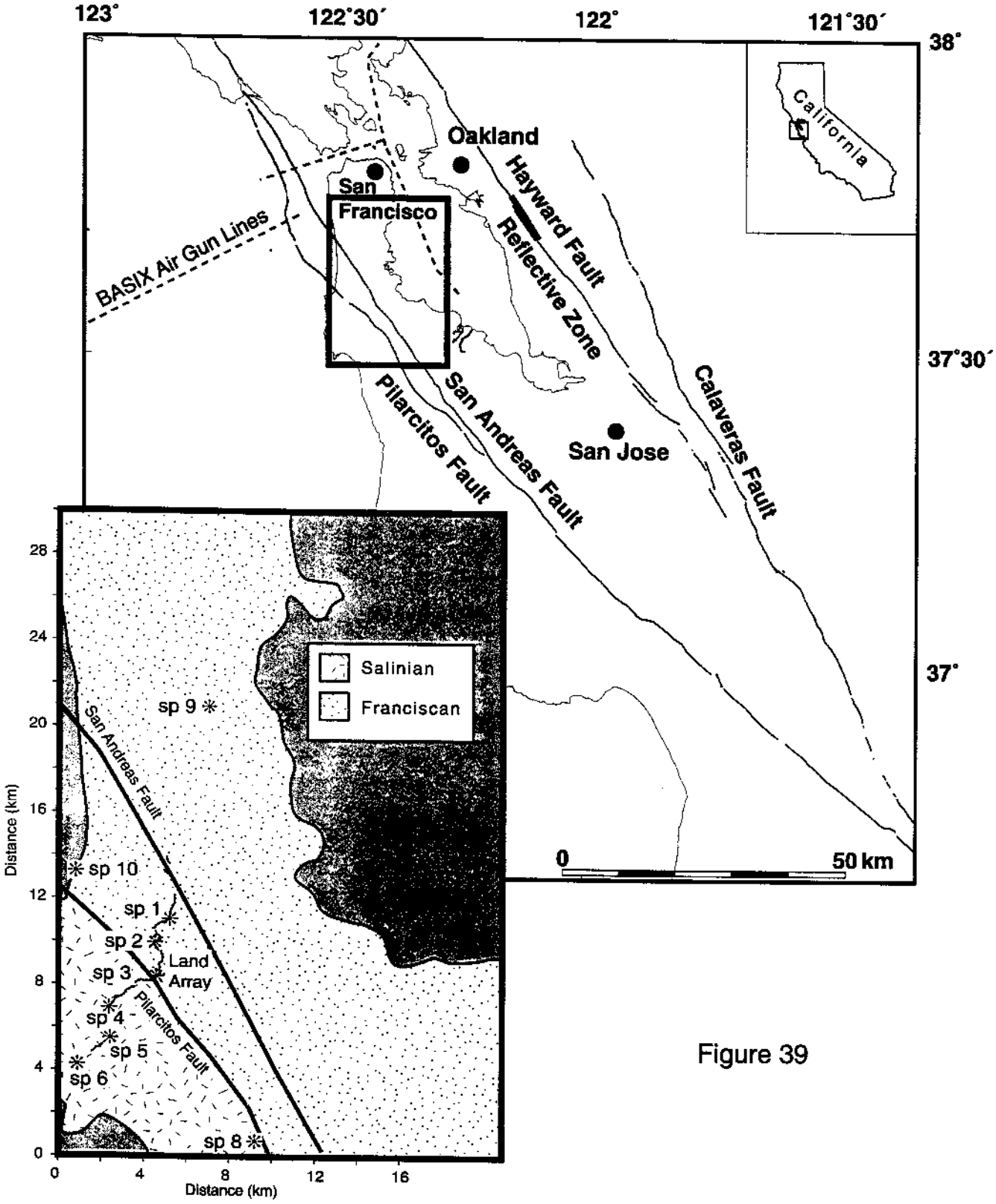
123°
122°30´
122°
121°30´
38°
37°30´
37°
Oakland
San Francisco
San Jose
Hayward Fault
Reflective Zone
BASIX Air Gun Lines
Pilarcitos Fault
San Andreas Fault
Calaveras Fault
California
0
50 km
Salinian
Franciscan
sp 9
sp 10
sp 1
sp 2
sp 3
sp 4
sp 5
sp 6
sp 8
Land Array
Pilarcitos Fault
San Andreas Fault
Distance (km)
Distance (km)
0
4
8
12
16
20
24
28

Figure 39

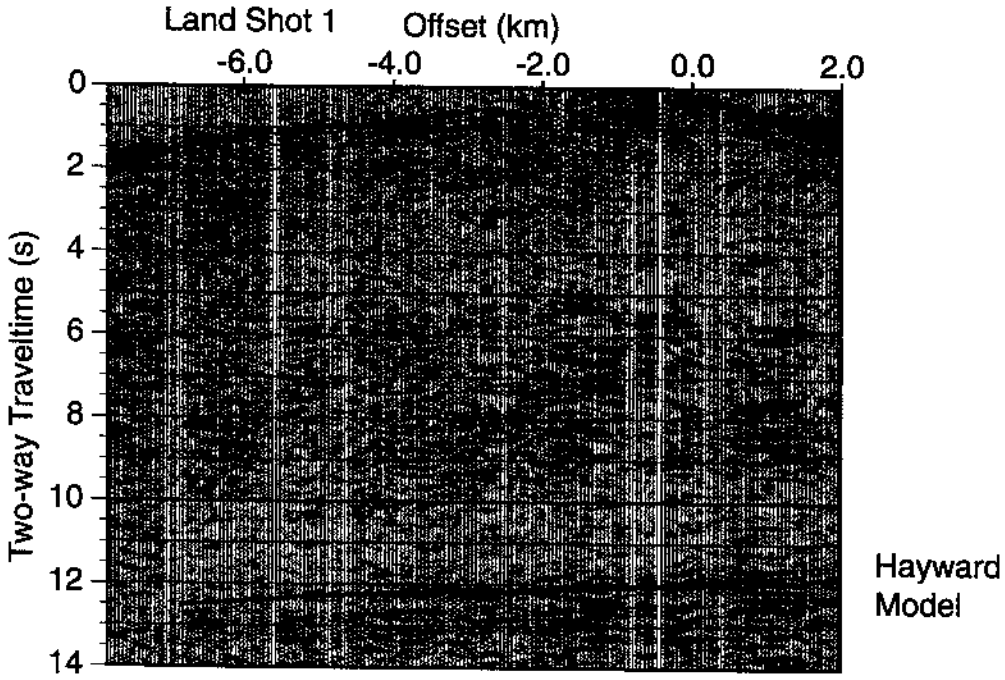
Land Shot 1
Offset (km)
-6.0
-4.0
-2.0
0.0
2.0
0
2
4
6
8
10
12
14
Two-way Traveltime (s)
Hayward
Model

Figure 40

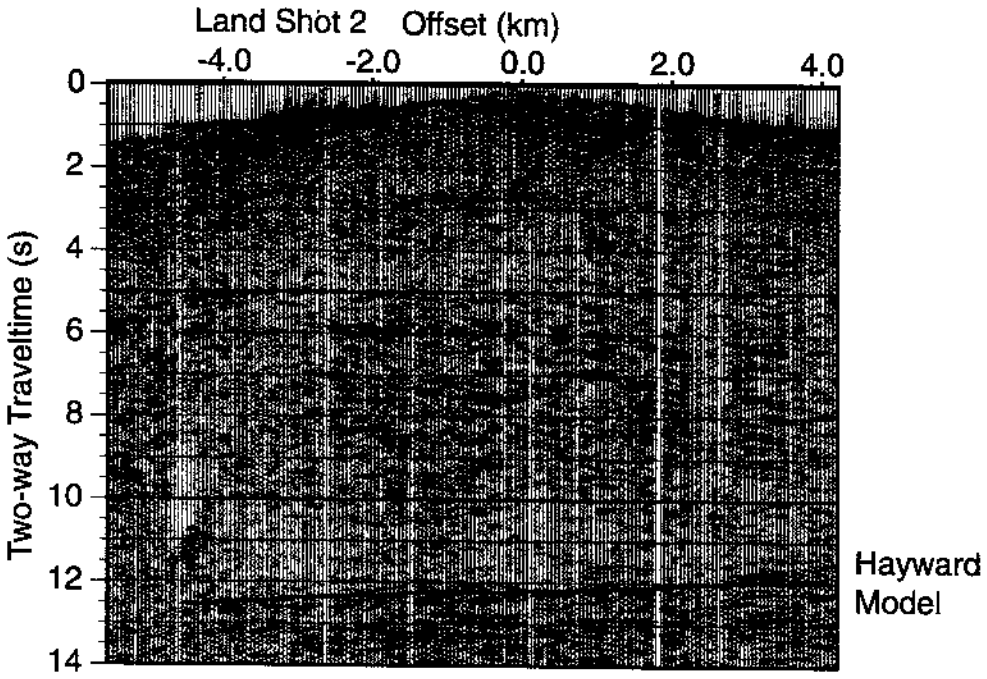
Land Shot 2 Offset (km)
-4.0
-2.0
0.0
2.0
4.0
0
2
4
6
8
10
12
14
Two-way Traveltime (s)
Hayward
Model

Figure 41

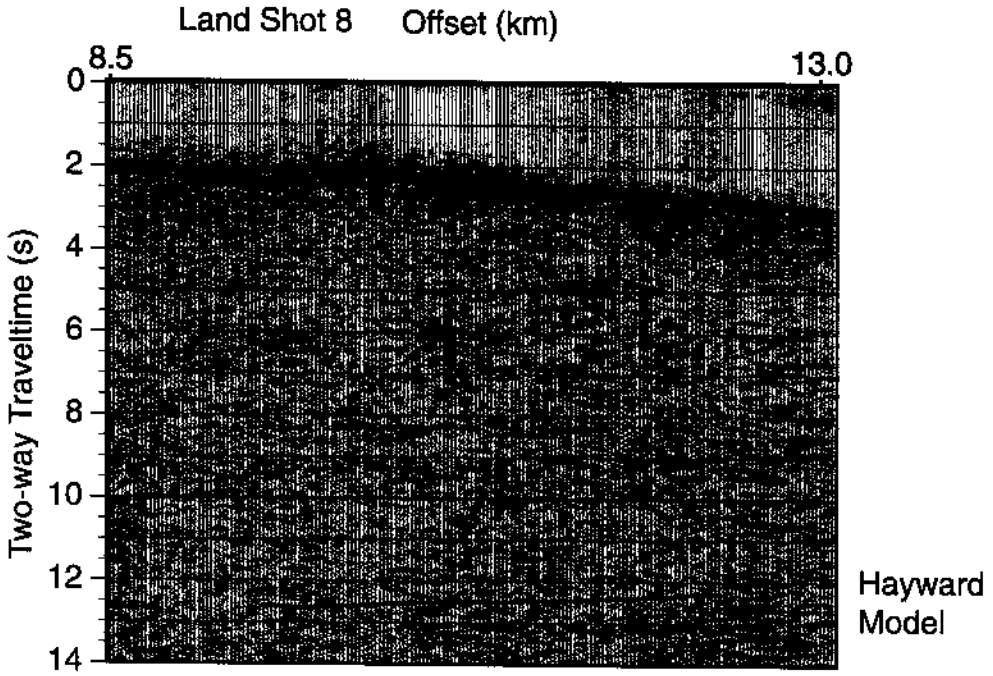
Land Shot 8
Offset (km)
8.5
13.0
0
2
4
6
8
10
12
14
Two-way Traveltime (s)
Hayward
Model

Figure 42

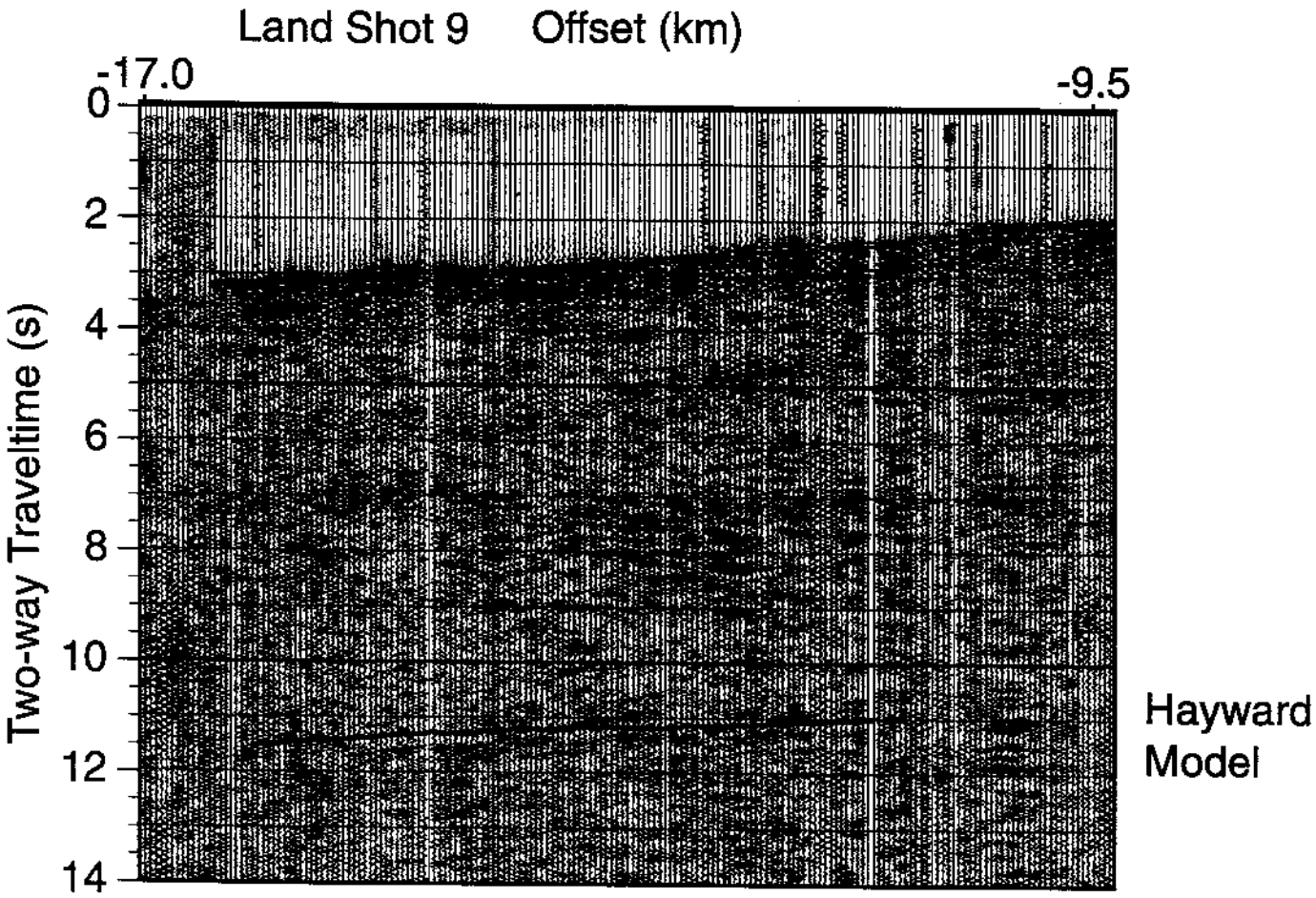
Land Shot 9 Offset (km)
-17.0
-9.5
0
2
4
6
8
10
12
14
Two-way Traveltime (s)
Hayward
Model

Figure 43

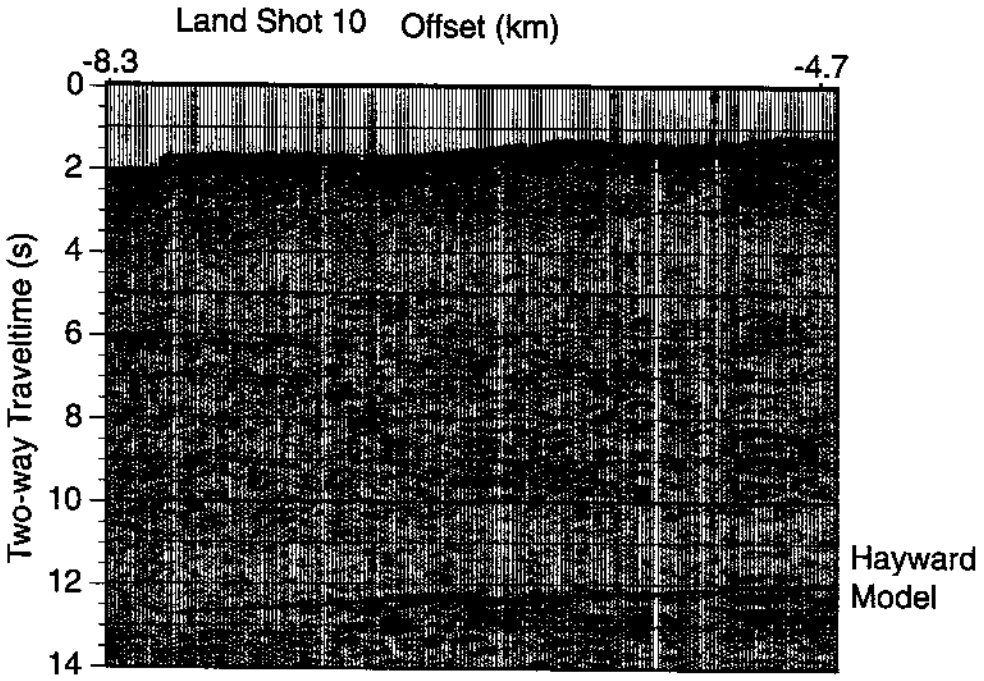
Land Shot 10
Offset (km)
-8.3
-4.7
0
2
4
6
8
10
12
14
Two-way Traveltime (s)
Hayward
Model

Figure 44