Continuous Monitoring and Interpretation of Crustal Velocity Changes Near Palmdale, California

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AIRGUN SEISMIC TRAVEL TIME AND STRUCTURAL STUDIES AT BOUQUET RESERVOIR

A) Between November 1978 and April 1980 seismic travel times from Bouquet Reservoir to two borehole sensors 13 km and 18 km to the northeast (Figure 1) were measured to an average precision of ± 3 msec ($\approx \frac{\Delta V}{V} = .1\%$) for the first arrival (P-wave) and to ± 6 msec for subsequent refraction and S-wave arrivals ($\frac{\Delta V}{V} \approx .2\%$). We observed no trending or prolonged travel time anomaly for a variety of sampling intervals (weeks to months) and sampling rates (hours to days). A total of 200 travel time determinations for each phase to each borehole were made during the 18 month study period. Of these the bulk occurred in month-long sampling periods, August 1979 (25 pts.), December 1979 (35 pts.), and January-February 1980 (100 pts.). The average P-wave (first arrival) travel times for these clusters are shown in Figure 2. Results for the P-wave and reflected P-wave over a shorter time interval (1 wk, January, 1980) are given in Figure 3.

B) Numerous distinct phases (P, S, reflected) appear in the borehole seismic traces. In three boreholes sufficiently deep to permit travel time logging (see Figure 1), we measured apparent uphole velocities for as many as 5 arrivals (Figures 4-6). At each of the boreholes, we measured true velocities with explosives. Combining true and apparent velocities to get ray parameters for prominant arrivals at the borehole sites, we were able to identify prominent refracted and reflected arrivals in surface site profiles (Figures 7-8). The current best model for traverses parallel to and transverse to the San Andreas fault are given in Figure 9. The structural determination allowed us to choose the most interesting arrivals for travel time monitoring (see paragraph A).

Figure 1

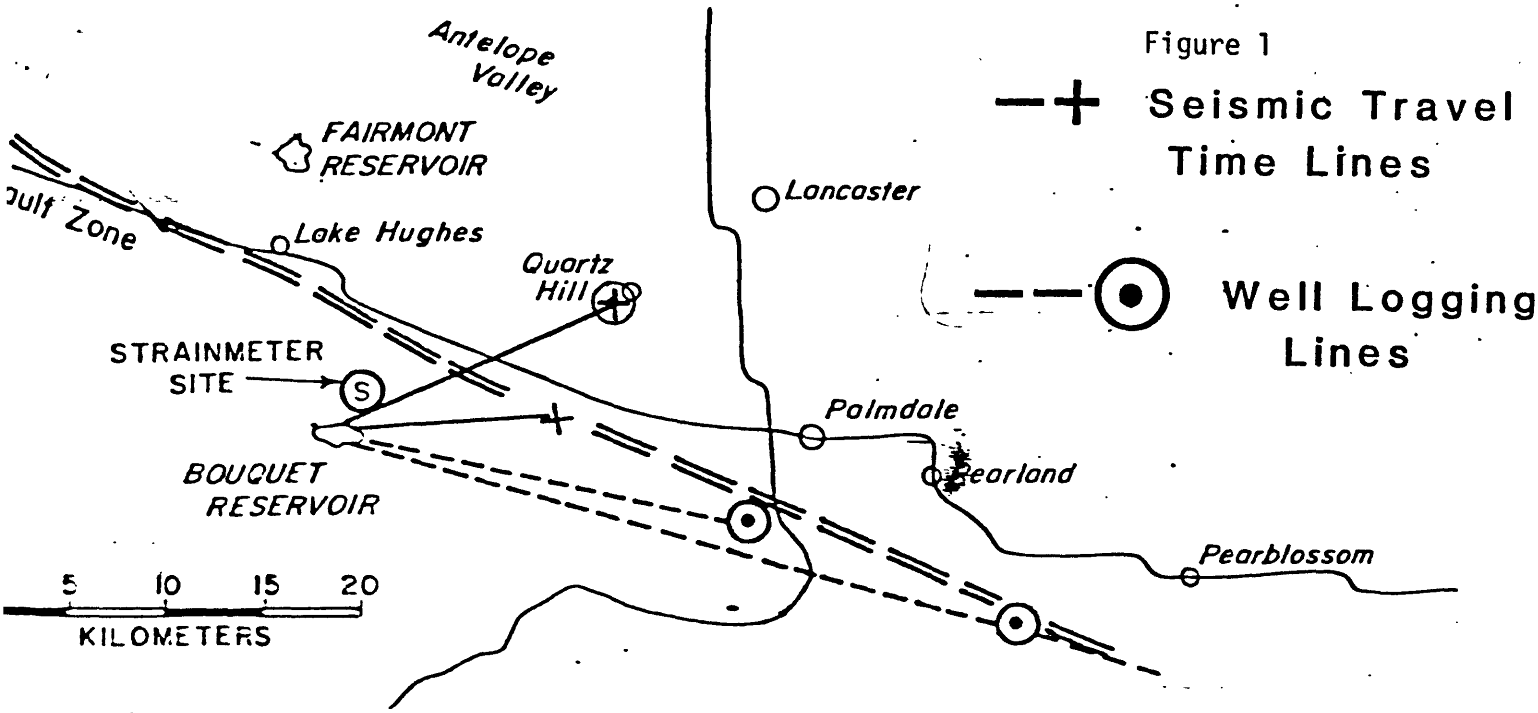


Figure 2

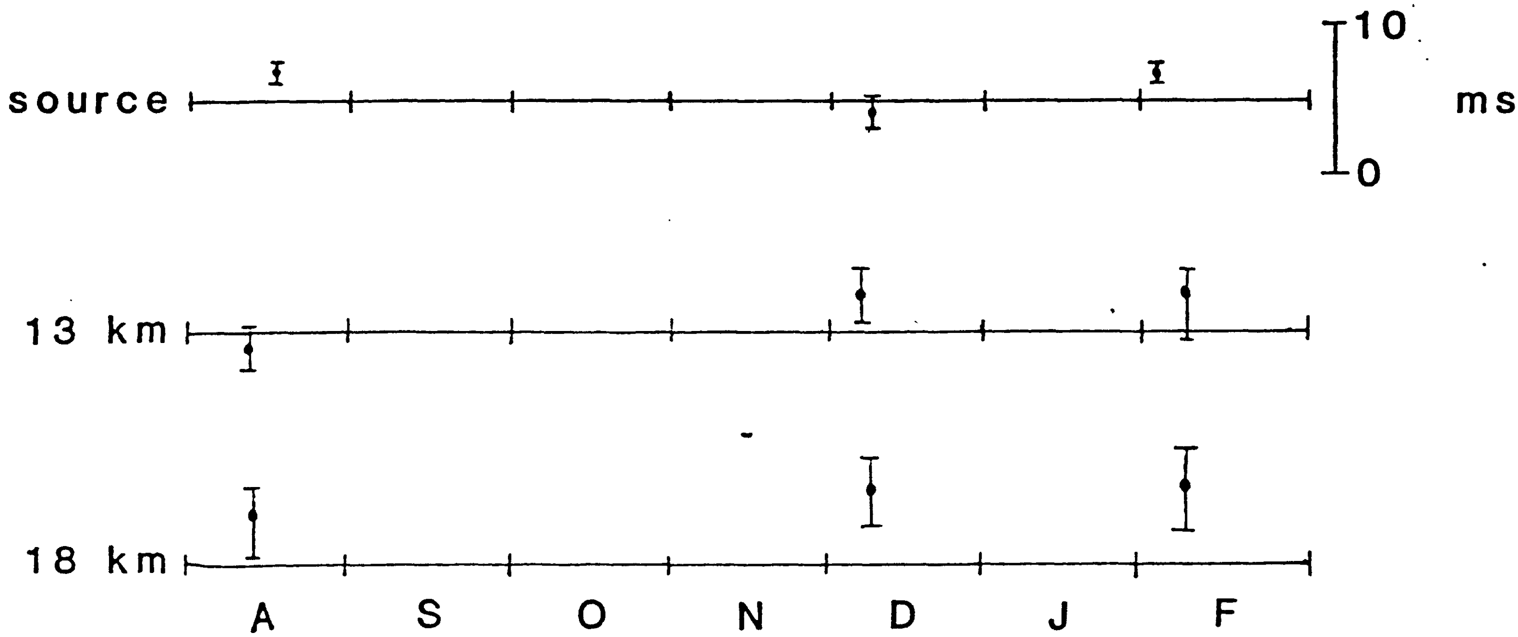


Figure 3

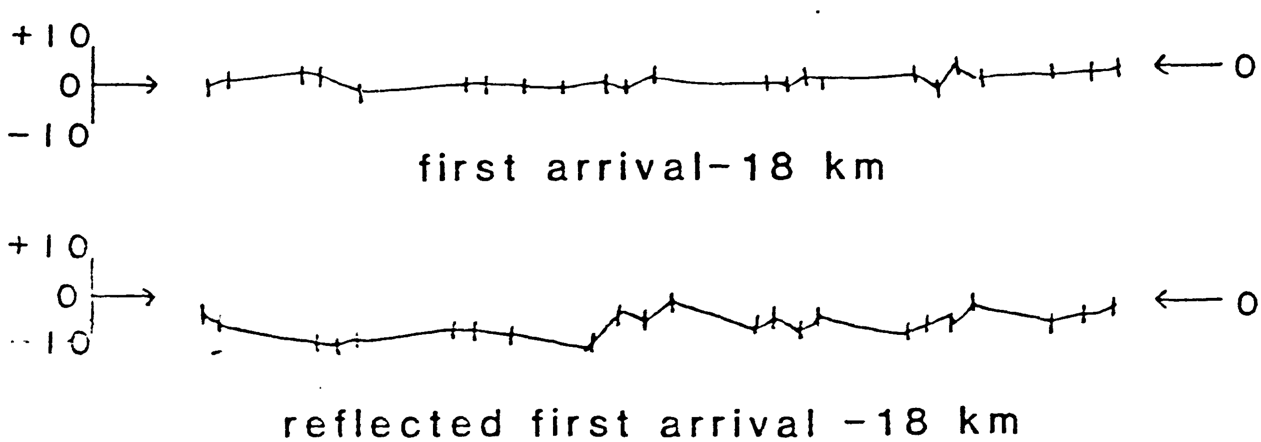


Figure 4

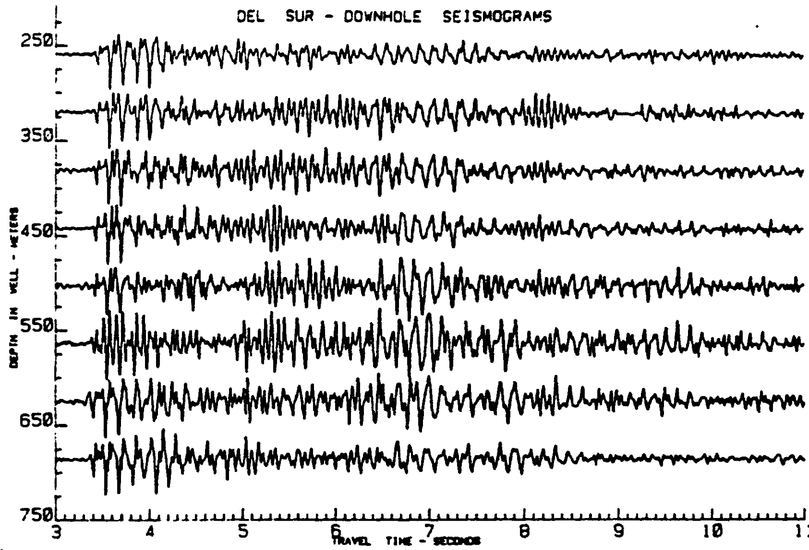


Figure 5

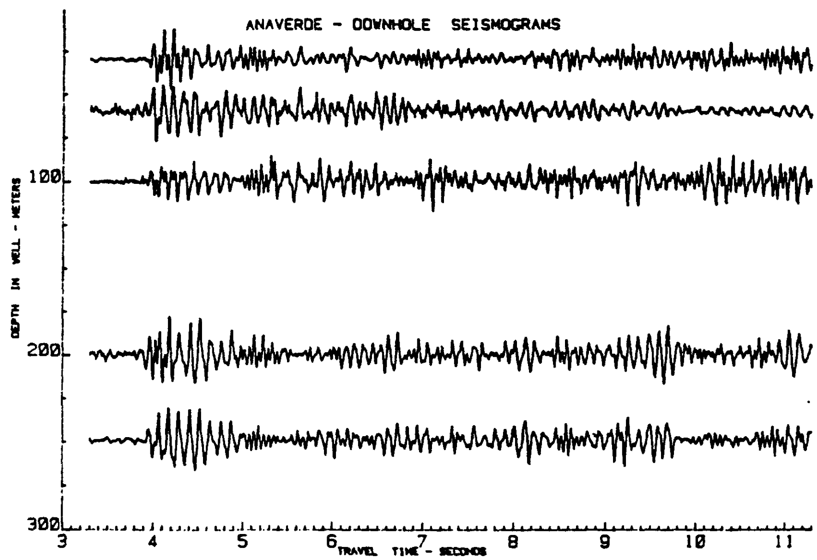


Figure 6

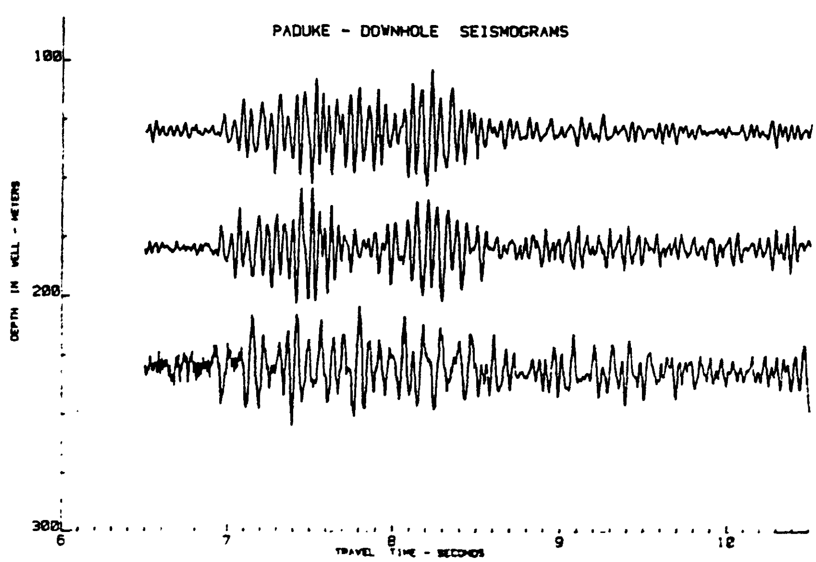


Figure 7

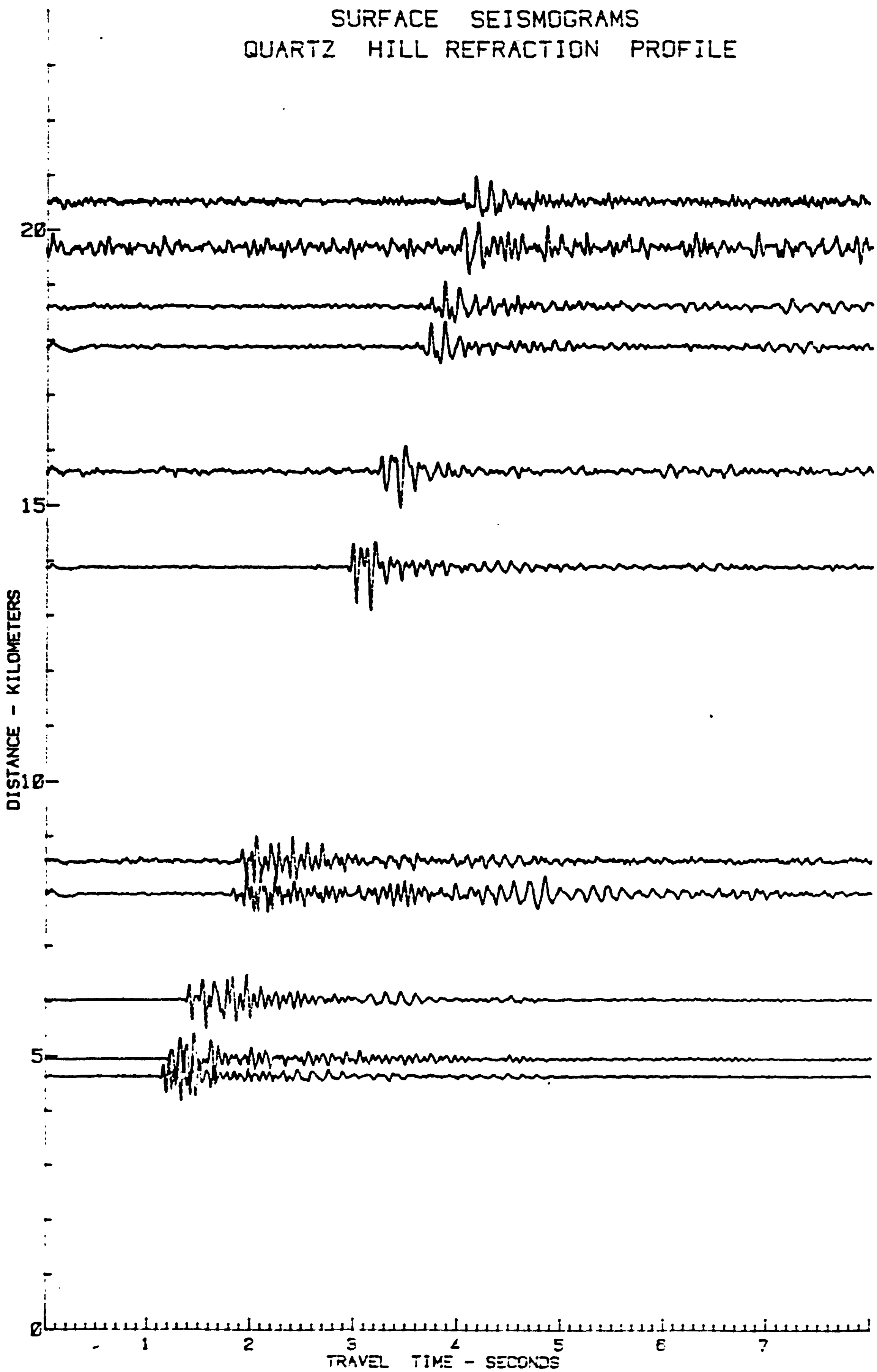

SURFACE SEISMOGRAMS
QUARTZ HILL REFRACTION PROFILE
DISTANCE - KILOMETERS
20
15
10
5
0
1
2
3
4
5
6
7
TRAVEL TIME - SECONDS

Figure 8

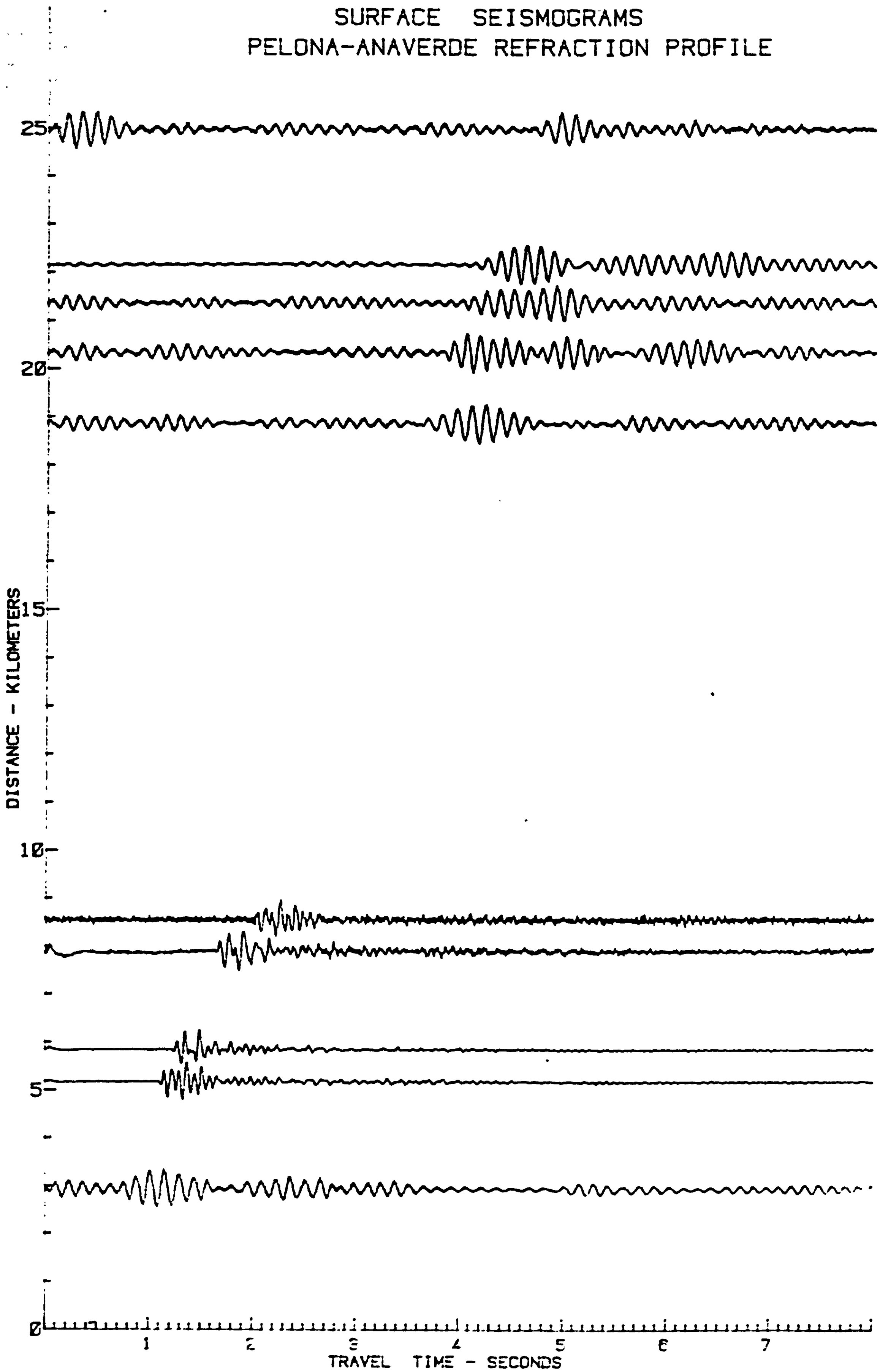
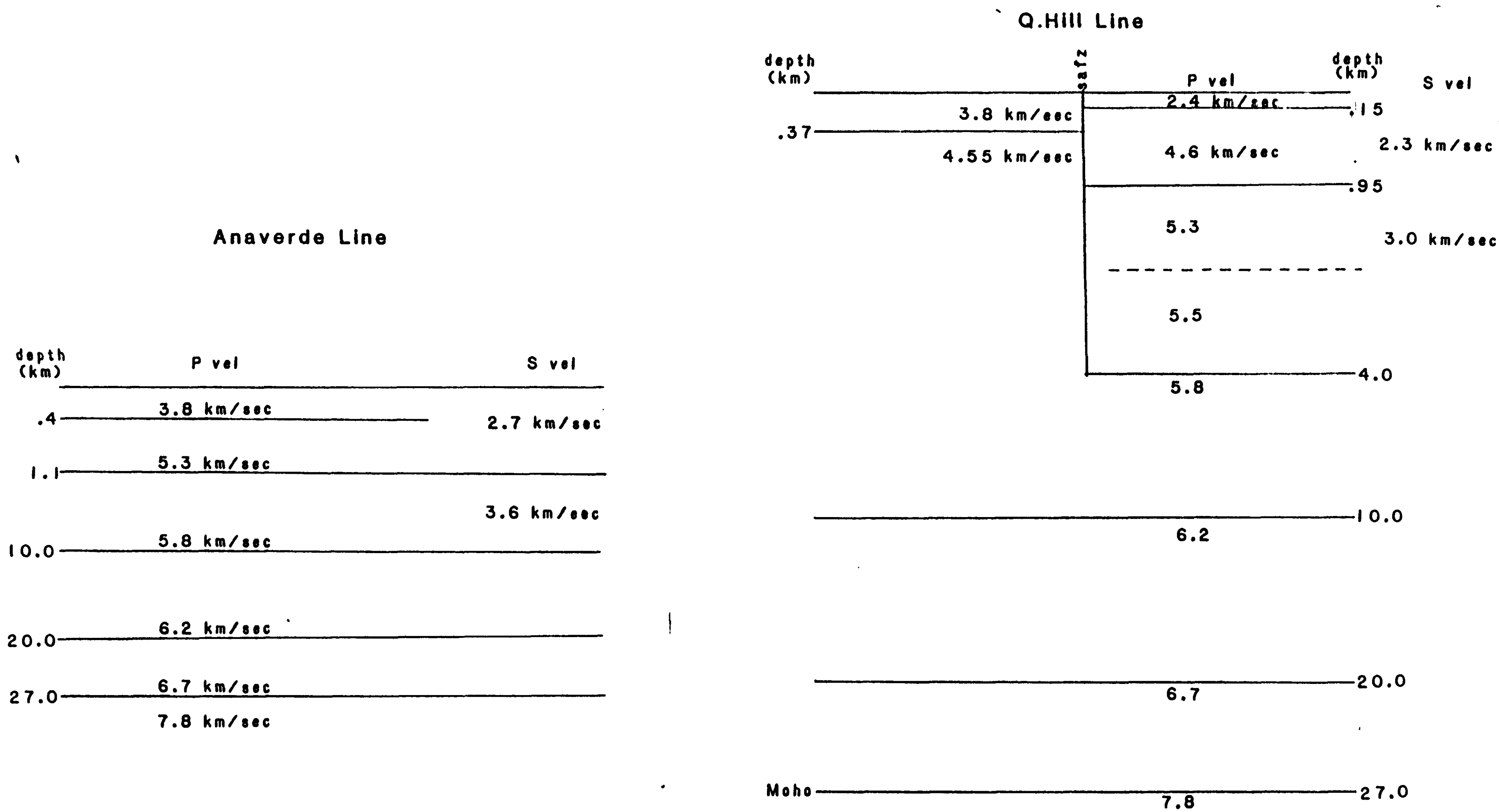

SURFACE SEISMOGRAMS
PELONA-ANAVERDE REFRACTION PROFILE
25
20
15
10
5
0
DISTANCE - KILOMETERS
1
2
3
4
5
6
7
TRAVEL TIME - SECONDS

Figure 9


Anaverde Line
depth (km)
P vel
S vel
.4
3.8 km/sec
2.7 km/sec
1.1
5.3 km/sec
3.6 km/sec
10.0
5.8 km/sec
20.0
6.2 km/sec
27.0
6.7 km/sec
7.8 km/sec
Q.Hill Line
depth (km)
safz
P vel
depth (km)
S vel
3.8 km/sec
.37
4.55 km/sec
2.4 km/sec
.15
2.3 km/sec
4.6 km/sec
.95
5.3
3.0 km/sec
5.5
4.0
5.8
10.0
6.2
20.0
6.7
Moho
27.0
7.8