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VII.4 Direct Measurements of Crustal P-velocities in the NORSAR Area

Using simulated data, it is demonstrated that one may estimate the body wave velocity in the crust by measuring the angle of incidence of P-waves provided only the very first part of the signal is used. It is important to use only the very first part of the signals, because converted and/or multiple reflected phases may make the particle motion for the later part of the signal very complicated (Fig. VII.4.1).

This angle has been measured at the 22 NORSAR long period instrument sites for ten events. Combining these observations with measurements of apparent velocities, we find that the data indicates a crust velocity of 6.1 ± 0.4 km/sec. While it is somewhat uncertain to what depth the value is representative, the observations are in obvious disagreement with previous authors who concluded that long period P-waves were not affected by the earth's crust. When the observed P-wave velocities are plotted on a map of the array configuration, we find that the velocity observations tend to group themselves into relatively large areas with respectively high and low values (Fig. VII.4.2), which indicates that real velocity variations in the medium under NORSAR contribute significantly to the variations observed. To discriminate between the effect of real velocity variations and measurement errors is, however, difficult, but as a very crude estimate we found a standard deviation corresponding to 3 per cent variation in the P-wave velocity.

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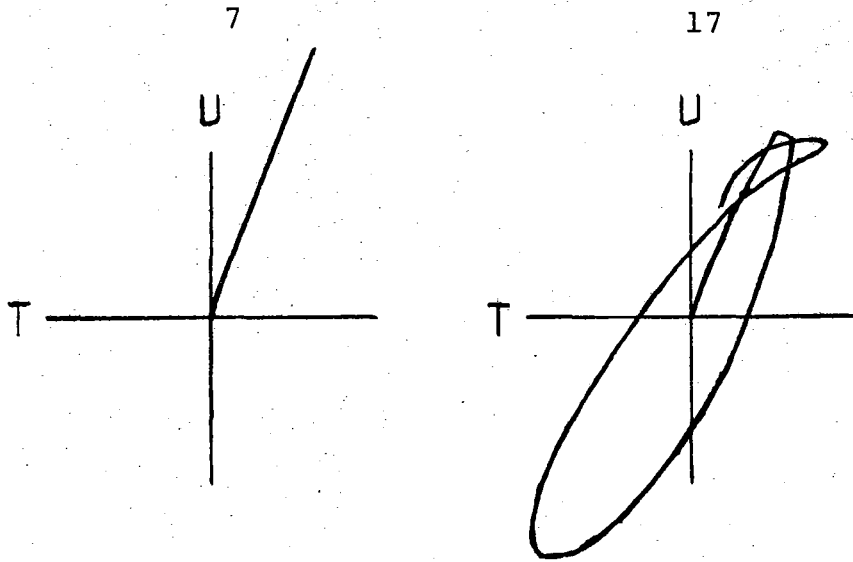


Fig. VII.4.1 Simulated particle motion diagrams for first 8 and 30 seconds of a delta-pulse P-signal having crossed a 35 km thick crust. Angle of incidence at Moho is 35 degrees. The upper 5 km of the crust has P-velocity 4.0 while the rest of the crust has a velocity of 6.2 km/sec. Mantle P-velocity is 8.2 and Poissan's ratio is 0.25. NORSAR long periodic instrument response has been included. The letter U on the figure means up, while T means towards the source. The numbers above give relative scaling.

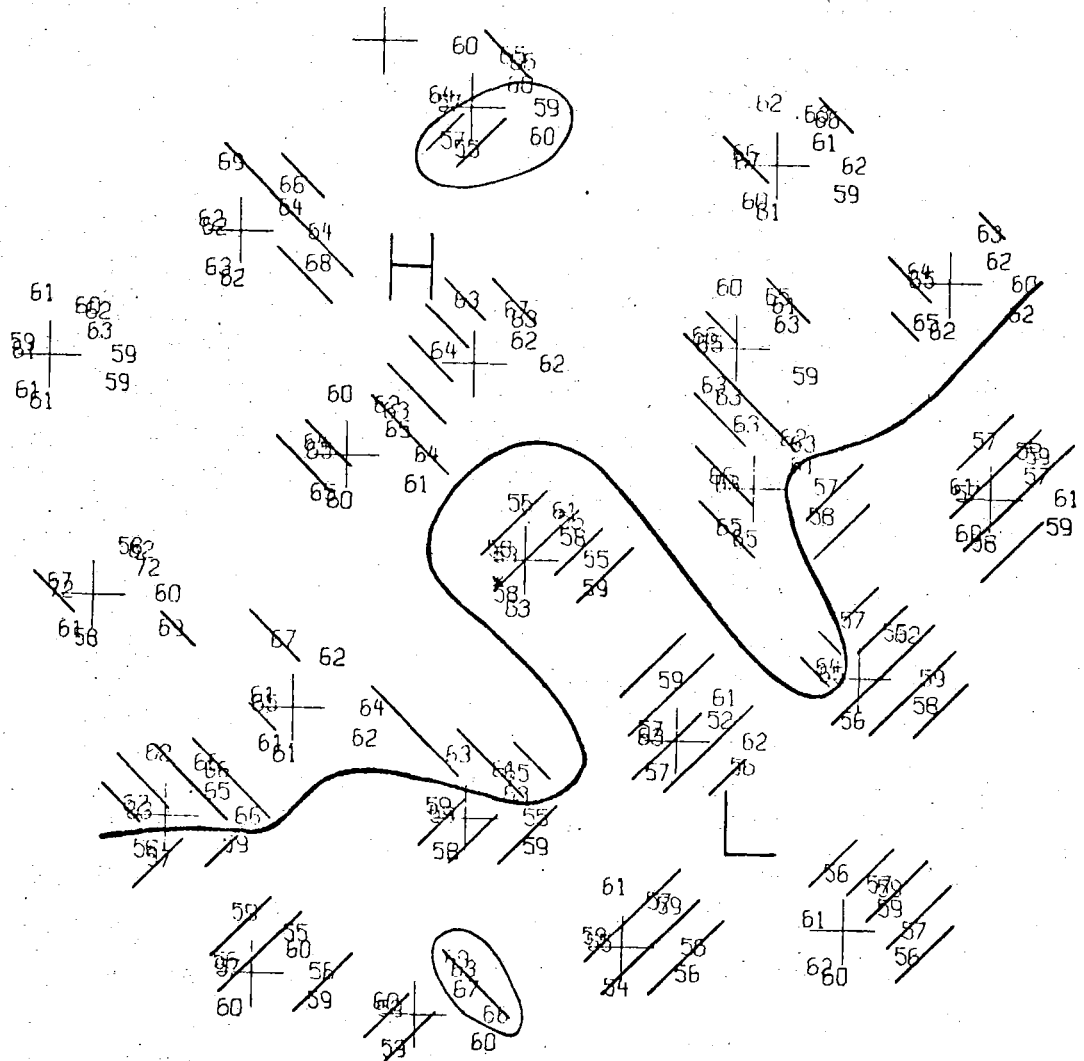


Fig. VII.4.2 Observed P-wave velocity multiplied with ten plotted directly on the array configuration. The crosses mark the location of the long period instruments. The star in the middle marks the center of the array. The values are plotted at the horizontal projection of the first 1/7 wavelength of the ray path.