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DETERMINATION OF CRUSTAL STRUCTURE FROM PHASE VELOCITY OF RAYLEIGH WAVES, PART II: SAN FRANCISCO BAY REGION

By FRANK PRESS

THE PHASE-VELOCITY method of measuring crustal thickness has been successfully applied in southern California.[1] Phase velocity of dispersed Rayleigh waves from distant earthquakes is determined locally by use of a tripartite array of seismograph stations. Local crustal thickness is obtained by comparing the observed phase velocity with an experimentally determined curve representative of the average continental crust.

In this paper we make use of the phase-velocity data of Evernden[2] to determine crustal thickness in the San Francisco Bay region of California. Evernden determined the phase velocity of Rayleigh waves entering the North American continent from the Pacific Ocean. He was primarily interested in studying the direction of approach of these waves. His tripartite array consisted of stations at Berkeley, San Francisco, and Palo Alto, and a number of earthquakes were studied so that a large variation in direction of approach could be obtained. The data for all the earthquakes were combined to obtain an average phase velocity for each period. These phase velocities are plotted in figure 1, where the region to which the data apply is also shown. Also plotted in figure 1 are phase-velocity curves for a 25-km., 35-km., and 45-km. crust having the same composition as the average crust of Africa. The method by which these curves have been derived is explained in Part I (see fn. 1, above). By interpolating between the curves one can use each phase-velocity determination to obtain a value of crustal thickness. Neglecting the lowest three points which fall outside the range permitted by the phase-velocity curves, one finds a mean value of 30 ± 1 km. for crustal thickness in the San Francisco Bay region. The three points which were excluded fall in a period range where experimental phase-velocity determinations are difficult to make. Moreover, for these short periods the phase velocity for the oceanic segment of the path differs greatly from that for the continental segment, with the result that refraction effects are most pronounced.

Implicit in this calculation of crustal thickness is the assumption that the average elastic properties of the crust in the vicinity of San Francisco Bay is the same as that of Africa. Partial support for this assumption may be found in the fact that

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[1] Frank Press, "Determination of Crustal Structure from Phase Velocity of Rayleigh Waves, Part I: Southern California," *Bull. Geol. Soc. Am.*, 67: 1647–1658 (1956)

[2] Jack F. Evernden, "Direction of Approach of Rayleigh Waves and Related Problems (Part II)," *Bull. Seism. Soc. Am.*, 44: 159–184 (1954).

Lg waves traverse the major structures of California with the same velocity as for transcontinental paths.[3]

The value of 30 km. determined for crustal thickness in the San Francisco Bay region by the phase-velocity method may be compared with Tocher's results of 27–32 km. based on refraction measurements,[4] providing a good check.

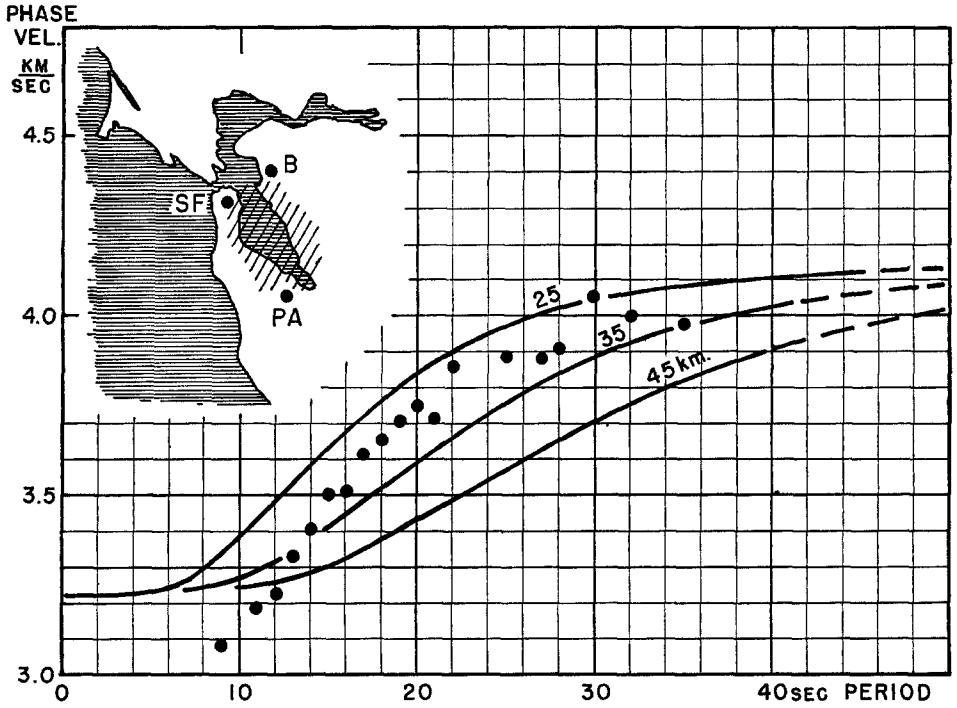

Fig. 1. Comparison of Rayleigh-wave phase velocity for the San Francisco Bay region with curves representative of a continental crust 25 km., 35 km., 45 km. thick.

Crustal thickness in the San Francisco Bay region is definitely smaller than the value of about 35 km. usually reported for continental interiors. A similar indication of thinning of the crust in a coastal region was found in southern California. These results suggest that crustal structure in the coastal region of California is influenced by proximity to the margin of the continent. The systematic decrease of the Bouger gravity anomaly inland from the coast is another indication of the coastward thinning of the continent.

Conclusions: Evernden's data on the phase velocity of Rayleigh waves in the San Francisco Bay region has been interpreted as indicating a crustal thickness of 30 ± 1 km., in agreement with the results from refraction reported by Tocher. Crustal thickness in the coastal regions of California is less than that reported for inland regions. This is an effect of proximity to the continental margin, where the continental crust merges into the thin oceanic crust.

[3] Frank Press, "Velocity of Lg Waves in California," *Trans. Am. Geophys. Union*, 37: 615–618 (1956).

[4] Personal communication, May 27, 1956.

SEISMOLOGICAL LABORATORY,
CALIFORNIA INSTITUTE OF TECHNOLOGY,
PASADENA, CALIFORNIA.
(Division of the Geological Sciences, Contribution No. 822)