EMPIRICAL STUDY OF RAYLEIGH WAVE DISPERSION, SOUTH AMERICAN EARTHQUAKE OF DECEMBER 17, 1949.

by

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Introduction

The earthquake of December 17, 1949 which occurred in the Tierra del Fuego region at the southern tip of South America was chosen for an empirical study of Rayleigh wave dispersion because of its magnitude, its geographic and geological position and because it was preceded by a foreshock of almost equal magnitude. It was believed that many problems of surface wave propagation can be better attacked by a detailed study of the dispersion curves of a particular earthquake rather than average curves derived from many quakes.

Of particular interest is the investigation of the effect of high mountain ranges, submarine topographic highs, and continental borderlands on the propagation of Rayleigh waves.

The problem of the variation of period with path and distance travelled of the "maximum phase" was investigated.

Method

Seismograms from eighty four leading earthquake observatories of the world were borrowed for this study. Of these, only 120 records from fifty five stations were suitable for analysis. The R-group was determined for each record and a graph of period versus velocity was plotted for each record for as great a range of periods as the record would permit, using the method of Press and Ewing.

Each path from epicenter to station was broken up into integral geological units and the group velocity for the observable periods were calculated for each unit by a process of addition and subtraction. From these observed or calculated "pure" curves, such interpretation of the physical structure of the regions was made as was believed valid by comparison with theoretical dispersion curves and with each other.

Results

The small scatter of the Pacific data, and the excellent agreement of this data with Oliver's theoretical and observed curves over a different set of Pacific paths, indicate that the Pacific basin is structurally quite uniform, as seen by Rayleigh waves, and is presumably simpler than other "pure" paths.

The data indicate that the border of the Atlantic Ocean is not as sharp as that of the Pacific, and that the sialic layer does not end sharply at the edge of Europe and Africa but probably terminates gradually toward the deep basins.

Low velocities to Mexico and the West Coast of the United States can most logically be explained by the intervention of lower velocity rocks associated with the Albatross Plateau and other submarine highs. A water and sediment depth of 4.7 kilometers is indicated for the southwest Pacific as contrasted to 5.57 kilometers over the Pacific basin proper.

A definite decrease in Rayleigh wave velocities was occasioned by their path through high mountains as contrasted to non-mountainous continental structure. The effect is noted for the Andes and for the Alps.

The period of the maximum wave is not strictly a function of the recording system at a station but is influenced by the distance travelled and, more particularly, by the structure of the travelled path. An increase of period with distance is noted over Pacific paths.

The dispersion data are independent of the method of recording and the period of the recording system.

Whereas the waves over homogeneous paths give a smooth dispersion curve, waves travelling over mixed paths many times show a very real dip in them with the periods most affected centering around 21 seconds. A systematic, but unexplained, difference in dispersion was noted between the foreshock and the quake.