A COMPUTATION OF AVERAGE CRUSTAL THICKNESS FROM LOVE-WAVE DISPERSION, FOR A EURASIAN WAVE PATH

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SUMMARY

The thickness of the crust was determined by analyzing the dispersion curve of the Love-waves of two Southern Chinese earthquakes. The crustal thickness obtained is 33 kilometres, in spite of the fact that one third of the wave path has traversed mountains of high elevation.

For the determination of crustal thickness several methods may be adopted. One of them is the analysis of the dispersion of the Love-wave.

Assuming the crust to be homogeneous and to be limited by plane parallel surfaces, the thickness of the crust along the wave path may be calculated from

$$\operatorname{tg} K\gamma_1 H = \frac{\mu_2}{\mu_1}\frac{\gamma_2}{\gamma_1} \tag{1}$$

the period equation of the Love-wave. The letters denote the following quantities:

$$\gamma_1 = \sqrt{\left(\frac{c}{v_1}\right)^2 - 1} \qquad \gamma_2 = i\sqrt{1 - \left(\frac{c}{v_2}\right)^2}$$

$$\mu_1 = \varrho_1 v_1^2$$

$$\mu_2 = \varrho_2 v_2^2$$

$$K = \frac{2\pi}{c\,T}$$

H being the thickness of the crust, ϱ_1 the density of the rocks of the crust, ϱ_2 the density of rock below the Mohorovič i ć interface, T the period of the Love-wave, v_1 the velocity of the transverse wave in the crust, v_2 the velocity of the transverse wave along the Mohorovič i ć interface, c the phase velocity of the Love-wave.

Differentiating graphically the function obtained from (1) we have

$$U = c + K\frac{\Delta c}{\Delta K}$$

U being the group velocity of the Love-wave.

By the aid of this graph the theoretical and actual curves can be compared.

We have investigated two Asian shocks for which the wave path was nearly identical (Fig. 1.)

Time of release	Epicentral coordinates	M = magnitude	Epicentral distance in kilometres
1931. I. 27. 20 19 13	25,6 N 96,8 E	7,6	7041,5
1934. XII. 15. 01 57 37	31,3 N 89,3 E	7,1	6073,8

In Hungary horizontal seismographs are set up only. Therefore, the Love and Rayleigh wave types can be distinguished in the record only in case the surface waves arrive perpendicularly to the plane of oscillation of one of the components of the horizontal seismograph. This condition is fulfilled for the two shocks treated.

The measured values of T, the period, and U, the velocity, are listed as below.

Shock of I. 27, 1931.

T	U	T	U
49	3,71	34,5	3,40
44,5	3,65	30,2	3,37
44,2	3,62	29,8	3,33
41,5	3,57	30,1	3,32
40,1	3,53	27,4	3,30
38,1	3,5	27,4	3,28
35,5	3,47	27,4	3,26
34,9	3,43	23,9	3,23
		20,8	3,21

Shock of XII. 15, 1934.

T	U	T	U
40,3	3,51	29,6	3,34
31,6	3,46	28,0	3,31
36,6	3,43	26,8	3,29
35,3	3,40	24,4	3,26
29,2	3,36	20,8	3,24

The above data are also shown in Fig. 2. Of the curves computed by the aid of the equation only those two are shown which do best approximate the points.

The data of the two curves are:

1. *full line* $v_2 = 4{,}3$ km sec^{-1} $H = 34$ km
   $v_1 = 3{,}35$ km sec^{-1}
   $\frac{\mu_2}{\mu_1} = 1{,}923$
2. *dashed line* $v_2 = 4{,}3$ km sec^{-1} $H = 32$ km.
   $v_1 = 3{,}32$ km sec^{-1}
   $\frac{\mu_2}{\mu_1} = 2$

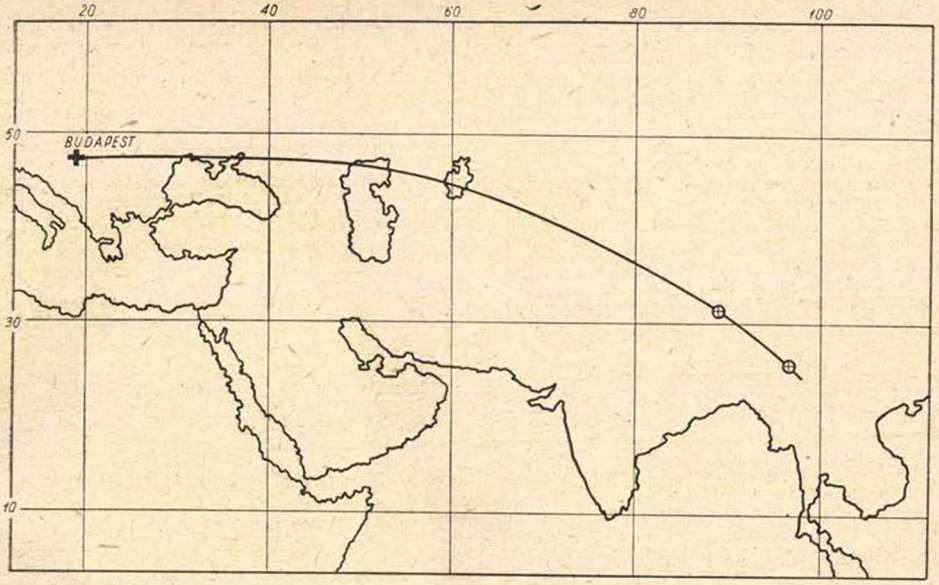

Fig. 1. Epicenters of two Southern Chinese Shocks with wave paths to Budapest. The epicenters are designated by circles

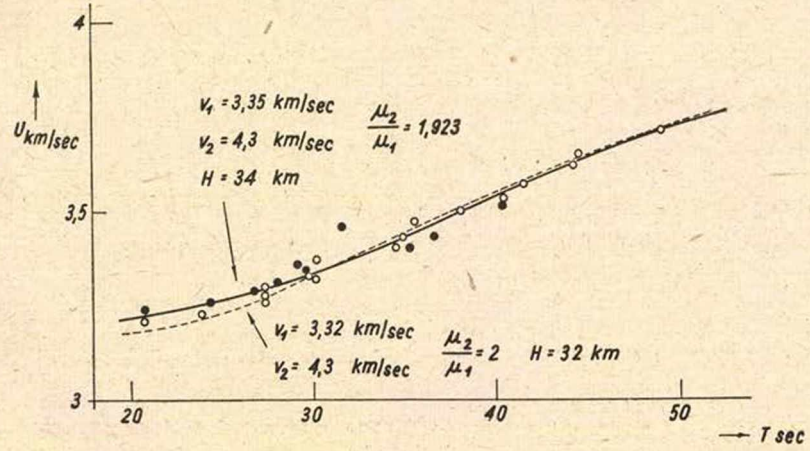

Fig. 2. Dispersion curves of the L o v e-waves of two Southern Chinese Shocks. The full and dashed lines indicate, respectively, the theoretical curves computed from the data shown in the figure. The empty circles designate the observed data of the shock of I. 27, 1931, the full circles those of the shock of XII., 15, 1934.

It can be seen on the map that one-third of the L o v e-wave path crosses mountains of high elevation, which ought to be characterized by a deep root according to the principle of isostasy. The results obtained do not reflect this crustal thickening. Maybe this is due to the circumstance that in the path sector off the mountains the crustal thickness is very small.