LATERAL VARIATION
AND
FREQUENCY DEPENDENCE OF CRUSTAL Q_β

Horng-Jye Jay Hwang, B.S.

A Digest Presented to the Faculty of the Graduate
School of Saint Louis University in Partial
Fulfillment of the Requirements for the
Degree of Doctor of Philosophy

1985

DIGEST

The propagation of Rayleigh waves within the South American continent and Indian subcontinent has been studied to determine the lateral variation and frequency dependence of Q_β. Inversions of group velocities, phase velocities and attenuation coefficients of fundamental and first-higher mode Rayleigh waves produce shear-wave velocity and Q_β models for both shield and tectonically active regions in those continents. Lateral variation of attenuation and velocity are thus amenable to study. The frequency dependence of Q_β in different tectonic provinces is determined by comparing observed Q values for 1-Hz *Lg* waves to values which are predicted by the derived velocity and Q_β models.

Both single-station and two-station methods are employed in this study to determine the velocities and attenuation coefficients. A new procedure is applied to invert the observed dispersion data starting from a half space. With this new procedure, velocity discontinuities can be objectively resolved by the data themselves, instead of being imposed by the initial model. The shear velocity models for the Indian shield and eastern South America obtained from inverting Rayleigh wave velocities are very similar to one another, being somewhat slower than for shields in Canada and South Africa. The models for the Himalayas and Andes have similar crustal thicknesses (about 55 km), but velocities of the models differ considerably. A low-velocity zone cannot be resolved in the upper mantle of either region.

A new procedure for inverting observed attenuation coefficients is also presented. With this procedure, we can obtain a more reliable Q_β

model at all depths by combining two models which were obtained by inverting attenuation coefficient data twice using two different damping factors. This procedure is also applied to invert previously obtained attenuation of Rayleigh wave data in North America. It is found that the values of Q_β for stable regions are generally greater than those for tectonic regions at all depths, and that a low Q zone exists in the upper mantle of all regions of this study, both stable and tectonic except the Indian shield. Those low-Q zones are centered around a depth of 80 or 90 km with higher Q_β values beneath stable regions than those beneath tectonic regions.

The Q_β models obtained for tectonic regions adequately predict recently reported Q values for 1-Hz *Lg* for those regions. The Q values for 1-Hz *Lg* predicted by those models in eastern North and South America, and Indian shield, however, are significantly smaller than the observed values. A similar result had been found earlier for North America (Mitchell, 1981). These results imply that Q_β in the crust is independent of frequency over the frequency range of this study in tectonically active regions, but varies with frequency in the stable regions.