

ON ADVANCES IN THE THEORY OF SEISMIC WAVE PROPAGATION IN LAYERED VISCOELASTIC MEDIA

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Advances in the general theory of wave propagation in layered viscoelastic media reveal insights regarding seismic waves in the Earth that are not predicted by elasticity or one-dimensional anelasticity. For example, the general theory of viscoelasticity predicts: 1) P and S body waves are predominantly inhomogeneous in a layered anelastic Earth with seismic travel-times, particle motion orbits, energy speeds, Q^{-1} , and amplitude characteristics that vary with angle of incidence and the degree of inhomogeneity of the incident wave, 2) two types of shear waves exist, one with linear and the other with elliptical particle motions with each type having a different absorption coefficient, and 3) Rayleigh- and Love-type surface waves propagate with amplitude and particle motion characteristics not predicted by elasticity theory. The theoretical results include closed form analytic solutions for body-waves, reflection-refraction problems, response of multiple layers, and surface wave problems valid for any material with a viscoelastic response, including the infinite number of models, derivable from various configurations of springs and dashpots, such as elastic, Voight, Maxwell, and a Standard Linear solid. The closed form solutions are valid independent of the amount of intrinsic absorption. They provide explicit analytic expressions for physical characteristics of body waves in low-loss media such as the deep Earth. Corresponding numerical results explain laboratory and seismic observations not explained by elasticity or one-dimensional Q models with important implications for some forward modeling and inverse problems. Theoretical and numerical results as compiled in the book "*Viscoelastic Waves in Layered Media*" (Cambridge University Press) will be reviewed.