Finite difference model of wave propagation in an anisotropic body -hexagonal system-

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There are various studies of seismic

anisotropy, such as shear wave splitting dut to aligned cracks in the crust and anisotropy of compressional and shear waves and surface waves due to a lattice preffered orientaion of constituent olivine in the upper mantle beneath the Pacific Ocean(Ando, 1984; Kawasaki, 1989; Kaneshima, 1991; Utsu, 2000). In the studies of seismic anisotropy the estimation of seismic wave velocities of the medium along the wave path in high accuracy is indispensable. Generally, the modeling of wave propagation based on three dimensional structures of orthorhombic system is desirable for those studies. In this paper, as a preliminary analysis, a two dimensional finite difference model of wave propagation in an anisotropic body of hexagonal system is implemented and the anisotropic properties of the transversely isotropic body are analyzed through travel time of seismic waves.

The equation of wave motion used is based on the stress-strain relation in an anisotropic body. Firstly we examine whether the difference in travel times of compressional waves for isotropic and anisotropic bodies can be detected or not. Secondly we check the velocity difference between qSV and qSH waves. The elastic constants of HDM (Hidaka Dunite Model) (Kawasaki and Kon'no, 1984) were modified and used for those of the hexagonal system. The media consist of three elastic bodies; (I) isotropic, (II) anisotropic, and (III) isotropic bodies. A ricker wavelet is impinged on the free surface of (I) and the wave propagates towards (II) and (III). The waves are recorded at site A, the boundary between (I) and (II) and site B, the boundary between (II) and (III). Both sites are located on the free surface. The travel times of compressional and shear waves of the vertical, radial and transverse components are determined using those waves.

The difference in travel times of compressional waves for isotropic and anisotropic bodies agreed with that expected from the elastic constants used, and the velocities of qSV and qSH waves also showed a marked discrepncy, which coincides with theoretical one. The results suggest that he present method will be useful for the study of anisotropic medium structure.