STUDIES OF SEISMIC ANISOTROPY BENEATH THE HAWAIIAN ISLANDS

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Observed polarization ellipses for fundamental-mode surface waves observed at a digital station on Hawaii deviate from those expected for isotropic models of crust and mantle structure for that region. The anomalous motion occurs as rotations of the ellipse about all three axes in a cartesian coordinate system. The largest and most consistent deviations occur as anomalous slopes of the ellipse about the axis transverse to the direction of propagation.

The observed orientations and magnitudes of these angles can be explained by models of the upper mantle which contain olivine for which the a-axis dips significantly from the horizontal and which includes a sufficiently thick sedimentary layer (1 km) and a thicker than normal oceanic crust (15 km). The ellipses are also generally inclined from great circle paths about the vertical axis and are tilted about the axis aligned with the propagation direction. Both angles are small and difficult to measure, but the inclination angles are consistent with a model of the upper mantle in which the a-axis of olivine is preferentially oriented in an east-west direction.

Short-period synthetic time histories for an anisotropic Earth model indicate that the amplitude ratios of different phases vary with azimuth and with source depth. The amplitude ratios are also sensitive to the number of layers in the upper crust and anisotropic lithosphere.

Computations of synthetic seismograms show that the anisotropic model obtained from surface-wave particle motion studies

adequately explains observed short-period seismograms recorded in Hawaii. This model is, however, non-unique since other layered models, perhaps homogeneous or with different degrees of anisotropy could produce a similar effect. This non-uniqueness might be reduced if better azimuthal coverage is available in later studies. To constrain the parameters of the anisotropic layer using waveform analysis, a large number of events with known focal mechanisms will be required. In addition, better information on the nature of lateral inhomogeneities in the crust of the Hawaii region will be desirable.