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Modeling Anomalous Rayleigh-wave Azimuthal Anisotropy near Hawaii

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The 2005-2007 Hawaiian PLUME (Plume-Lithosphere Undersea Melt Experiment) deployment yielded continuous seismic data at ten land stations and nearly 70 ocean bottom sites. Both the usage broad-band seismometers as well as the central location of Hawaii with good azimuthal seismicity coverage has allowed us to conduct a comprehensive analysis of surface wave azimuthal anisotropy at periods between 20 and 100 s. We use a sub-array approach to obtain 'in-situ' estimates of azimuthal variations in the attempt to minimize imaging trade-offs and cross-mapping with lateral heterogeneity. We apply the standard Smith-and-Dahlen trigonometric expansion to express azimuthal variations. A systematic comparison between results obtained for different truncation levels in the trigonometric expansion allows us to assess stability of the results and assign error bars.

At long periods, azimuthal anisotropy is increasingly disturbed away from the pattern expected for a cooling Pacific plate where ambient plate motion is 'frozen' to the bottom of the thickening plate. We present results from grid-search modeling for best-fitting several-layer models that contain anisotropic mantle material with hexagonal symmetry. Finding the optimal orientation of the symmetry axis and the corresponding thickness of anisotropic layers are some of the focus aspects in the grid search. Results suggest that ascending mantle plume material penetrates the asthenosphere to the southwest of Hawaii but does not reach into the upper lithosphere. Part of this work was conducted through a DAAD-sponsored (Deutscher Akademischer AustauschDienst) undergraduate RISE fellowship.