ABSTRACT FINAL ID: DI22A-05;

TITLE: S and P-wave velocity structure beneath the Hawaiian hotspot from the PLUME deployments of ocean-bottom and land seismometers *(Invited)*

SESSION TYPE: Oral

SESSION TITLE: DI22A. Mantle Plumes: Combining Perspectives from Geophysics, Geochemistry, and Geodynamics II

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ABSTRACT BODY: Seismological studies can provide key constraints on the existence and characteristics of mantle plumes. Remotely located oceanic hotspots pose challenges for mantle seismic imaging with land stations because of the limited areal extent of oceanic islands and thus are excellent targets for dedicated marine experiments. The PLUME project at Hawaii successfully deployed two networks of ~35 ocean-bottom seismometers and a concurrent set of portable land seismometers, providing unprecedented, dense seismic coverage around Hawaii across an ~1,000-km-wide aperture. Three-dimensional finite-frequency body-wave tomographic images of S- and P-wave velocity structure beneath the Hawaiian Islands show an upper-mantle low-velocity anomaly that is elongated in the direction of the island chain and surrounded by a high-velocity anomaly in the shallow upper mantle that is parabolic in map view. Low velocities continue downward to the mantle transition zone between 410 and 660 km depth and extend into the topmost lower mantle. For P-waves, comparisons of inversions with separate data sets at different frequencies suggest that contamination by water reverberations is not markedly biasing the imaging. Many aspects of the S- and P-wave images are consistent with each other and support the hypothesis that the Hawaiian hotspot is the result of an upwelling, high-temperature plume. The broad upper-mantle low-velocity region beneath the Hawaiian Islands may reflect the “diverging pancake” at the top of the upwelling zone; the surrounding region of high velocities could represent a downwelling curtain; and the low-velocity anomalies southeast of Hawaii in the transition zone and topmost lower mantle are consistent with predictions of a tilted plume conduit. However, there are some differences in upper mantle structure between P-wave and S-wave velocity. Inversions without station terms show a southwestward shift in the location of lowest P-wave velocities in the uppermost mantle relative to the pattern for shear waves, and inversions with station terms show differences between P-wave and S-wave velocity heterogeneity in the shallow upper mantle beneath and immediately east of the island of Hawaii. Upper mantle structure from both S and P waves is asymmetric, with lower velocities just southwest of Hawaii and higher velocities to the east. Independent Rayleigh-wave tomography of the lower lithosphere and asthenosphere reveals a similarly asymmetric upper mantle structure. Much work has been performed (e.g., examination of delay time patterns, examination of wave path coverage, resolution tests, squeezing tests, inversions with subsets of data, assessment of the possible contaminating effects of outside structure) to ascertain that the body wave inversions, and our interpretations, are well constrained.

KEYWORDS: [7208] SEISMOLOGY / Mantle, [8137] TECTONOPHYSICS / Hotspots, large igneous provinces, and flood basalt volcanism, [7270] SEISMOLOGY / Tomography, [7203] SEISMOLOGY / Body waves.

(No Image Selected)

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Additional Details

Previously Presented Material: The body wave tomography material has been published in two papers: in 2009 in Science Magazine and in 2011 in Earth Planetary Science Letters. The Rayleigh wave tomography is not yet published.

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