2017 Geodynamics Seminar

Seismic Imaging of the Erupting East Pacific Rise at 9°50'N: Insights into the architecture of mid-ocean ridge magmatic systems and eruption dynamics

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Tuesday, March 7th
1:30 - 2:30 p.m.
Carriage House, Quissett Campus, WHOI

Talk Summary

Many of the commonly held notions of crustal formation at fast spreading ridges derive from active source seismic studies conducted in the late 1980s and early 1990s. Key features arising from these studies include the notion that the dikes and lava flows that make up the upper crust are sourced from a shallow melt reservoir or axial melt lens (AML) that caps a broader crystal mush zone that extends through the lower crust, that a significant portion of the lower crust may form from crystal settling and downward and outward flow from the AML reservoir, and that crustal formation is focused to a narrow few-kilometer-wide zone beneath the ridge axis. From high-resolution imaging using 3D multi-channel seismic techniques, a detailed picture of the interior of the recently erupting portion of the East Pacific Rise centered at 9°50N has been obtained providing a new perspective on the architecture of magmatic systems as well as insights into eruption dynamics. Rather than a single elongate magma sill that extends continuously for 10's of kilometers beneath the ridge axis above a lower crystal mush zone, the new images reveal multiple finely segmented and vertically stacked magma sills present beneath the ridge axis at different levels and that these lenses may be hydraulically connected such that magma may ascend from one sill to another during a volcanic eruption. Away from the axial zone, numerous magma sills are found at a range of depths in the crust, indicating that delivery of mantle melts to the ridge axis is not as narrowly focused as previously believed. Almost complete imaging of Moho is achieved for the study area and reveals coherent spatial variations in crustal thickness inferred from Moho travel times that can be used to test recent models of sea-level modulation of ridge magmatism.