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Axial Magma System Geometry beneath a Fast-Spreading Mid-Ocean Ridge: Insight from Three-Dimensional Seismic Reflection Imaging on the East Pacific Rise 9º42' to 9º57'N

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Abstract:
The fast-spreading East Pacific Rise at the 9º50'N Ridge 2000 Integrated Study Site was the focus of the first academic 3D, multi-source, multi-streamer seismic survey, carried out aboard R/V Langseth in summer 2008. The main area of 3D coverage extends from 9º42-57'N, spanning the seafloor extent of two documented volcanic eruptions. There, the 3D geometry of the mid-crustal axial magma lens (AML), located ~1.5 km below the seafloor, was initially investigated using a best 1D stacking velocity function hung from the seafloor and two-pass post-stack time migration. Preliminary results suggested a relatively narrow (~0.5-1.8 km wide) AML showing fingering and overlap of individual magma bodies, particularly in association with several small-scale ridge-axis discontinuities identified from seafloor morphology and structure of the axial summit trough. A westward-dipping limb of the AML was imaged near 9º51'N, where the AML attains its largest width. From 9º53-56'N, the AML was seen to veer slightly westward, in accordance with a shift in orientation of the ridge. Sub-axial magma lenses (SAMLs) have been recently imaged between 9º20' and 9º56'N on along-axis reflection profiles from the same survey, with the suggestion that these deeper lenses may have contributed melts to the 2005/06 eruption. In the cross-axis dataset, SAML events are observed down to ~600-700 ms (~1.7-2 km) below the AML. They sometimes appear slightly offset with respect to the center of the AML. They are generally less bright than the AML reflection, some of them display prominent diffraction tails on un-migrated sections, and the deeper events have a distinctly lower frequency content than the shallower ones. New images for the 9º42-57'N area are currently being generated from a suite of detailed stacking velocities for the AML and SAML events and 3D post-stack time migration, which will provide insight into the width and along-axis continuity of individual magma bodies at multiple levels within the crust. The fine-scale AML structure will be constrained from the reprocessed seismic volume, beyond the main features noted above. The 3D geometry of the AML and SAMLs will be discussed in relation with other ridge properties along this ~27-km long section of the EPR.

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