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Upper Crustal Dynamics of the 9N OSC at the East Pacific Rise: Linking Surficial and Melt Sill Structures

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The Overlapping Spreading Center (OSC) at 9°03'N on the EPR is a non-transform discontinuity of the ridge axis which has been migrating southward with an average rate of 42 km/Ma since 2 Ma. The present OSC has been widely studied since the 80's, however, the magma supply and the mechanisms of migration of the OSC are still debated. The 1997 ARAD seismic survey allowed the mapping of the magma lenses in 3D beneath the OSC. Multibeam (Hydrosweep) bathymetry data was also acquired during the survey. Here, we present results from the joint analysis of seismic reflection data and geomorphologic data, with a particular emphasis on the relationship between magma chamber and seafloor volcanic and tectonic features. We provide a new structural map of the OSC using bathymetry obtained from multibeam and seismic reflection data, along with existing surface and deep towed side-scan sonar data. Seismic reflection data has higher resolution inline (25 m) than multibeam bathymetry (50m) that allows a better identification of the surface volcanic and tectonic structures. Our results show a misalignment between the melt lens and surface features orientation at the propagating tip, which is interpreted as a decoupling between the ductile magma chamber and the brittle upper crust. To explain the anomalous width of the melt lens and its offset from the bathymetric ridge, we propose a new model of magma supply where the locus of the neovolcanic zone is set by lithospheric constraints, and not by the deep supply. The structural characterization of the propagating and dying ridge tips gives new insights into the mechanisms of propagation and recession of the ridge segments. At the propagating tip, accretion occurs beyond the melt lens in the form of elongated and curved volcanic ridges. On the dying segment, the higher abundance of large scarps suggests reduced magmatism. The coexistence of structures of different orientations shows the different stress-field states experienced by the dying limb throughout the OSC migration.