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East Pacific Rise axial structure from a joint tomographic inversion of traveltimes picked on downward continued and standard shot gathers collected by 3D MCS surveying

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We present traveltime tomographic models along closely spaced (∼250 m), strike-parallel profiles that flank the axis of the East Pacific Rise at 9°41' – 9°57' N. The data were collected during a 3D (multi-streamer) multichannel seismic (MCS) survey of the ridge. Four 6-km long hydrophone streamers were towed by the ship along three along-axis sail lines, yielding twelve possible profiles over which to compute tomographic models. Based on the relative location between source-receiver midpoints and targeted subsurface structures, we have chosen to compute models for four of those lines. MCS data provide for a high density of seismic ray paths with which to constrain the model. Potentially, travel times for ∼250,000 source-receiver pairs can be picked over the 30 km length of each model. However, such data density does not enhance the model resolution, so, for computational efficiency, the data are decimated so that ∼15,000 picks per profile are used. Downward continuation of the shot gathers simulates an experimental geometry in which the sources and receivers are positioned just above the sea floor. This allows the shallowest sampling refracted arrivals to be picked and incorporated into the inversion whereas they would otherwise not be usable with traditional first-arrival travel-time tomographic techniques. Some of the far-offset deep-penetrating 2B refractions cannot be picked on the downward continued gathers due to signal processing artifacts. For this reason, we run a joint inversion by also including 2B traveltime picks from standard shot gathers. Uppermost velocity structure (seismic layer 2A thickness and velocity) is primarily constrained from 1D inversion of the nearest offset (<500 m) source-receiver travel-time picks for each downward continued shot gather. Deeper velocities are then computed in a joint 2D inversion that uses all picks from standard and downward continued shot gathers and incorporates the 1D results into the starting model. The resulting velocity models extend ∼1 km into the crust. Preliminary results show thicker layer 2A and faster layer 2A velocities at fourth order ridge segment boundaries. Additionally, layer 2A thickens north of 9° 52' N, which is consistent with earlier investigations of this ridge segment. Slower layer 2B velocities are resolved in the vicinity of documented hydrothermal vent fields. We anticipate that additional analyses of the results will yield further insight into fine scale variations in near-axis mid-ocean ridge structure.