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Crustal Thickness and Moho Character of the Fast-Spreading East Pacific Rise Between 9º37.5'N and 9º57'N From Poststack and Prestack Time Migrated 3D MCS data

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Abstract:
We measured crustal thickness and mapped Moho transition zone (MTZ) character over an 880 km^2 section of the fast-spreading East Pacific Rise (EPR) using the first full 3D multichannel seismic (MCS) dataset collected across a mid-ocean ridge (MOR). The 9°42'-9°57'N area was initially investigated using 3D poststack time migration, which was followed by application of 3D prestack time migration (PSTM) to the whole dataset. This first attempt at applying 3D PSTM to MCS data from a MOR environment resulted in the most detailed reflection images of a spreading center to date. MTZ reflections are for the first time imaged below the ridge axis away from axial discontinuities indicating that Moho is formed at zero age at least at some sections of the MOR system. The average crustal thickness and crustal velocity derived from PSTM are 5920±320 m and 6320±290 m/s, respectively. The average crustal thickness varies little from Pacific to Cocos plate suggesting mostly uniform crustal production in the last ~180 Ka. However, the crust thins by ~400 m from south to north. The MTZ reflections were imaged within ~92% of the study area, with ~66% of the total characterized by impulsive reflections interpreted to originate from a thin MTZ and 26% characterized by diffusive reflections interpreted to originate from a thick MTZ. The MTZ is dominantly diffusive at the southern (9°37.5'-9°40'N) and northern (9°51'-9°57'N) ends of the study area, and it is impulsive in the central region (9°42'-9°51'N). No data were collected between 9°40'N and 9°42'N. More efficient mantle melt extraction is inferred within the central region with greater proportion of the lower crust accreted from the axial magma lens than within the northern and southern sections. This along-axis variation in the crustal accretion style may be caused by interaction between the melt sources for the ridge and the local seamounts, which are present within the northern and southern survey sections. Third-order, but not fourth-order ridge discontinuities are associated with changes in the Moho reflection character and/or near-axis crustal thickness. This suggests that the third-order segmentation is governed by melt distribution processes within the uppermost mantle while the fourth-order ridge segmentation arises from mid- to upper-crustal processes.

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