Research Article

Lithospheric structure across the California Continental Borderland from receiver functions

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lithosphere; crust; Continental Borderland; ocean bottom seismometers; receiver functions

Abstract

Due to its complex history of deformation, the California Continental Borderland provides an interesting geological setting for studying how the oceanic and continental lithosphere responds to deformation. We map variations in present-day lithospheric structure across the region using Ps and Sp receiver functions at permanent stations of the Southern California Seismic Network as well as ocean bottom seismometer (OBS) data gathered by the Asthenospheric and Lithospheric Broadband Architecture from the California Offshore Region Experiment (ALBACORE), which enhances coverage of the borderland and provides first direct constraints on the structure of the Pacific plate west of the Patton Escarpment. Noisiness of OBS data makes strict handpicking and bandpass filtering necessary in order to obtain interpretable receiver functions. Using H-κ and common-conversion point stacking, we find pronounced lithospheric differences across structural blocks, which we interpret as indicating that the Outer Borderland has been translated with little to no internal deformation, while the Inner Borderland underwent significant lithospheric thinning, most likely related to accommodating the 90° clockwise rotation of the Western Transverse Range block. West of the Patton Escarpment, we find that the transition to typical oceanic crustal thickness takes place over a lateral distance of ~ 50 km. We detect an oceanic seismic lithosphere-asthenosphere transition at 58 km depth west of the Patton Escarpment, consistent with only weak age-dependence of the depth to the seismic lithosphere-asthenosphere transition. Sp common-conversion point stacks confirm wholesale lithospheric thinning of the Inner Borderland and suggest the presence of a slab fragment beneath the Outer Borderland.

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