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Crustal and upper mantle structure beneath 20S of South America

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Structure beneath South America has not been examined very well, although many earthquakes occur along a subduction zone in the west where the Nazca plate subducts beneath the South America plate. In this study, we investigated the crust and upper mantle structure beneath the central South America, using ScS reverberations and receiver functions. ScS reverberations are S waves repeatedly going up and down between the earth surface and core mantle boundary. Their waveforms have information on crust and mantle structure in terms of S-wave velocities, attenuation (Q), and depths and SS reflection coefficients of discontinuities. These values were determined in a grid search technique by modeling waveforms of ScS reverberations. Synthetic waveforms were computed based on the ray theory, convolving a source time function with a finite duration, so that we can successfully deal with an earthquake of a great size. A receiver function is computed by deconvolving a vertical component from a radial component of a P waveform recorded at a station, and its shape is sensitive to P-to-S conversion phases produced beneath the station. By modeling receiver functions, we determined crust velocity models, while depths of mantle discontinuities were estimated from arrival times of PS conversion phases on receiver functions. Our studies of ScS reverberations and receiver functions show significant differences in the crust and uppermost mantle between the western coast and eastern continent of the central South America. Both results suggest that the Moho beneath the station NNA on the western coast is deeper than the one beneath the station BDFB in the eastern continent. The velocity model determined beneath NNA has discontinuities at depths of 25, 35, 60, and 70 km. We found evidence of inclination of the discontinuities at the depths of 60-70 km, so it is a possible notion that the discontinuities are manifestations of the top of the subducting Nazca plate. A high Q value larger than 400 was determined for the upper mantle beneath NNA in the ScS analysis. By comparing the Q value with the one predicted from the mantle transition zone temperature, it was proposed that the high Q may exist in the uppermost mantle. In contrast, these characteristics of the Moho and Q were not found for BDFB in the eastern continent. The depths of the Conrad and Moho were estimated to be 22 and 40 km, respectively. A high Q value cannot be seen in the upper mantle beneath BDFB. Thus, the detected differences of the crust and uppermost mantle could be attributed to the subducting plate. The shallow 410-km discontinuity (~400km) beneath the western coast was found in both studies of ScS reverberations and receiver functions. The thickness of the mantle transition zone is thinner in the western coast (260km) than that in the eastern continent (270km), and the both thickness is larger than that beneath Japan. On the receiver functions in the western coast, we can see a phase from the 520-km discontinuity. Using SS reflection coefficients from the ScS reverberations and PS conversion coefficients from the receiver functions, we attempted to estimate density and S-wave velocity contrasts at mantle discontinuities. For the 410-km and 660-km discontinuities, the upper bounds of density contrast are 7 to 9 % and 15 to 20 %, respectively, while the upper bounds of S-wave velocity contrast are 6 to 14 % and 7 to 20 % or more, respectively.